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Asian Journal of Organic & Medicinal Chemistry

Special Issue

on

**Current Trend on Research in Applied Science, Management and
Technology**

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Growth Response of Pennisetum Glaucum (L.) R. Br. to Organic Manures and Biofertilizers

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ABSTRACT

Organic manures Vermicompost and Neem Cake as well as Biofertilizers Azotobacter and Phosphate solubilizing bacteria were used to cultivate Pearl millet (*Pennisetum glaucum* (L.) R.BR. Treatments were given as Vermicompost (VC), Neemcake (NC) and Biofertilizers Azotobacter and Phosphate solubilizing bacteria (BIO), Inorganic fertilizer NPK (90 N, 40 P and K 30 Kg ha⁻¹) and Control. Crop was cultivated in Randomized Block design, experimental plots size were 1.5x1.5 m. Organic manures added in the experimental plot at the rate 4444 Kg ha⁻¹. Biofertilizer Azobacter and biophos as well as Vrakshamitra were used at the rate 10 kg, 10kg and 26 kg ha⁻¹ respectively. Chemical analyses of organic manures were done. Ascorbic acid was estimated from leaves at 67 DAS. It was recorded highest in NC followed by BIO. Fresh Vegetation was collected at 70DAS. DM of leaves of single plant was recorded. Leaves biomass were oven dried separately for DM. Dried samples were pulverized and used for Chemical analyses. All the results were statistically analyzed by using standard statistical methods. Analyses of leaves were shown the results as %DM, %N %Crude Protein and %P recorded highest in Vermicompost. %Total reducing sugar was highest in NC. DM yield, N yield, Crude Protein yield, Total reducing sugar yield and %Ca were recorded highest in Bio. All results are statistically significant.

Keywords: *Pennisetum glaucum*, Neem cake, Vermicompost, Biofertilizers Azotobacter, Phosphate solubilizing bacteria, Organic manures.

INTRODUCTION

Vermicomposting is a simple biotechnological process of composting, in which certain species of earthworm are used to enhance the process of waste conversion and produce a better end product, resulting earthworm castings which are rich in microbial activity and plant growth regulators. Vermicomposting converts household waste into compost within 30 days reduces the C: N ratio and retain more N than the traditional methods of preparing composts (Gandhi *et al* 1997). The uptake of N, phosphorus (P), potassium (K) and magnesium (Mg) by rice (*Oryza sativa*) plant was highest when fertilizer was applied in combination with vermicompost (Jadhav *et al*, 1997). Vermicompost could increase the growth and yield of medicinal plant turmeric (Vadiraj *et al*, 1998). Addition of vermicompost in the soil increases the availability of micronutrients to plant (Sainz *et al* 1998; Vasanthi & Kumaraswamy, 1999). Enhanced Growth of tomato plants was observed in horticulture potting media amended with Vermicompost (Atiyeh *et al* 1999). Vermicompost has a potential to improve plant growth and dry matter yield when added to the soil (Atiyeh *et al*, 2000; Zaller, 2007). Vermicompost led to greater improvements in fruit yield (74%), vitamin C (47%), and soluble sugar (71%) in soils with no tomato planting history (Xin-Xin Wang *et al* 2017). Arancon *et al*. (2003) indicated the improvements in crop growth could be due to partially to large increase in soil microbial biomass after application of Vermicompost. Manh *et al* (2014) reported the application of VC with rice hulls ash and coconut husk resulted higher germination, plant height, leaf biomass and leaf area. Vermicompost contain nutrients which are in available forms such as nitrates, phosphates, and exchangeable calcium and soluble potassium (Orozco, 1996). Vermicompost have high levels of available nitrogen, phosphorous, potassium and micro nutrients as well as microbial enzymatic activities and growth regulators (Parthasarathi and Ranganathan 1999; Chaoui *et al* 2003). Addition of Vermicompost to soil can increase plant height and number of leaves significantly (Peyvast, G *et al* .2008). The Vermicompost served as a potential source of nutrients for plant growth (Md. Abul Kashem *et al* 2015). Biofertilizers are an important alternative source of plant nutrients. They are bacteria, algae, or fungi; they have ability to provide nutrients to plants (Javorekova *et al*. 2015; Rao *et al*. 2015). The application of Azotobacter chroococcum enhanced the crop yield in rice-wheat (Mahajan *et al*.2008)

METHODOLOGY

Pearl millet cultivated in field at Shevgaon District Ahmednagar Maharashtra, India during the period January to April 2006. The experiment was carried out in a randomized block design (RBD) with five treatments and three replicates. Organic fertilizers like Vermicompost and Neem Cake, Biofertilizers Azotobacter and Phosphate solubilizing bacteria as well as inorganic fertilizer NPK ((90 N, 40 P and K 30 Kg ha⁻¹) was given as a treatment with respect to Control. To conduct the experiment Vermicompost (VC) and Neemcake (NC) were

used at the rate 4444 kg ha⁻¹. In BIO treatment Biofertilizers Azobacter and biophos as well as Vrakshamitra were used at the rate 10 kg, 10kg and 26 kg ha⁻¹ respectively. No chemical fertilizer added in organic manure treatment plots except inorganic treatment (NPK) plots. Pearl millet (*Pennisetum glaucum* (L.) R.Br.) Variety "Rijka Bajara" was sown in the research plots of size 1.5x1.5 m. at the rate of 10 kg ha⁻¹. Ascorbic acid was estimated from fresh leaves at 67 DAS. Samples were collected randomly during the early hours of the day at vegetative state 70 days after sowing (DAS). Samples of single plants kept in oven at 90 °C for 48 hours. The dried samples were weighted to measure DM of root, stem and leaves. Fresh biomass of 100 gram leaves kept in oven. Dried samples were pulverized and used for chemical analyses for nutrient uptake by using standard agronomical methods. Chemical analyses of organic manures were done before cultivation.

RESULTS

According to N balance method N kg ha⁻¹ fixed by Azotobacter Biofertilizer treatment was 35.25 kg ha⁻¹ (Peoples and Herridge, 1990)

Treatments	Fresh weight kg plot ⁻¹	Fresh weight Kg ha ⁻¹	DM		N		%		
			%	DM kg/hect	% N	kg/hect	P	K	Ca
VC	1.00	4444	31.12	1383.11	1.46	20	1.19	0.18	3.00
NC	1.00	4444	97.94	4352.88	1.96	85	0.81	0.48	0.87

Treatments	%			C:N
	Ash	C	N	
VC	41.85	24.27	1.46	16.63
NC	74.93	43.46	1.96	22.17

Treat ment	Fresh wt. in gm	DM		N		Crude Protein		Total RS		%		
		%	Yield (gm)	%	Yield (gm)	%	Yield(gm)	%	Yield (gm)	P	K	Ca
VC	24.37	27.10	6.60	1.44	0.095	9.02	0.596	2.56	0.169	0.41	0.20	0.40
BIO	32.12	26.46	8.50	1.33	0.113	8.33	0.708	2.52	0.214	0.22	0.20	0.55
NC	27.40	22.84	6.26	1.44	0.090	9.02	0.565	2.59	0.162	0.12	0.21	0.41
NPK	31.86	23.80	7.58	1.42	0.107	8.85	0.671	2.29	0.174	0.30	0.19	0.42
CON	10.17	26.78	2.72	1.14	0.031	7.12	0.194	2.26	0.061	0.08	0.10	0.34
SE	4.02	0.87	0.98	0.06	0.015	0.36	0.092	0.07	0.025	0.06	0.02	0.03
CD	9.29	2.00	2.27	0.13	0.030	0.83	0.210	0.16	0.060	0.14	0.05	0.08

VC=Vermicompost, NC=Neem cake

DISCUSSION

Analyses of manure amendments

Analyses of VC (Vermicompost) and NC (Neem cake)

Table-1 The fresh weight of Vermicompost (VC) and Neemcake (NC) administered in experimental plots were 1.00 kg plot⁻¹ and 4444 kg ha⁻¹. Dry matter kg ha⁻¹ of VC was 1383.11 and NC was 4352.88, similarly the %N of VC (1.46) and NC (1.96), N kg ha⁻¹ of VC (20) and NC (85). %Phosphorus of VC was (1.19) and NC (0.81), %potassium of VC(0.18) and NC (0.48), %Ca contents of VC(3.00) and NC (0.87). According to N balance method N kg ha⁻¹ fixed by Azotobacter biofertilizer treatment was 35.25kg ha⁻¹ (Peoples and Herridge, 1990).

C: N ratio of organic amendment

Table 2: % Ash was more in NC (74.93) followed by VC (41.85), %C was found maximum in NC (43.46) followed by VC (24.27). C: N ratio highest in NC (22.17) followed by VC (16.63).

Ascorbic acid content of pearl millet(Fig-1)

The Ascorbic acid (Vitamin C) contents of Pearl millet were influenced on 67 DAS by the organic manures and biofertilizer. The percentage of vitamin C was highest in NC (0.25) followed by BIO (0.24) VC (0.23), NPK (0.21) and lowest in CON (0.18). (Fig-1). Vitamin C and total sugar content in tomatoes increase with using vermicompost (Abduli, M.A. et al 2013)

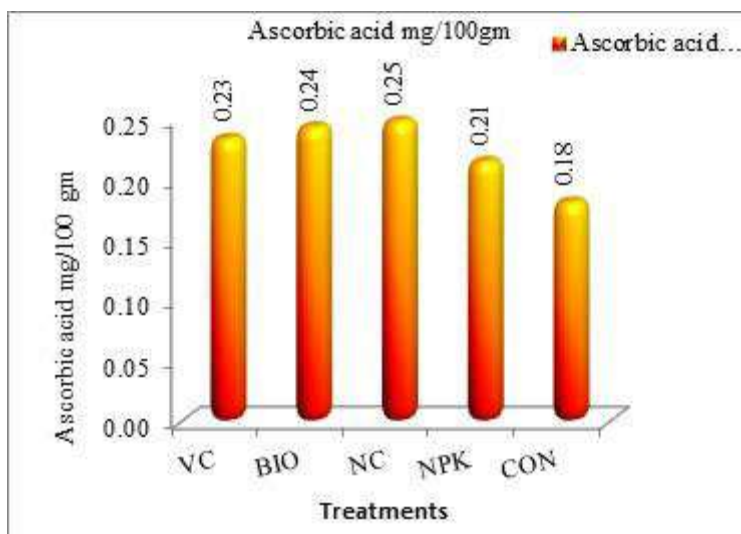


Fig 1: Ascorbic acid contents of Pearl millet influenced by different fertilizers at 67DAS

Analyses of leaves (Table-3)

Fresh weight was recorded highest in BIO (32.12) followed by NPK, NC, VC and lowest in CON (10.17). FW was statistically significant in all treatments. **%DM** recorded highest in VC (27.10) followed by CON, BIO, NPK and lowest in NC (22.84). **DM yield (gm)** was recorded highest in BIO (8.50) followed by NPK, VC, NC lowest in CON (2.72). DM was statistically significant in all treatments. **%N and %Crude protein** recorded highest in VC and NC (1.44, 9.02), NPK, BIO and lowest in CON (1.14, 7.12), all values were statistically significant. **N yield (gm) and Crude protein Yield (gm)** recorded highest in BIO (0.113, 0.708) followed by NPK, VC, NC and lowest in CON (0.031, 0.194), all values were statistically significant. **%TRS** was recorded highest in NC (2.59) followed by VC, BIO, NPK and lowest in CON (2.26). All values were statistically significant **except NPK**. **TRS Yield (gm)** was recorded highest in BIO (0.214) followed by NPK, VC and NC and lowest in CON (0.061), all values were statistically significant. **%P** was recorded highest in VC (0.41), NPK, BIO, NC and lowest in CON (0.08), statistically significant in all treatments except NC. **%K** was highest in NC (0.21) followed by VC and BIO and NPK and lowest in CON (0.10), statistically significant in all treatments. **%Ca** was highest in BIO (0.55) followed by NPK, NC, VC and lowest in CON (0.34), statistically significant only in BIO and NPK treatment.

Plant dry biomass of Strawberry increased significantly on addition of Vermicompost in different concentrations in soil (Arancon et al.2004). Vermicompost application Increases soil quality is reflected in plant growth and production (Shristi Piya et al 2018). Effect of vermicompost and phosphate biofertilizer application on yield and yield components in Anise (*Pimpinella anisum* L) shown improved growth and yield (Darzi et al., 2011) Influence of biofertilizers on growth, biomass and biochemical constituents of *Ocimum gratissimum*.L showed improved growth and biomass yield (Rashmi et al., 2008).

CONCLUSION

Pearl Millet crop gives better results for fresh vegetation and nutrient content by applying the Vermicompost and biofertilizer. Vermicompost and biofertilizer proved better than NPK in production of DM, N, Total Crude protein, Total Reducing Sugar, P, K, Ca content. Good quality fodder crop can help to improve the economy and health of animals. Vermicompost requires small place for its production with the help of earthworms. We can create wonder manure which works with high efficiency giving best quality food and feed. These manures can reduce the dependence of farmers on chemical fertilizers and reducing their efforts and input cost of the crop plants. The eco friendly low cost organic manures as Vermicompost and Biofertilizer for the best quality of fodder with higher yield which will reduce the production cost and increase the financial status of the farmers within a short time and protecting the environment.

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Computer Aided Drug Design (CADD): A Magical Tool in Research in Current Era

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ABSTRACT

Background: Computer Aided Drug Design (CADD) is an evolving cascade of research area encompassing many facets. Over the last few decades, computer-aided drug design has emerged as a powerful technique playing a crucial role in the development of new drug molecules. It involves all computer assisted techniques used to discover, design and optimize biologically active compounds which are used as drugs. Here various aspects of applied and basic research merge and stimulate each other. **Objectives:** To study a chemical compound that can fit to a specific cavity on a protein target both geometrically and chemically.

a) To study the process of discovery, design and optimization of drug.

b) To learn different types of screening process.

c) To study different types of software used in CADD.

Key finding: 1) Brief information about Drug Design. 2) Approach involved in Drug Design by CADD. 3) Methodologies involved in Drug Design 4) Comparative assessment between two drugs using CADD softwares

1) INTRODUCTION

Bringing a new drug to market is an expensive endeavor that takes a lot of time and money. The average time taken to discover or develop a drug is around 10-15 years and the cost is around \$ 800 million. Unsurprisingly, pharmaceutical companies are focused on reducing development time and budgets without negatively impacting quality. Many developments were undertaken in the 1990s using combinatorial and high throughput screening technologies, which accelerated drug discovery. These technologies have been widely adopted because they have enabled the rapid synthesis and screening of large libraries, but unfortunately no significant success has been achieved and little progress has been made towards the development of new molecular entities. A combination of advanced computer techniques, life sciences, and chemical synthesis were introduced to facilitate the discovery process, and this combinatorial approach improved the scale of discovery. Eventually, the term computer aided drug design (CADD) was adopted for the use of computers in drug discovery. Advanced computer applications have proven to be effective tools and remarkable successes have been achieved through these techniques. CADD is a specialized discipline, in which different computational methods are used to simulate interactions between receptors and drugs to determine binding affinities. However, the technique is not limited to studies of chemical interactions and predictions of binding affinity, as it has many other applications ranging from the design of compounds with the desired physicochemical properties to the management of digital archives of compounds. The development and discovery of any drug takes many years because it begins with scientific studies such as determining the disease, determining the specific target receptor, and determining the active compound from the mass of compounds, etc.

2) IN SILICO DRUG DISCOVERY PROCESS

In silico methods can help in identifying drug targets via bioinformatics tools. They can also be used to analyze the target structure for possible binding/active sites, generate candidate molecules, check for their likeness, dock these molecules with the target, rank them according to their binding affinities, further optimize the molecule to improve binding characteristics. The uses of computers and computational methods permeate all aspects of drug discovery today and forms the core of

- structure-based drug design
- ligand-based drug design.

It consists of 3 stages-

Stage 1- Identification of the therapeutic target and generation of a library of small compounds for testing and screening against the target molecule.

Stage 2- Interaction test of the hits selected by attachment to the binding sites.

Stage 3- Subjecting the selected compounds to pharmacokinetic studies and the compound which passes the pharmacokinetic parameters is used as the lead compound

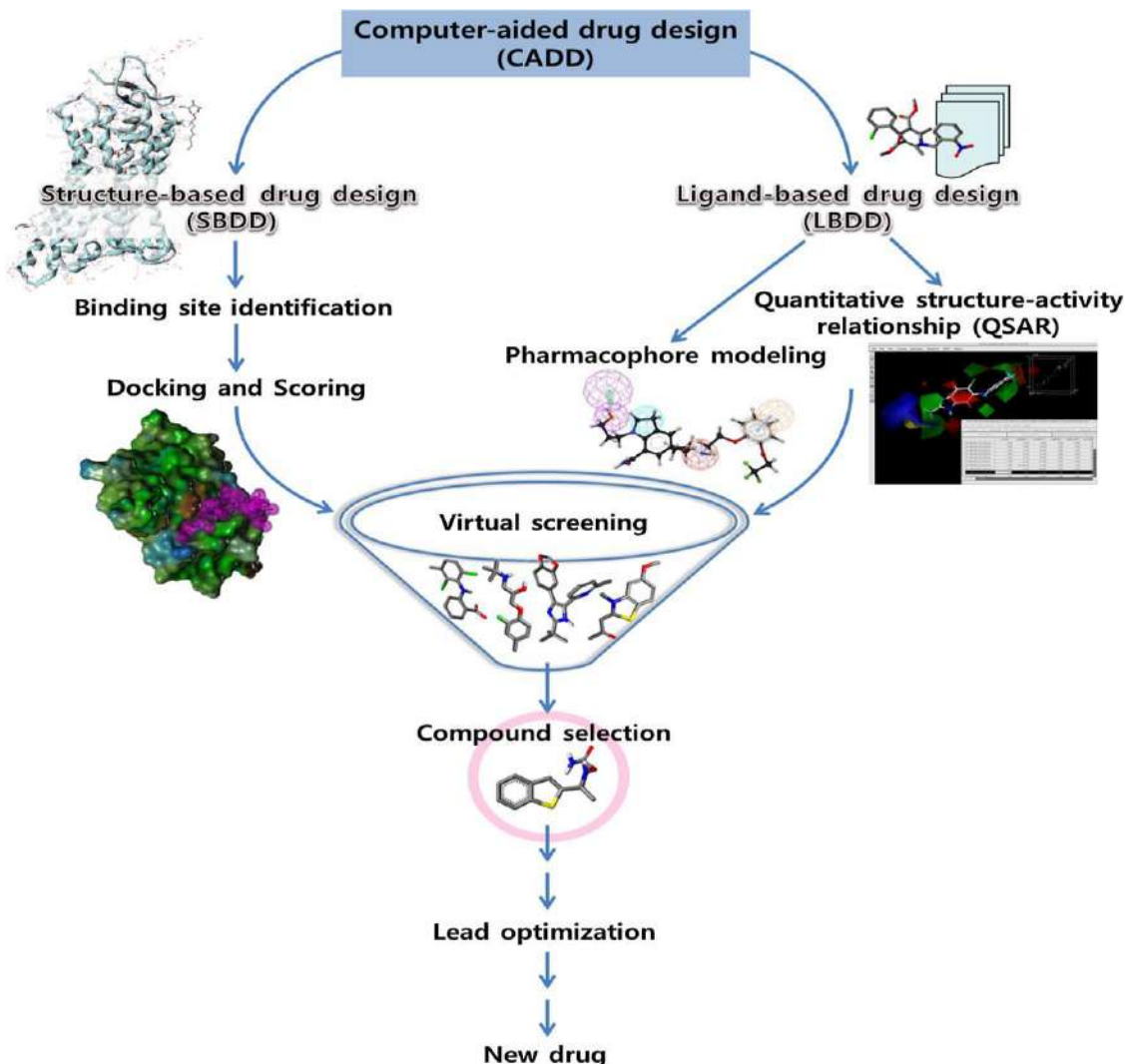


Figure 1: Representative workflow for computer-aided drug design

3) TYPES OF CADD

3.1) Structure-Based Drug Design (SBDD) -

SBDD, or direct drug design, is based on knowledge of the 3D structure of the biological target (protein) obtained by methods such as X-ray crystallography or NMR spectroscopy. A 3D atomic resolution receptor protein structure is mandatory to initiate the SBDD structure paradigm. The crystal structure must be well defined, with a resolution of at least 2.5 generally considered necessary. In cases where the 3D structure of the target is not available, a virtual model can be generated by homology modeling of the protein bound to the nearest target for which the 3D structure is known and available. However, unless there is a very high conservation of receptor site residues, the use of virtual screening homology models is much more risky than the use of resolved structures.

3.2) Ligand-Based Drug Design (LBDD)

The ligand-based computer-aided drug discovery (LBDD) approach involves the analysis of ligands known to interact with a target of interest. These methods use a set of reference structures collected from compounds known to interact with the target of interest and analyze their 2D or 3D structures. The overall objective is to represent these compounds in such a way as to retain the physicochemical properties most important for the desired interactions, while extraneous information not relevant for the interactions is discarded. It is considered an indirect approach to drug discovery because it does not require knowledge of the structure of the target of interest.

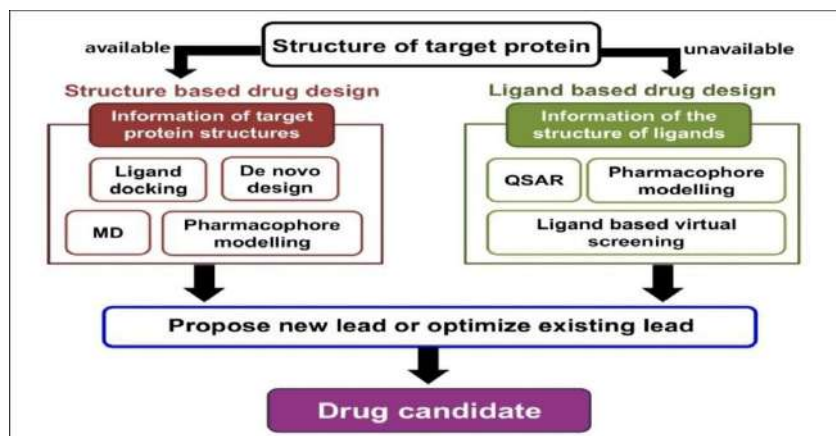


Figure 2: Types of CADD

4) METHODOLOGIES USED IN CADD-

4.1) Homology Modeling

In the absence of experimental structures, computer methods are used to predict the 3D structure of target proteins. Comparative modeling is used to predict the target structure based on a model with a similar sequence, taking advantage of the fact that the structure of the protein is better conserved than the sequence, i.e. proteins with similar sequences have similar structures. Homology modeling is a specific type of comparative modeling in which the model and the target proteins share the same evolutionary origin.

Comparative modeling involves the following steps-

- (1) Identification of related proteins to serve as model structures,
- (2) Alignment of target and model protein sequences.
- (3) Copy coordinates for securely aligned regions.
- (4) Construction of missing atomic coordinates of the structure target.
- (5) Refinement and evaluation of the model.

There are several computer programs and web servers that automate the process of homology modeling, such as PSIPRED and MODELLER. The main objective of structural biology concerns the formation of protein complexes and ligands; in which the protein molecules act energetically during binding. Therefore, the perception of the protein-ligand interaction will be very important for the design of structure-based drugs.

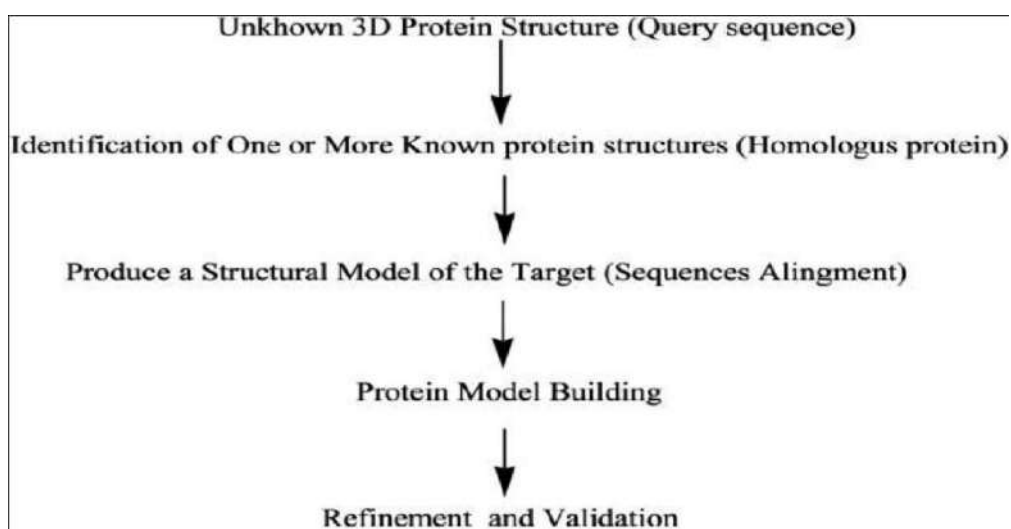


Figure 3: Structure prediction by homology modeling⁶

4.2) Ligplot Analysis

Ligplot analyzes a computer program that generates 3D schematic representations of protein-ligand complexes from the standard "protein database (PDB)" file entry.

Figure 4: Website demonstrating ligplot analysis⁷

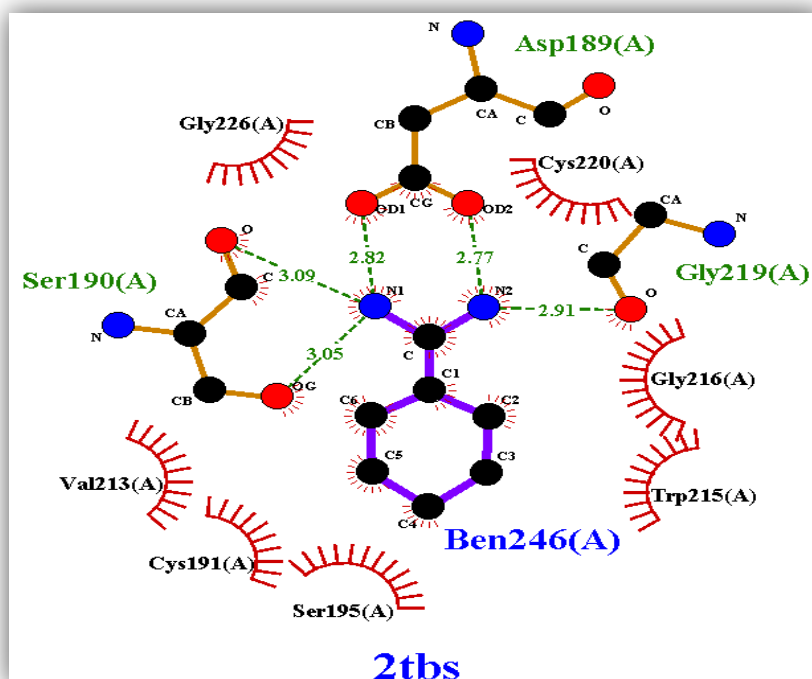


Figure 5: Ligplot Analysis⁷

Above figure represents-

- Hydrogen bonds are indicated by dashed lines between the atoms involved.
- Hydrophobic contacts are represented by an arc with spokes radiating towards the ligand atoms they contact. The contacted atoms are shown with spokes radiating back.

4.3) Molecular Docking

Molecular Docking is a method which anticipates the favored orientation of ligand against receptor (Protein) to make a stable complex. Favored orientation possibly utilized to predict the strength of connection or binding affinity among ligand and protein by utilizing scoring functions. Docking is often applied to anticipate the

binding orientation of drug candidates against protein targets in order to predict the affinity and activity of the drug. Therefore docking plays a pivotal role in the drug design and discovery process. The main aim of molecular docking is to computationally simulate the molecular identification process and accomplish an optimized conformation so that the free energy of overall system is minimized. The process of discovery of a new drug is a very difficult task. Modern drug discovery is mainly based In-silico–chemico biological approach. Use of computer aided techniques in drug discovery and development process is rapidly gaining popularity, implementation and appreciation.

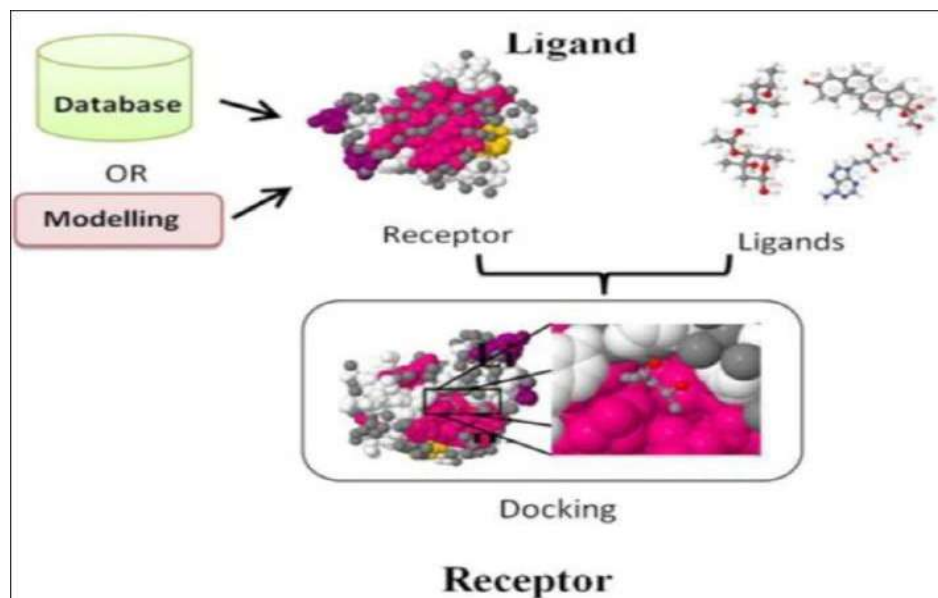


Figure6: Molecular docking flow chart⁸

Thus, the docking process includes the following steps:

Step I - Protein Preparation-

The three-dimensional structure of the protein should be extracted from the protein database (PDB) subsequently the recovered structure must be pretreated. This should help remove water molecules from the cavity, stabilize charges, fill in missing residues, generate side chains, etc. depending on the available settings.

Step II - Prediction of the active site-

After the preparation of the protein, the active site of the protein must be predicted. The receptor can have many active sites, but only the one of interest should be selected. Most water molecules and heteroatoms are removed if they are present.

Step III - Preparation of ligands-

Ligands can be recovered from different databases such as ZINC, Pub Chem or they can be sketched by applying the Chem sketch tool. When choosing the ligand, LIPINSKY RULE 5 should be used. Lipinski's Rule 5 helps to distinguish between non-drug candidates and drug candidates. It promises a high probability of success or failure due to the drug's similarity to molecules that adhere to two or more of the compliance rules.

For the choice of a ligand which allows the LIPINSKY RULE-

- (1) Less than five hydrogen bond donors.
- (2) Less than ten hydrogen bond acceptors.
- (3) Molecular mass less than 500 Da
- (4) High lipophilicity (expressed in LogP not greater than 5)
- (5) Molar refraction must be between 40-130.

Step IV-Docking-

The ligand is docked to the protein and the interactions are analyzed. The scoring function provides the score based on the best anchored ligand complex.

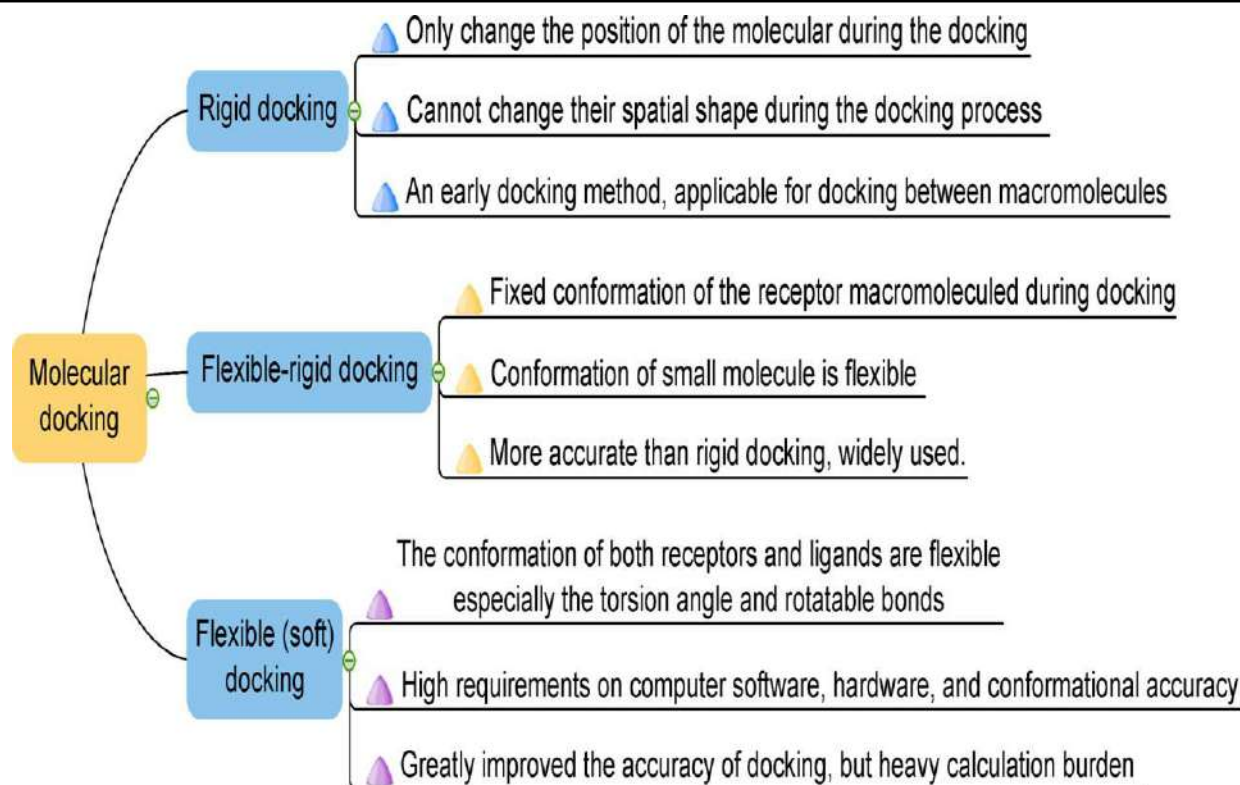


Figure 7: Molecular docking software classification⁸

4.3.1) Docking Software

Various docking programs have been formulated throughout the last twenty years. Table (1) summarizes basic features such as endorsed platforms, license conditions, algorithms and scoring functions of currently available docking tools.

Table 1: Basic characteristics for current protein-ligand docking tools.

Entry	Designer/Company	License terms	Supported Platforms	Docking Approach	Scoring function
1	D. S. Good sell and A. J. Olson The Scripps Research Institute	Free for Academic Use	Unix, Mac OSX, Linux, SGI	Genetic algorithm Lamarckian genetic algorithm Simulated Annealing	Auto Dock (force-field methods)
2	Schrödinger Inc.	Commercial	Unix, Linux, SGI, IBM AIX	Monte Carlo Sampling	Glide Score, Glide Comp

4.3.2) Applications of Docking

Molecular docking interactions may lead in activation or inhibition of the protein, whereas ligand binding may lead in agonism or antagonism. It can be employed to

1. Hit Identification (Virtual Screening)
2. Lead Optimization (Drug discovery)
3. Binding site prediction (Blind docking)
4. Protein – Protein/ Nucleic acid interactions
5. Studies of Structure – function

4.4) De Novo Drug Design

De novo design is the uses of docking programmes to design new leadstructures that fit a particular target site.

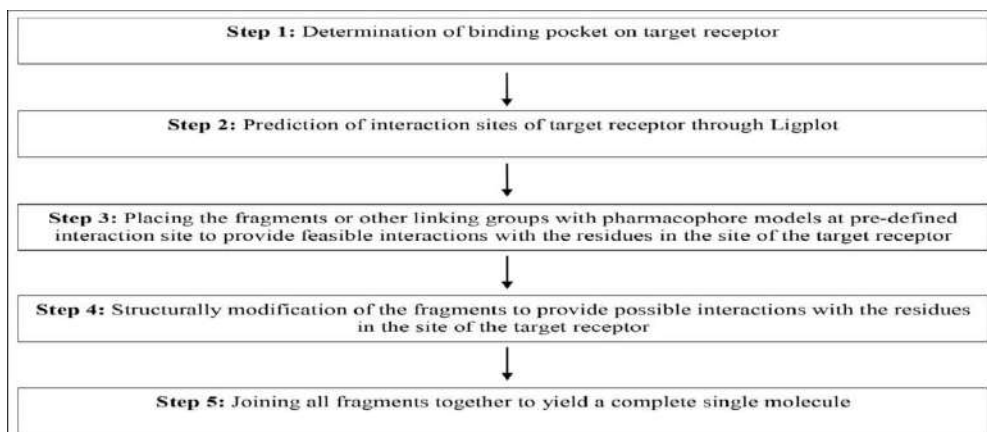


Figure 8: Steps of de novo drug design methodology.⁹

4.5) Pharmacophore-Based Drug Design

The original concept of the pharmacophore was developed by Paul Ehrlich in the late 1800s. At that time, it was understood that certain "chemical groups" or functions in a molecule were responsible for a biological effect, and molecules having an effect similar had similar functions in common. The word pharmacophore was coined much later, by Schueler in his 1960 book *Chemobiodynamics and Drug Design*, and has been defined as "a molecular structure which carries (phoros) the essential characteristics responsible for the biological activity of a drug (pharmakon). The definition of the pharmacophore therefore no longer concerned "chemical groups" but "models of abstract characteristics". Since 1997, a pharmacophore has been defined by the International Union of Pure and Applied Chemistry as: A pharmacophore is the set of steric and electronic characteristics necessary to ensure optimal supramolecular interactions with a specific biological target and to trigger (or block) its biological response. The definition is simplified to A pharmacophore is the model of the characteristics of a molecule responsible for a biological effect", which captures the essential idea that a pharmacophore is made up of characteristics rather than defined chemical groups.¹¹

Pharmacophore-

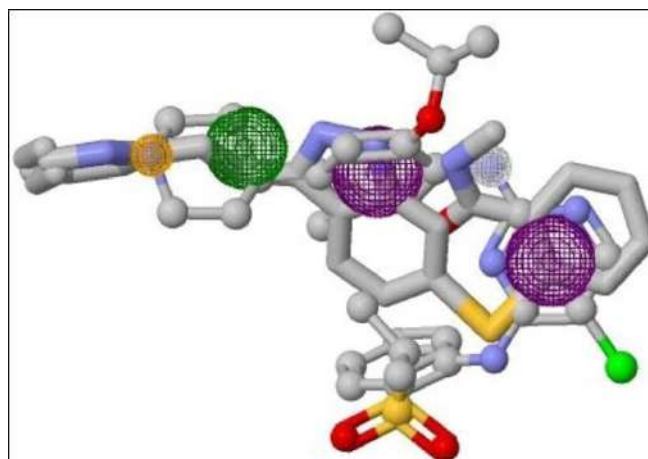


Figure 9 :Pharmacophore¹⁰

Colors of Pharmacophoric Features

1. Hydrogen bond acceptor: Orange,
2. Hydrogen bond donor: White,
3. Aromatic ring: Magenta,
4. Hydrophobic centroid: Green.

Uses-

Pharmacophores are frequently used as a tool for searching databases for compounds with similar pharmacophores.

4.6 Virtual Screening (VS)

Virtual screening is to find the lead compound and hit compound from the molecular databases according to the scoring function, which has tremendously improved the screening efficiency compared with the traditional screen method.⁷

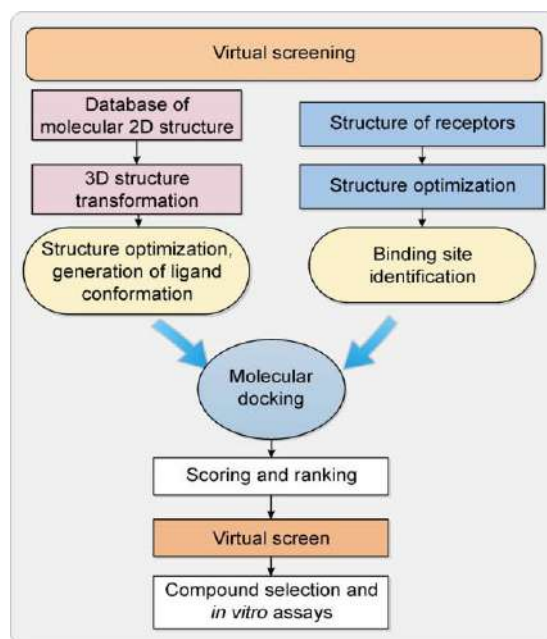


Figure 10: The process of virtual screen.¹¹

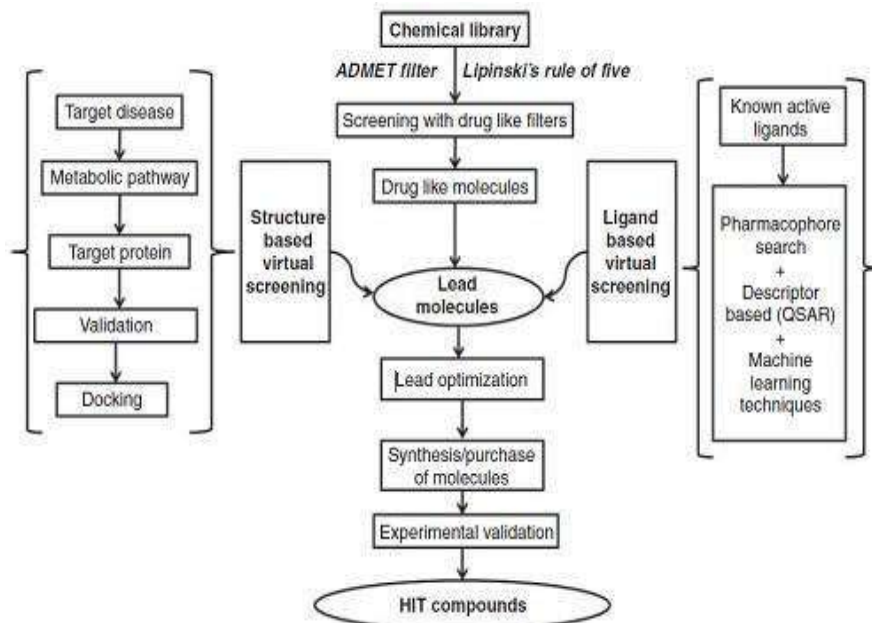


Figure 11: Schematic diagram of VS process for SBDD & LBDD¹²

4.7 Quantitative Structure- Activity Relationship (QSARs)

Quantitative modeling of the structure-activity relationship (QSAR) concerns the construction of predictive models of biological activities as a function of the structural and molecular information of a library of compounds. The concept of QSAR has generally been used for drug discovery and development and has gained wide applicability to correlate molecular information not only with biological activities but also with other physicochemical properties, which has therefore been termed as quantitative structure property relationship (QSPR). **Regression Analysis-**

Regression analysis is a group of QSAR mathematical methods used to obtain mathematical equations related to different sets of data obtained from experimental work or calculated by theoretical studies. The data is entered into a dedicated computer program which, when executed, produces an equation representing the row that best

matches that data. Regression the analysis would calculate the values of m and c that gave the best fit line to the data.

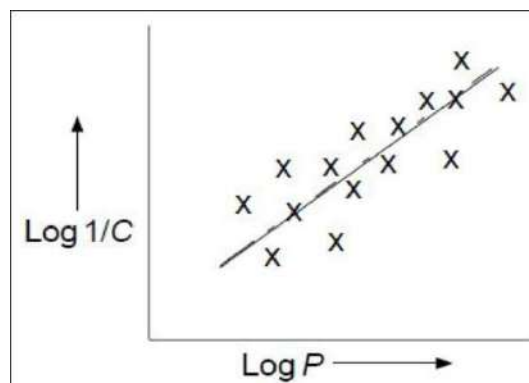


Figure 12: Graph of series of compounds against logarithm of their partition coefficients parameters.¹³

Importance-

The value of r (regression coefficient) is a measure of how close the data is to the equation. A value of r (regression coefficient) greater than 0.60 is generally considered to represent an adequate degree of precision. For example, a value of $r > 0.60$ or $R^2 > 0.50$ for natural or herbal compounds indicates that 80% of the results can be adequately explained by regression analysis using the specified parameters.

4.8) In Silico ADMET And Drug Safety Prediction

ADMET (Absorption, Distribution, Metabolism, Excretion, Toxicity)

Lipinski's rule is related to ADMET which states that in general an orally active drug has only one violation of the following components.

1. The hydrogen bond donor (the total number of nitrogen-hydrogen and oxygen-hydrogen bonds) in a molecule does not more than 5.
2. The hydrogen bond acceptor (all nitrogen or oxygen atoms) in a molecule does not more than 10.
3. The molecular weight of a molecule is less than 500 daltons or 800 g.
4. The octanol water partition coefficient ($\text{Log } P$) of a molecule is not more than 5.
5. The polar area of a molecule is not more than 190 \AA^2 .
6. The molar refractivity of a molecule is in between 40 to 130.
7. The total number of rotatable bonds in molecule is not greater than 10
8. The total number of atoms in a molecule is in between 20-70.

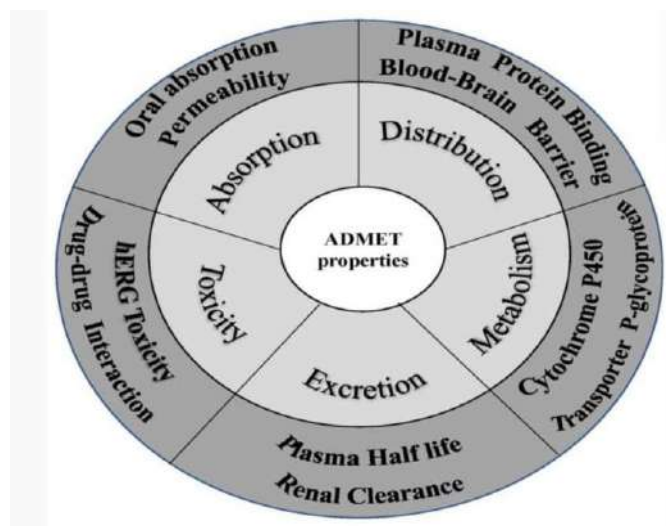


Figure 13: Diagram of In Silico ADMET¹⁴

5) LIST OF DRUG DISCOVERED USING CADD

Table 2: List of some clinically approved drug discovery through CADD approaches.

Drug	Year of approval	Therapeutic Action
Captopril	1981	Antihypertensive
Saquinavir	1995	HIV inhibitor
Dorzolamide	1995	Carbonic anhydrase inhibitor
Indinavir	1996	HIV inhibitor
Ritonavir	1996	HIV inhibitor
Triofiban	1998	Fibrinogen antagonist
Zanamivir	1999	Neuraminidase inhibitor
Oseltamivir	1999	Active against influenza A and B viruses
Raltegravir	2007	HIV inhibitor
Aliskiren	2007	Human rennin inhibitor

6) VARIOUS TYPES OF SOFTWARES USED FOR IN SILICOCADD

Table 3: Different tools and databases used in drug design process

Tool	Brief description with uses
BLAST	Basic local alignment search tool; used for sequencing of DNA and protein
Discovery studio	Software; used for modeling and simulation
Pub Med	Free search engine; used for searching matter related to medical and life sciences
PDB	Protein data bank; used to collect information related to macromolecule
Chem Draw	Part of the Chem. office programs; used to draw chemical molecule
Marvin Sketch	Advanced chemical editor; used to draw chemical structures and reactions
PubChem	Database; used to collect information about structure and physiochemical properties of chemical compound.
Auto Dock	Software; used for molecular docking

7) COMPARATIVE ASSESSMENT BETWEEN TWO DRUGS USING MOLECULAR DOCKING.

7.1) METHODOLOGY-

Lead molecule employed here are favipiravir and remdesivir whereas target taken into consideration are SARS-CoV-2 and HCoV-NL63. Comparative assessment is based on protein ligand docking method, the tool involved in CADD. The interaction analysis were produced from the discovery studio visualizer tool.

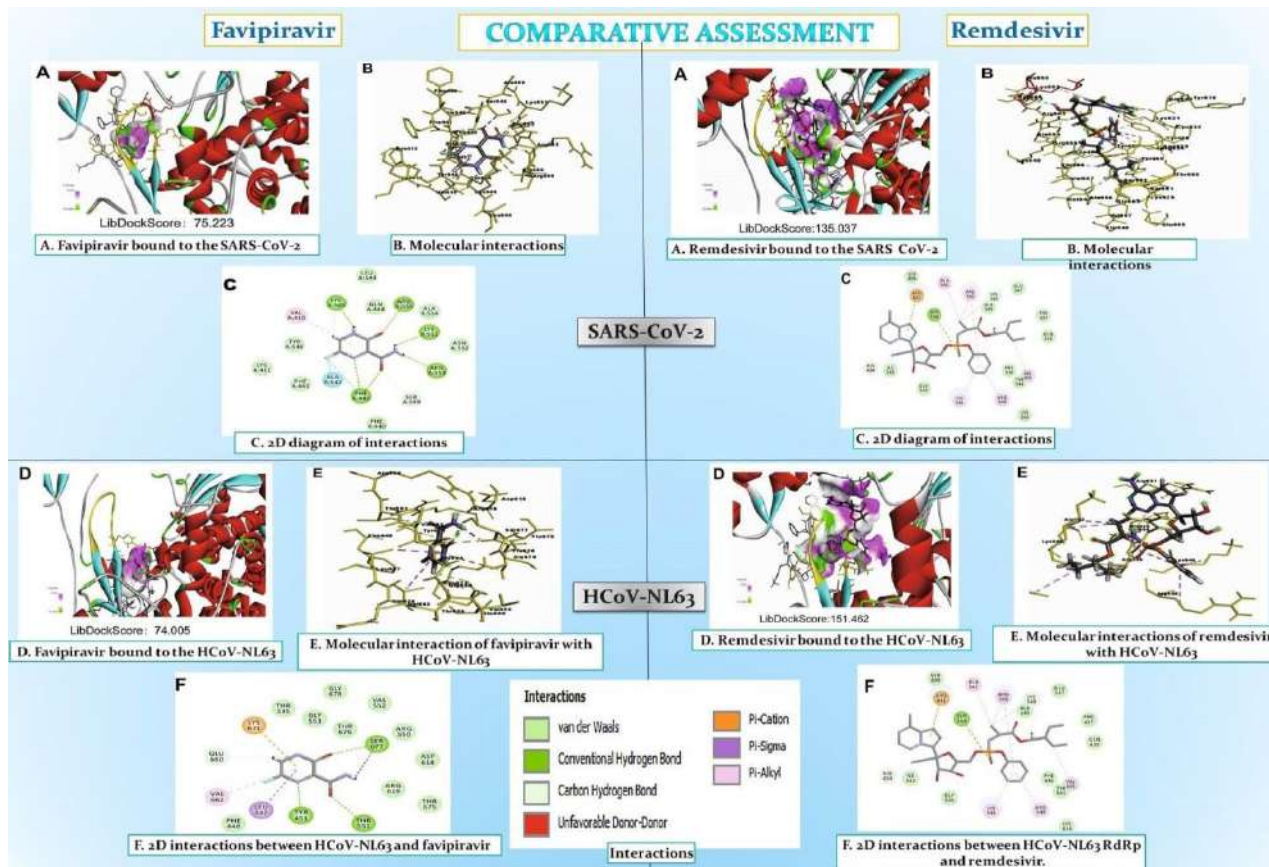


Figure 14: Binding mode of favipiravir to the SARS-CoV-2 and HCoV-NL63 RdRp & Binding mode of remdesivir to the SARS-CoV-2 and HCoV-NL63 RdRp.¹⁵

7.2) RESULT

Coronaviruses are enveloped, single-stranded positive sense RNA viruses. There are seven species of corona viruses known to infect humans. Among them, the highly pathogenic members includes MERS-CoV, SARS-CoV and SARS-CoV-2 can cause severe acute respiratory diseases, whereas the seasonal coronaviruses include NL63 cause mild and self-limiting respiratory tract infections. Molecular docking indicated that favipiravir has similar binding affinities to SARS-CoV-2 and HCoV-NL63 RdRp with LibDock scores of 75 and 74, respectively. The LibDock scores of remdesivir to SARS-CoV-2 and HCoV-NL63 were 135 and 151, suggesting that remdesivir may have a higher affinity to HCoV-NL63 compared to SARS-CoV-2 RdRp

8) CONCLUSION

The discovery of the drug and the development process are an expensive long. It begins with the target identification, after which, validates the objectives and identifies drug medicines before any newly discovered medicine that the market is positioned. Chemistry, whose traditional role involves the creation and dissemination of a penetrating conceptual infrastructure for bioinformatics, chemical sciences, especially at the atomic and molecular level. The clear concept and advanced knowledge of CADD methods will improve research quality and facilitate identification of new chemical entities, leading to development of useful drugs.

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Corrosion Inhibition Efficiency of Fruits Extracts of *Casuarina Equisetifolia* on Mild Steel in Acid Media

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ABSTRACT

The corrosion inhibition efficiency of fruit extracts of *Casuarina equisetifolia* on mild steel has been studied in different acidic medium such as HNO₃, H₂SO₄ and HCl. Weight loss and thermometric methods have been employed. Various concentration of ethanolic fruit extracts used in both these methods are 0.2, 0.4, 0.6, 0.8 and 1% and 1, 2 and 3 M concentration of different acids were utilized in weight loss method, While higher concentration of acids were used in thermometric method such as 2, 3 and 4 M. Results show that corrosion inhibition efficiency increases with increase in concentration of inhibitor. The inhibition efficiency increases with increase in concentration of inhibitor in HCl, H₂SO₄ and HNO₃. Weight loss and thermometric methods are in good agreement with each other. Maximum inhibition efficiency (91.15 %) was observed in 1M HCl with 1% inhibitor concentration.

Keywords: Corrosion, Fruit Extracts, HCl, Acids

INTRODUCTION

Everyone existing on this planet experienced corrosion in one form or another. It's existence varies from sewage underground pipes, steel gate exposed to rain, balcony railing, railway scrap lying on the ground to various equipments used in chemical industry and another industry as well. These examples depicting destruction phenomena. When metal comes in contact with oxygen and moisture it results in the formation of rust. Iron scrap coming in contact with atmosphere follows oxygen absorption mechanism. Whereas hydrogen evolution mechanism witnessed in case metal coming in contact with acids.

Corrosion is the response of stimulus that brings metals back to its naturally occurring form in which metals are existing on the surface of earth in the form of ores and minerals. Which is actually carbonates sulphates, oxides of metals. Corrosion can be considered as metallic cycle. In which conversion of ores to metals and back to original form in which existed occur. Metals react with acids resulting in the evolution of hydrogen gas along with formation of salts take place.

Corrosion is a naturally occurring process. In this process metals undergo slow destruction because of chemical or electrochemical interaction of metal with environment. Various metallic properties are affected as a result of corrosion. Complete removal of corrosion is impossible. However, severity can be reduced by the use of corrosion inhibitor and mixing corrosion resistant elements to the metal Tripathi et al., (2017).

As per mechanical and structural purposes different applications of mild steel include construction of bridge, buildings, boiler plates, steam engine parts and automobile. Because of its low cost and easy availability it finds many uses in most of the chemical industries for fabrication of various reaction vessels, tanks, pipes etc. Protection of mild steel is required because of the damage occurred by reaction with aggressive environment Sethi et al., (2007).

One of the reliable methods to prevent corrosion is use of inhibitors. Which slow down the rate of corrosion. Mild steel corrosion rate can be decreased by the use of organic species as corrosion inhibitors. The various phytochemical constituents are present as organic molecules in plant extract. These organic molecules contain various heteroatoms such as P, S, N, and O atoms in the organic species. Which play a vital role in both adsorption and efficiency. The different factors on which adsorption depends are: molecular structure, donor sites, electron density, steric factor, solution temperature, molecular weight, aromaticity and electrochemical potential at the mild steel-solution interface. The heteroatoms are adsorbed on metal surface forming protective layer and preventing corrosion. The Heterocyclic compounds containing O, N, P, and S atoms have been used as corrosion inhibitor in acid media Raghavendra et al., (2019).

The natural inhibitors are environment friendly, compatible, non-polluting, less toxic, easily available, biodegradable and cheaper to be used as effective corrosion inhibitor Ameh, et al., (2012); Selvi et al., (2009); Kumpawat et al., (2012); Dharmaraj et al., (2017); Kumpawat et al., (2013); Ebenso et al., (2008).

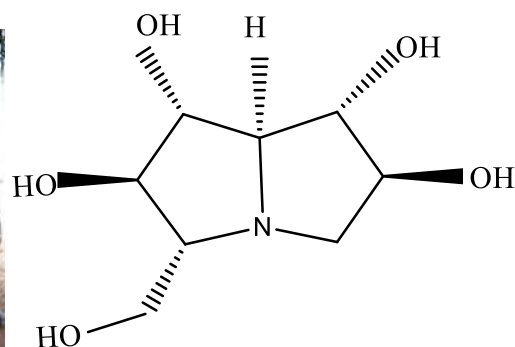
Apart from plants which occur naturally, other organic compounds like Schiff's bases act as effective corrosion inhibitors for most of the metals. These compounds contain atoms of N, O, S, P and sometimes Se possessing

lone pair of electrons and are very much effective in reducing the rate of corrosion and increasing the efficiency. Which is attributed to high electron density and high basicity Jeenagar et al., (2012).

Pergularia daemia Singh et al., (2015)., *Parkia biglobosa* Liyu et al., (2019)., *Murraya koenigii* Jyothi et al., (2019)., *Salix babylonica* Khed and Upadhyay et al., (2018), African breadfruit Fouda et al., (2018), *Phyllanthus amarus* Ejikeme et al., (2015)., *Antigonon leptopus* Abeng et al., (2013), *Tylophora indica* Aejitha et al., (2015), etc. are established as good inhibitor for preventing the severity of corrosion and emerged as very much effective green corrosion inhibitor .

C. equisetifolia revealed the presence of following organic compounds such as: carbohydrates, alkaloids, proteins, glycosides, saponins, phenolics, flavonoids, tannins, steroids, gum, reducing sugars and triterpenoids. Different pharmacological effects of *C. equisetifolia* showed its importance as pharmaceuticals, agrochemicals, flavours, fragrances, colours, bio-pesticides and food additives.

MATERIAL AND METHOD



Casuarine $C_8H_{15}NO_5$

. This plant is traditionally used to treat constipation, cough, diabetes, diarrhea, dysentery, gonorrhea, nervous disorders, stomach-ache, throat infections and ulcer also. As per biological activity is concerned plant is found to be anti-asthmatic, antimicrobial, antioxidant, antifungal, hepatoprotective, nitrogen fixation, antidiarrheal, antidiabetic, antihyperlipidemic, antiulcerogenic etc. Leaf oil depicts the presence of seventy-six compounds comprising of monoterpene hydrocarbons (29.3%), oxygenated mono terpenoids (16.2%), sesquiterpene hydrocarbons (2.7%), oxygenated derivatives (1.0%), aliphatic (40.6%) and non-terpenoid (7.2%). Following phyto constituents reported in *C. equisetifolia* constitute β -sitosterol, campesterol, stigmasterol, cholesterol, cholest-5-en-3- β -ol derivatives, casuarine, catechin, citrulline, cupressuflavone, epicatechin, gallicin, gentisic acid, isoquercitrin, juglanin, kaempferol, proanthocyanidins, rutin, trifolin Esmail and Snafi, (2015).

EXPERIMENTAL

¹. Fruits of *C. equisetifolia* plant were dried in the absence of sunlight. Dried fruits were crushed and grinded and wrapped in Whatmann filter paper and kept in Soxhlet's middle part. Soxhlet is basically consists of flask, extractor and condenser. Fruit extract obtained from Soxhlet was heated on water bath to evaporate the alcohol. After evaporation, semi-solid /viscous liquid extract was obtained. Five different concentrations of solution were prepared by using this extract in ethanol (0.2, 0.4, 0.6, 0.8 and 1 %). A mild steel specimens having dimension 2 cm x 2 cm with 0.5 mm thickness and a hole about 2 mm diameter near the upper edge of the specimen were diced from the mild steel sheet. 1, 2 and 3 and 4 M concentration solutions of HCl, HNO₃ and H₂SO₄ were prepared using distilled water. Specimen was immersed in a beaker containing 50 mL of the test solution with the help of V-shaped glass hook drawn up from capillary tube. Specimens were allowed to remain in test solution for fixed time, then removed from the solution and weighed. Weight loss was determined from the different initial and final weights. The percentage inhibition efficiency was calculated by using the formula Kumari et al., (2018); Meena et al., (2017).

$$\eta\% = \frac{\Delta W_u - \Delta W_i}{\Delta W_u} \times 100$$

And surface coverage (θ) was calculated as
$$= \frac{\Delta W_u - \Delta W_i}{\Delta W_u}$$

Where ΔW_u is weight loss of metal in acid solution in the absence of inhibitor (uninhibited condition) and ΔW_i is weight loss of metal in acid solution in the presence of known amount of inhibitor (inhibited condition) in milligrams.

The corrosion rate (CR) in mm/yr can be calculated by the following equation:

$$\text{Corrosion Rate} = \frac{\Delta W_u \times 87.6}{A \times d \times T}$$

Where ΔW is weight loss in mg, A is area of specimen in cm^2 , T is time of exposure in hours and d is density of metal in g/cm^3 .

Reaction number was calculated by using formula:

$$\text{Reaction number} = \frac{T_m - T_i}{t}$$

Where T_m is the maximum temperature and T_i is initial temperature and t is the time in minutes required to attain maximum temperature.

RESULT AND DISCUSSION

Table 1 represents inhibitor concentration, weight loss, Inhibition efficiency, corrosion rate and surface coverage.

Table 1: Weight loss Data and percentage Inhibition efficiency for Mild steel in HCl, HNO_3 , H_2SO_4 with inhibitor fruit extract.

Temperature: 25 ± 0.1 °C

Area of specimen: 8 cm^2

C.I.%	1 M HCl (216 h)					2 M HCl (144 h)				
	W	I.E.	Corrosion Rate	Θ	Log($\Theta/1-\Theta$)	W	I.E.	Corrosion Rate	Θ	Log($\Theta/1-\Theta$)
Uninhibited	1.561		9.3316			1.567		15.1792		
0.2	0.662	57.59	4.2697	0.5769	0.1346	0.597	61.90	5.7830	0.6190	0.2107
0.4	0.470	69.89	3.0313	0.6989	0.3657	0.437	72.11	4.2331	0.7211	0.4125
0.6	0.248	84.11	1.5995	0.8411	0.7237	0.427	72.75	4.1362	0.7275	0.4264
0.8	0.148	90.51	0.9545	0.9051	0.9794	0.402	74.34	3.8941	0.7434	0.46191
1	0.138	91.15	0.8900	0.9115	1.0128	0.145	90.74	1.4045	0.9074	0.9911
	3 M HCl (72 h)					1 M HNO_3 (30 min)				
Uninhibited	1.518		29.3718			1.590		4430.1		
0.2	0.652	57.04	12.6155	0.5704	0.1231	0.528	66.79	1471.1	0.6679	0.3034
0.4	0.650	57.18	12.578	0.5718	0.1255	0.520	67.29	1448.8	0.6729	0.3132
0.6	0.652	57.04	12.6155	0.5704	0.1231	0.499	68.61	1390.3	0.6861	0.3395
0.8	0.569	62.51	11.0095	0.6217	0.2157	0.470	70.44	1309.5	0.7044	0.3771
1	0.517	65.94	10.0034	0.6594	0.2869	0.460	71.06	1281.6	0.7106	0.3901
	2 M HNO_3 (15 min)					3 M HNO_3 (10 min)				
Uninhibited	1.538		8570.5			1.551		13026.6		
0.2	0.423	72.49	2357.1	0.7249	0.4207	0.344	77.82	2889.2	0.7782	0.5451
0.4	0.393	74.44	2190.0	0.7444	0.4642	0.214	86.20	1797.3	0.8620	0.7956
0.6	0.403	73.79	2245.7	0.7379	0.4495	0.210	86.46	1763.7	0.8646	0.8051
0.8	0.372	75.81	2072.9	0.7581	0.4960	0.206	86.71	1730.1	0.8671	0.8145
1	0.370	75.94	2061.8	0.7594	0.4991	0.204	86.84	17870.4	0.8684	0.8194
	1M H_2SO_4 (168 h)					2 M H_2SO_4 (72 h)				
C.I.%	W	I.E.	Corrosion Rate	Θ	Log ($\Theta/1-\Theta$)	W	I.E.	Corrosion Rate	Θ	Log ($\Theta/1-\Theta$)
Uninhibited	1.536		11.4285			1.551		30.0103		
0.2	0.546	64.45	4.0625	0.6445	0.2583	0.533	65.63	10.3130	0.6563	0.2809
0.4	0.502	67.31	3.7351	0.6731	0.3136	0.492	68.27	9.5197	0.6827	0.3327

0.6	0.466	69.66	3.4672	0.6966	0.3609	0.480	69.05	9.2875	0.6905	0.3485
0.8	0.412	73.17	3.0654	0.7317	0.4357	0.465	70.01	8.9972	0.7001	0.3681
1	0.327	78.71	2.4330	0.7871	0.5678	0.441	71.56	8.5329	0.7156	0.4007
3 M H ₂ SO ₄ (32 h)										
Un inhibited	1.512		65.8253							
0.2	0.540	64.28	23.5090	0.6428	0.2551					
0.4	0.502	66.79	21.8564	0.6679	0.3034					
0.6	0.430	71.56	18.7201	0.7156	0.4007					
0.8	0.409	72.94	17.8059	0.7294	0.4306					
1	0.390	74.20	16.9787	0.7420	0.4587					

Table 2: Reaction number (RN) and inhibition efficiency for mild steel in 2, 3 and 4 M HCl, HNO₃ and H₂SO₄ with fruit extract as inhibitor

	2 M HCl		3 M HCl		4 M HCl	
	RN	I.E.	RN	I.E.	RN	I.E.
Uninhibited	0.2578		0.4035		0.7431	
0.2	0.0768	70.20	0.1433	64.85	0.3891	47.63
0.4	0.0706	72.61	0.1387	65.62	0.3351	54.90
0.6	0.0681	73.58	0.1259	68.79	0.2986	59.81
0.8	0.0567	78.00	0.1145	71.62	0.2861	61.49
1	0.0437	83.04	0.1037	74.29	0.2651	64.32
	2 M HNO ₃		3 M HNO ₃		4 M HNO ₃	
	RN	I.E.	RN	I.E.	RN	I.E.
Uninhibited	0.7000		1.4000		4.000	
0.2	0.1965	72.35	0.3281	76.56	0.6660	83.35
0.4	0.1789	74.44	0.2594	81.47	0.5694	85.76
0.6	0.1872	73.25	0.1980	85.85	0.4687	88.28
0.8	0.1692	75.82	0.1876	86.60	0.3651	90.87
1	0.1651	76.41	0.1748	87.51	0.3496	91.26
	2M H ₂ SO ₄		3M H ₂ SO ₄		4M H ₂ SO ₄	
	RN	I.E.	RN	I.E.	RN	I.E.
Uninhibited	0.6578		0.7103		0.8543	
0.2	0.2365	64.04	0.2571	63.80	0.2567	69.95
0.4	0.2113	67.87	0.1932	72.80	0.2457	71.23
0.6	0.2036	69.04	0.1826	74.29	0.2359	72.38
0.8	0.1962	70.17	0.1761	75.20	0.2074	75.72
1	0.1845	71.95	0.1593	77.57	0.1634	80.37

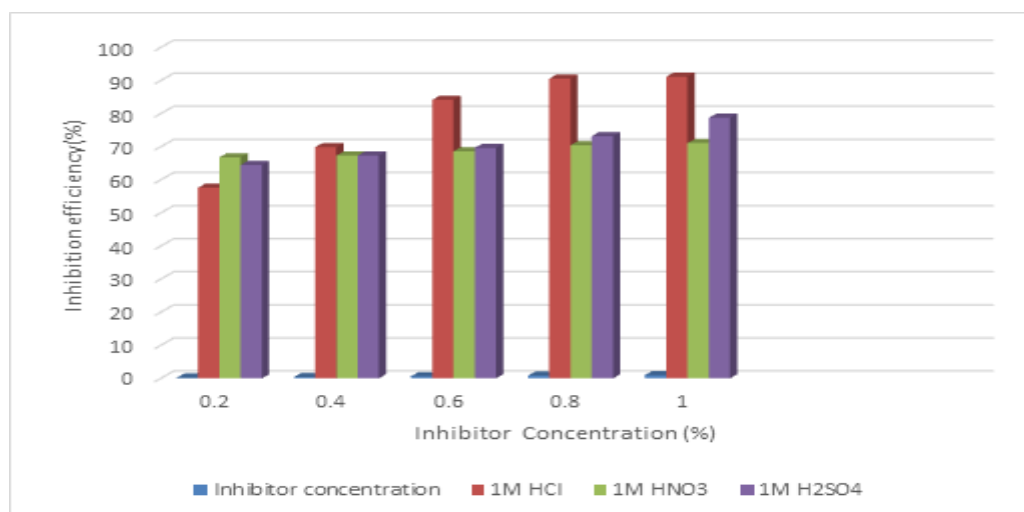


Figure 1: Variation of inhibition efficiency with concentration of fruit extract for mild steel in 1 M HCl, 1 M HNO₃ and 1 M H₂SO₄

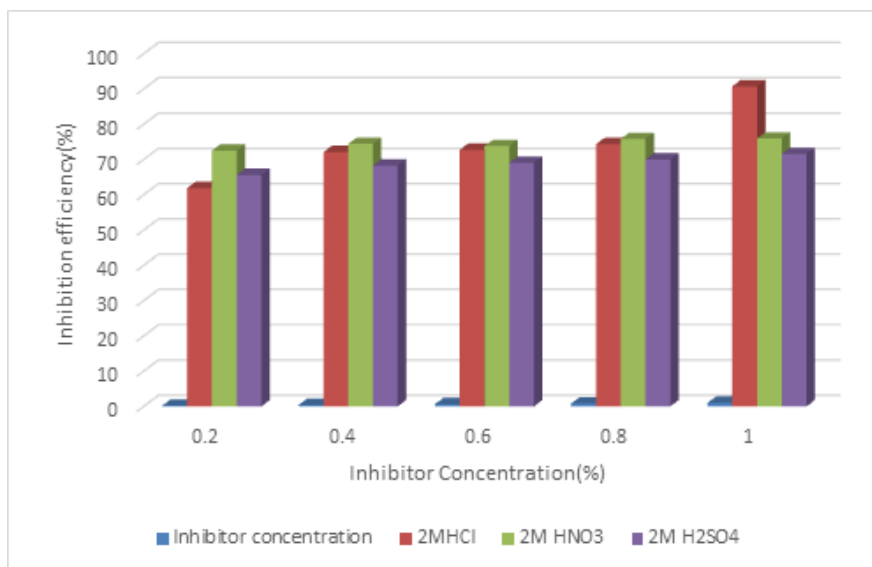


Figure 2: Variation of inhibition efficiency with concentration of fruit extract for mild steel in 2 M HCl, 2 M HNO₃ and 2 M H₂SO₄

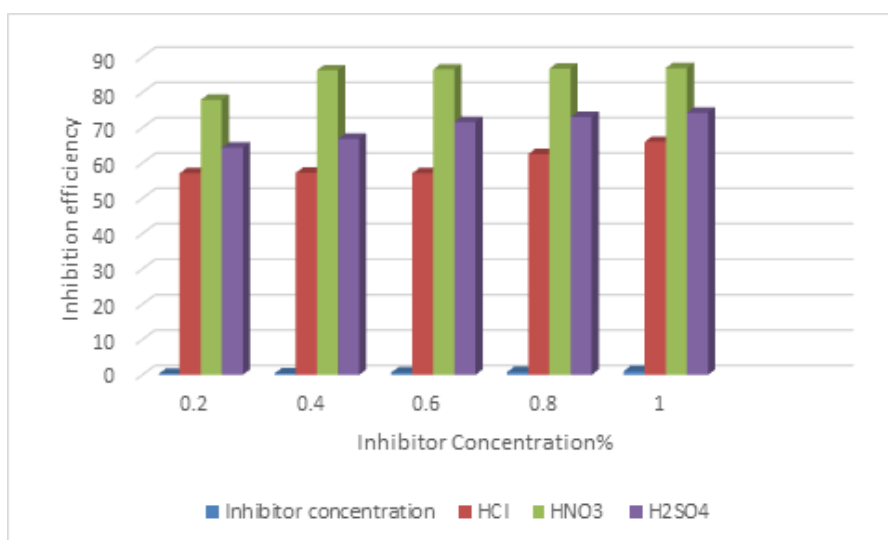


Figure 3: Variation of Inhibition efficiency with concentration of fruit extract for mild steel in 3M HCl, 3M HNO₃ and 3M H₂SO₄

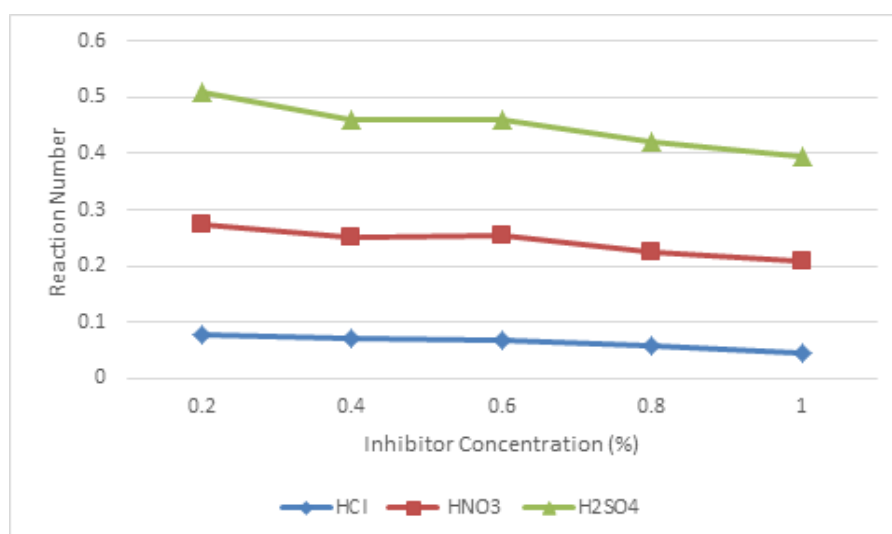


Figure 4: Variation of reaction number with concentration of fruit for mild steel in 2 M HCl, 2 M HNO₃ and 2 M H₂SO₄

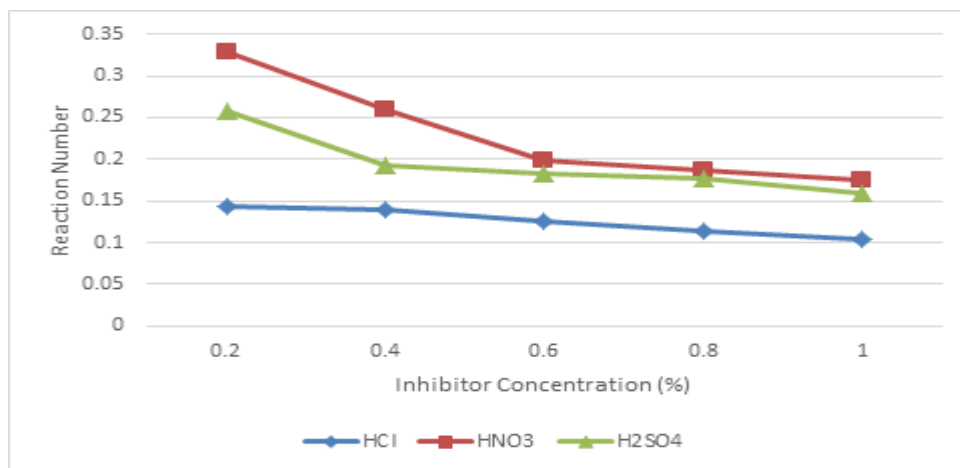


Figure 5: Variation of reaction number with concentration of fruit extract for mild steel in 3 M HCl, 3 M HNO₃ and 3 M H₂SO₄

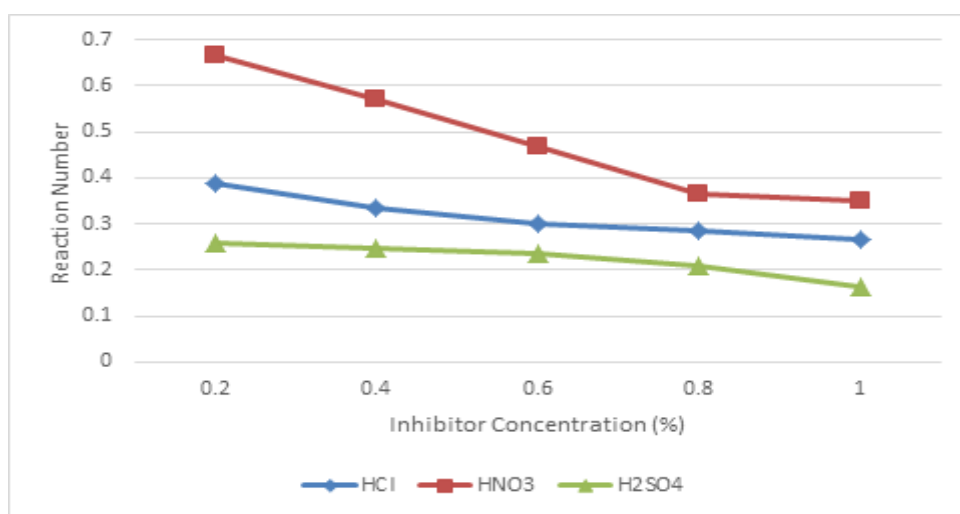


Figure 6: Variation of reaction number with concentration of fruit extract for mild steel in 4 M HCl, 4 M HNO₃ and 4 M H₂SO₄

Data show that inhibition efficiency increases with increasing concentration of inhibitor and decreases with acid strength of HCl. Maximum inhibition efficiency (91.15 %) in case of 1 M HCl was observed with 1% inhibitor concentration. Inhibition efficiency of HNO₃ increases with increase in concentration of inhibitor and acid strength as well. Maximum efficiency of 86.84 % in 3 M HNO₃ with 1% inhibitor concentration has been observed. 1 M H₂SO₄ shows maximum inhibition efficiency of 78.71 % with fruit extract concentration inhibitor concentration of 1 %. Data revealed that fruit extract shows higher inhibition efficiency in HCl than HNO₃ and H₂SO₄. Figure 1 to 3 unfolds variation of inhibition efficiency with concentration of fruit extract for mild steel in 1, 2 and 3M acid strength respectively. Variation of reaction number with concentration of fruit for mild steel in 2, 3 and 4M concentration of acid strength being portrayed in fig 4 to fig 6. Table 1 and table 2 delineate surface coverage increases with increase in concentration of fruit extract and corrosion rate decreases. Thermometric method and weight loss methods were found to be in good agreement with each other.

.A study of fruit extract of *C. equisetifolia* showed different corrosion inhibition properties of mild steel with different acid. The comparative results of weight loss method and thermometric method have been tabulated in table III and IV.

Table III: Comparative study of weight loss method

Acid	Acid strength	Inhibition efficiency (%)	Concentration of inhibitor (%)
HCl	1 M	91.15	1
	2 M	90.74	1
	3 M	65.94	1
HNO ₃	1 M	71.06	1
	2 M	75.94	1

	3 M	86.84	1
H ₂ SO ₄	1 M	78.71	1
	2 M	71.56	1
	3 M	74.20	1

The above data shows that inhibition efficiency increases with increasing concentration of inhibitor and decrease with acid strength of HCl. The Maximum inhibition efficiency (91.15%) was obtained in 1 M HCl with 1% inhibitor concentration.

Table III: Comparative study of thermometric method

Acid	Acid strength	Inhibition efficiency (%)
HCl	2 M	83.04
	3 M	74.29
	4 M	64.32
HNO ₃	2 M	76.41
	3 M	87.51
	4 M	91.26
H ₂ SO ₄	2 M	71.95
	3 M	77.57
	4 M	80.37

The thermometric method data shows that inhibition efficiency increases with increasing concentration of acid as well as inhibitor. The Maximum inhibition efficiency (90.26%) was obtained in 4 M HNO₃ with 1% inhibitor concentration.

CONCLUSION

C. equisetifolia fruit extract was found to be a better corrosion inhibitor for mild steel in HCl. Inhibition efficiency increases with the increase in concentration of inhibitors and the acid strength as well. The maximum inhibition efficiency of 91.15% was obtained with fruit extract inhibitor concentration in 1 M HCl and 86.84 % in 3 M HNO₃, 78.71 % in 1 M H₂SO₄ as well. Thermometric method shows inhibition efficiency increases with fruit extract inhibitor concentration. Both weight loss and thermometric methods were found to be in good agreement with each other. It may be concluded that *C. equisetifolia* fruit extract is a better corrosion inhibitor in HCl as compared to HNO₃ and H₂SO₄.

Corrosion control of metals is technically, economically, environmentally, and aesthetically important. Corrosion of metals is the major problem in industries. The fruit of plant *C. equisetifolia* are less expensive and environmentally friendly. The fruit extracts of plant contain many organic heterocyclic compounds. They contain polar atoms such as S, N, O, P etc. Because of this nature, the lone pair of electrons present on these atoms is jumped on to the metal surface; loss of electrons from the metal surface can be avoided. Thus corrosion inhibition takes place. Because of adsorption of inhibitor molecules on metal surface, protective film is formed. Thus corrosion is controlled.

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A Biomechanical Analysis of Two Different Badminton Forehand Strokes

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ABSTRACT

The present study aimed to investigate the biomechanical analysis of two different badminton forehand strokes. The research was confined to two variables that are forehand smash and forehand clear. For the investigation of the study, total (N=12) subjects were randomly selected from the age range between 12 – 16 who have participated in the National Level competition were selected as the study of subjects. The data was collected with the help of GoPro Hero 8 camera. After extracting data from the camera, it was put in kinovea 0.8.15 software which developed a stick figure, t-test was used as a statistical tool, and the level of significance was set at 0.05.

Keywords: GoPro Hero 8, biomechanics, forehand smash, forehand clear, t-test, Kinovea software.

INTRODUCTION

In the world of sports, where the goal is to obtain the highest level of success, science and technology are required; they need the ability to analyze skill movements (Bartleet, 2007). Further research into human movement biomechanics and its application to athletics has discovered that this analysis is beneficial to the effectiveness of the technique and the development of the new and sustainable movement in technological advancement (Lu and Chang, 2012)

Smash is a badminton technique that involves an authentic hit with a strong, fast, and sharp punch. A smash is an overhead shot of the arm's power and speed, as well as the wrist's resuscitation, to make the ball slide sharply to dive (Purnama, 2010). Previous research has discovered that the smash was the most successful shot for scoring points (Ariff and Rambely, 2012).

Overhead Clear strokes are an overhead shot with a flat (offensive) or rising (defensive) trajectory towards the back of the opponents' court. They are the foundation for playing the shuttle from the player's own backline to the opponents' backline. A good lift shot, such as the type of clear stroke that reaches the back court's baseline, can occasionally help the player win the rally by leading the opponent to misjudge the shot and giving the player more time to prepare for the next shot.

Objective of the study

The purpose of the study

- To identify the difference shuttle velocity in forehand smash and forehand clear.
- To identify the difference arm velocity in forehand smash and forehand clear.

Method

The Sample utilized included 12 male badminton players from Manipur; only right-handed male players were selected (with the average age of 12 to 16 years). Subjects were randomly selected from Manipur, who has participated in the National Level Competition. A random sampling technique was deployed.

Materials

Before the test, the participants got warm-up for approximately 10 min. This was trailed by performing forehand smash and forehand clear utilizing their racket to become more comfortable & faster adapt to the test. All participants were approached to execute forehand smash and forehand clear to determine the mean velocity value in m/s.

Standard Badminton court, standard racket and plastic shuttlecock, weighing machine, Stadiometer were used. Data were collected with the help of a GoPro Hero 8 camera.

Procedure of collection of data

Videography was used in this study GoPro Hero 8 high-speed camera were used, which have a frequency from 60 to 240 frames per second (f/s). The camera was mounted on the tripod stand at the height of 1.05mts. from the ground. This video camera was placed perpendicularly at the sideline of the badminton court, the sagittal plane, at a distance of 3.20mts. The subjects performed the skilled three-set, and the best trial was used for the analysis. The data was analyzed by Kinovea 0.8.15 motion analysis software.

Statistical Technique

The statistical analysis of data pertaining to the study was collected on 12 male badminton players age range between 12 to 16. Data were analyzed by IBM SPSS Statistical Package using a t-test, and the level of significance was set at 0.05

TABLE-1: Independent t-test of shuttle velocity with f value for Levene's test.

Tactics	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t value	p values	F values	p values
Smash	5.3033	1.60046	0.46201	1.67	2.6	0.01	0.49	0.48
Clear	3.6267	1.55092	0.44771					

Interpretation of result

In the above table-1, Standard deviation, mean, and standard error of the mean for the shuttle velocity on forehand smash and forehand clear. The mean angle of forehand smash is more than forehand clear; however, the difference is whether significant or not, which can be revealed only through t-value and its associate's p-value.

One of the assumptions for using a two-sample Ratio-test for unrelated groups is that the variance of two groups must be equal. To test the equality of variance Levene's test was used. In the above table, F-value $0.07 > 0.05$; thus, the null hypothesis of equality of variance may be accepted, and it can be concluded that variances of two groups are equal.

It can be seen in the above table the value of t-statistics is 0.79. This t-value is insignificant as its p-value is 0.43, greater than 0.05. Hence the null hypothesis of equality of the population means is accepted. It may be concluded that the average shuttle velocity of forehand smash and forehand clear is not different, i.e., insignificant.

The comparison of selected kinematic variables, i.e., the shuttle velocity, showed the insignificance difference between the forehand smash and the forehand clear in badminton players. This insignificant difference may be due to the kinematics patterns are similar between the forehand smash and the forehand clear to performed the skill. This study used an independent t-test as a statistical tool to identify the difference in the shuttle velocity between forehand clear and forehand smash of badminton.

TABLE-2: Independent t-test of the arm velocity with f value for Levene's test.

Tactics	Mean	Std. Deviation	Std. Error Mean	Mean Difference	t value	p values	F values	p values
Smash	5.3033	1.60046	0.46201	1.67	2.6	0.01	0.49	0.48
Clear	3.6267	1.55092	0.44771					

Interpretation of result

In the above table-2, Standard deviation, mean, and standard error of the mean for the arm velocity on forehand smash and forehand clear. The mean angle of forehand smash is more than forehand clear; however, the difference is whether significant or not, which can be revealed only through t-value and its associate's p-value.

One of the assumptions for using a two-sample Ratio-test for unrelated groups is that the variance of two groups must be equal. To test the equality of variance Levene's test was used. In the above table, F-value $0.49 > 0.05$; thus, the null hypothesis of equality of variance may be accepted, and it can be concluded that variances of two groups are equal.

It can be seen in the above table the value of t-statistics is 2.6. This t-value is significant as its p-value is 0.01, which is less than 0.05. Hence the null hypothesis of equality of the population means is rejected. The average arm velocity of the forehand smash has greater values than the forehand clear. It may be concluded the average arm velocity of forehand smash and forehand clear is different, i.e., significant.

The comparison of selected kinematic variables, i.e., the arm velocity, showed the significance difference between forehand smash and forehand clear in badminton players. This significant difference may be due to the maximum strength and speed of the arm produced during the forehand smash compared to that during the forehand clear. This study used an independent t-test as a statistical tool to identify the difference in the arm velocity between the forehand clear and the forehand smash of badminton.

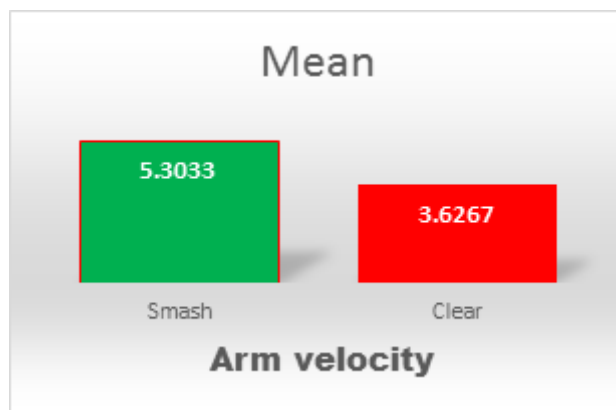


Figure-1: Arm velocity between forehand smash and forehand clear.

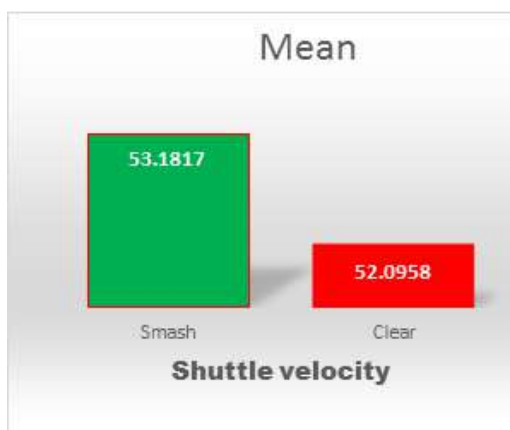


Figure-2: Shuttle velocity between forehand smash and forehand clear

CONCLUSION

The present study concluded that the shuttle velocity showed insignificance different between the forehand smash and the forehand clear. Further, the variable arm velocity in table 2 p-value was found out significance as the p-value is (0.01) at the level of 0.05, where the null hypothesis was rejected among the forehand smash and the forehand clear.

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A Study on the Digital Transformation of Workplace Due to Covid 19 in India

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ABSTRACT

The coronavirus outbreak has impacted all the small and big firms in various negative ways but it also increased the use of digital technologies in businesses. Moreover, the use of digital technologies has impacted the business in its development and also improves the economy of the companies and also various sectors. Along with that, the pandemic has not affected only one sector but it has affected all the sectors and industries of the countries and also the population of the country. Several digital technologies such as **Zoom, Google meet** and so on have helped the organizations to improve the business operations and growth of the businesses. The coronavirus has made the businesses perform with well-equipped technologies and market their products to a large volume of customers. In addition to this, the COVID-19 pandemic is impacted various businesses in positive and negative ways and made aware the new startups of the benefits of digital technologies for their businesses.

Keywords: Pandemic, Stress, AI (artificial intelligence), UPI (unified payment interface), Blockchain, UC, UCaaS, Cloud, Work Place Transformation

1. INTRODUCTION

The worldwide pandemic of COVID-19 has tremendously impacted the entire planet and also the various businesses of India. Moreover, in the country, there is an inevitable surge of various technologies because of the norms of social distancing and also due to the nationwide lockdowns. In addition to this, the population and the business of the entire world have to set new ways of working and the strategies to make the balance between life and work. The main aim of the study is to evaluate the increased use of digital technology in businesses due to the covid-19. The covid-19 pandemic has implemented a variety of changes in the working procedure of the employees and the firms all over the sectors and regions of the world. Most of the organizations have accelerated their business processes and made the digitization of the supply chain processes and the customer interactions.

The coronavirus has firstly been reported in the country China and from China; the virus has spread in the entire world and is responsible for all the transformation in the businesses. Furthermore, the impacts of digital transformation in the business due to the covid-19 pandemic and the increased use of the digital technologies the healthcare system and other sectors in India have started, these are also going to be discussed. Along with that, the methods used by the researcher for the completion of the study are also going to be illustrated in this study. The theories used in the study which are related to the digital transformation of businesses and the gap of the study which is not covered in the topic are also going to be described in this study.

2. LITERATURE REVIEW

2.1 COVID-19 and the future businesses

The coronavirus outbreak has been stated in the year December 2019 and was first reported in Wuhan of China. After the increasing number of cases of corona-affected patients, the World Health Organization (WHO) has declared this pandemic as a global pandemic and all the countries of the world have to face the critical situation. As time passes the virus has spread in the various parts of the world and reached India in January 2020 and caused many impacts on the life of the population of the country and also impacted the operations of the business. Furthermore, the pandemic has restricted the business operations and stopped all the workplaces where the people lost their jobs and also faced the situation of complete lockdowns. In addition to this, the economies and the development of the business have stopped. On the other hand, the outbreak of the covid-19 has ravaged the economy of the world and the social development and operation to a standstill (Dash and Chakraborty, 2021).

India is only one nation in the world where the daily operation of the business never stops but due to the covid-19 pandemic all the operation has been stopped and various activities have become silent. In addition to this, the worldwide pandemic has impacted the dependent sectors and the manufacturing sectors such as hospitality, travel, retail, banks, hotels, healthcare, education, recreation, IT, media and many other sectors of the country. The financial stress of the country is increasing rapidly and especially after the outbreak and impacts of the second wave of the coronavirus (Abdulrahim and Mabrouk, 2020). Additionally, the norms of the covid-19 such

as social distancing, wearing masks and regularly washing hands have impacted the loss of the productivity of the businesses and these impacts have decreased the demands of the services and goods by the consumers in the market. In contrast, for the massive and diverse countries like India, the adoption of digital technologies in businesses has been a complicated and critical issue and this is also long-drawn and time taking for the country.



Figure 1: Future businesses with implementation of digital technologies
(Source: Datta &Datta, 2020)

The adoption of digital technologies and their implementation processes is not complicated for organizations but also for the employees and customers. The best transformation in the business is the change of street economy into the screen economy. The critical pillars of the economy are payments and banking, these are the areas where the adoption of digital technologies is vital and have been the serious uptick in the digital offerings. In the words of Dwivedi et al. (2020), the banking sector is no stranger to digital technology adoption, the coronavirus pandemic has crucially accelerated the adoption process and it has made the financial system for a longer time. The various technologies such as data analytics, AI (artificial intelligence) and also the application of the payments process through QR codes, UPI (unified payment interface) and so on are coming into use by businesses. Therefore, the future of the businesses of India is developing on the basis of digital technologies and due to this; the entire process is changing from physical to digital.

2.2 Impact of digital transformation due to COVID-19

In the time of covid-19, the use of the audio and video tools is increasing exponentially and with these organizations is booming and their technological infrastructure is in account for this surge. According to the reviews of Singh et al. (2020), this leads to gain in the investments of software, network equipment and bandwidth expansion which are able for the leverage of the cloud services. Along with that, the employees of the organizations are becoming acclimated with the idea of remotely working, online transactions, and meetings and also the companies are shifting their operations from offline to online. Additionally, digital technologies such as the blockchain (BC), machine learning (ML), internet of things (IoT), cloud, and AI are the constituents that the organizations are going to implement and adopt in their operations and their efforts of transformation (Arora and Suri, 2020). The technology of blockchain represents the opportunity to secure important information and data to the tested control mechanism systems.

The healthcare and education sector are the witnesses for the shift to digital domain, BC enables a direction in order to authenticate and secure the medical records of the patients, health records, prescriptions and various certificates from loss. Most of the companies are dividing the gig force and also the gig economy by the online platforms which hire workers or employees on an urgent basis, mostly informal and short contracts. For example, these involve the companies like Uber, Swiggy, Airbnb and Ola in India (Lumunon et al. 2021). These platforms have grown and have recorded growth after the availability of the smartphones and internet. During the time of lockdown, most of the workers have lost their job and suffered lack of the customer, taxi rides, and rentals. On the other hand, from these online platforms, most of the workers have got their dream job and started their businesses and many others.

After the pandemic, the growth of the gig economy started to gain its previous position as all the manufacturing and service-providing companies have returned to their preconditions. However, there is also a great threat that after the increase of the infections and the waves of the corona the gig force and gig economy may thrive. In the opinion of Tripathi and Bagga (2020), the issue that arises in the work from home scenarios is that the allocation of the network becomes difficult and the collaboration becomes tough inside and across the teams and also across the projects. In addition to this, it became the most common problem in the world after the pandemic because of the increasing gig employees and remote working conditions. Apart from the benefits of remote working, there are also negative sides of working remotely as most of the employees get stressed with working from home and they are unable to make a balance between life and work.

Before the COVID-19 pandemic the traditional communication methods were email and telephone whereas after the outbreak of the coronavirus the communication methods were totally transformed either in the workplaces or the educational institutions. In addition to this, the cloud based technology *Unified Communication as a Service (UCaaS)* is compliant and also a secure way for the schools and workplaces in order to integrate the various communication techniques by the single provider of cloud (Almrezeq, 2021). Moreover, in the UCaaS tool all the data which are related to messaging, calling, audio, video, screen sharing, task management, presences and many others can be stored in one and secured place which can also be accessed from anytime and anywhere. In contrast, the data and information can be accessed by using various devices such as mobile phone, tablet, web browser and desktop.

On the other hand, the COVID-19 pandemic has forced many enterprises and organizations to shift their procedures into the work from home mode (Damme, 2019). In contrast, the remote working procedure has been developing for many years, but the pandemic of coronavirus has forced to new levels overnight. In the entire process of the changing working mode the digital tool UCaaS has been playing a significant role in order to make the new condition possible and the outcomes are expected to become better for employees and employers both. The UCaaS tool has also played the role of key enabler in suggesting the consistent technological tools regarding the location of remote working. Along with this, the UCaaS tool has enabled the forms of engagement of collaboration which does not make the employees tied in the meeting room or at the desk and the tool also has made the difficult technologies ebay for the people.

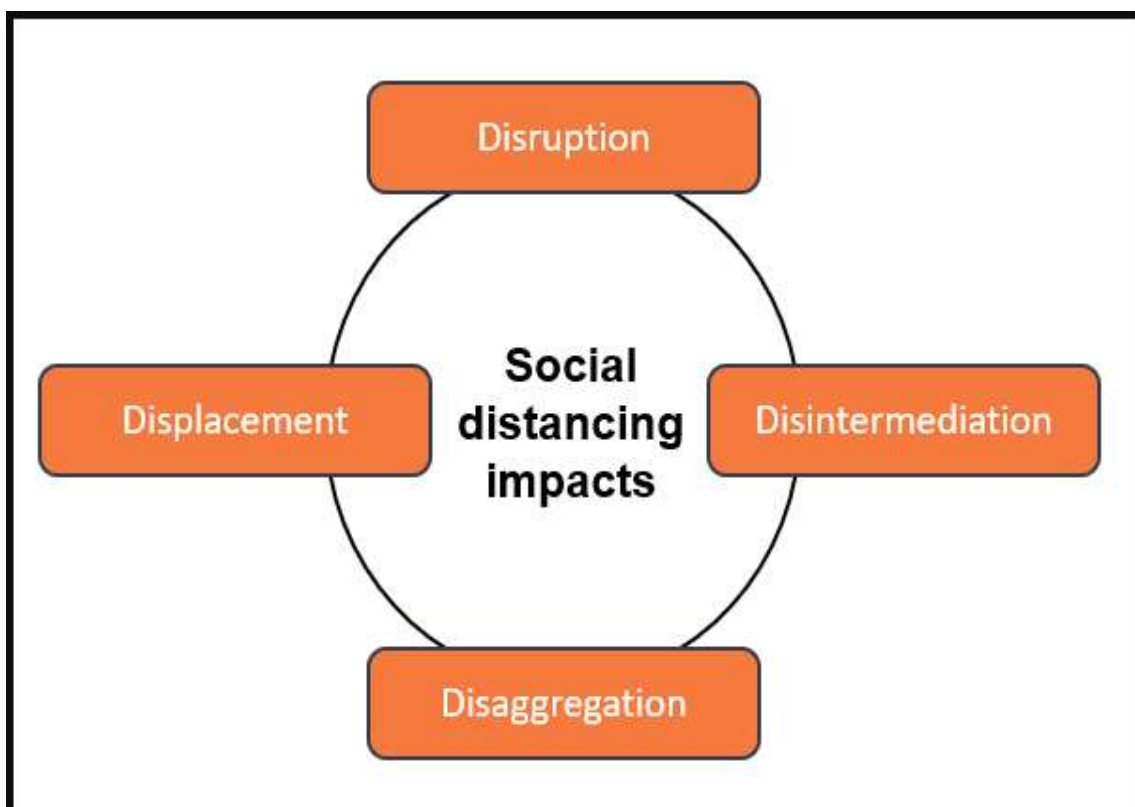


Figure 1: Norms of COVID-19 in workplaces
(Source: Leporeet al. 2021)

2.3 Utilization of digital technologies in the healthcare system due to COVID-19

Digital technologies help provide and track the records of the coronavirus-affected patients in the healthcare system across the world. It also includes surveillance of the population, identification of the cases, contact tracing and the evaluation of the interventions based on the mobility data and the collaboration with the population. The covid-19 pandemic is a type of respiratory illness caused by a coronavirus which is named by WHO as *Sars-CoV-2* on 11th of March 2020. In the last month of the year 2020, the total confirmed cases of covid-19 is recorded approximately 9.8 million all over the world and the number of deaths recorded is more than 495000 (Times of India, 2021). The concerns about the health of the population of the world are increasing, economic and the societal effects of the coronavirus specifically on the disadvantaged and vulnerable populations.

19 pandemic, most of the companies have changed the way of communications and working procedures of the employees and few of the companies have forbidden the telecommunication method for various positions in the workplace. In the opinion of Kumar and Sharma (2021), it has not been thought that the jobs can be done remotely; some of the companies have not valued the value of telecommunication before the pandemic. For the business operations, many applications have been developed such as for meetings and communications the applications utilized are *Zoom, Google meets, Slack, Teams* and so on (Alaparthi and Thakare, 2020).

2.5 Theoretical Underpinning

The effect of the digital transformation has become popular in the modern world and especially in the time of the coronavirus pandemic. The term digital transformation can also be defined as digitalization. This is the combination of digital technology in business operations. In addition to this, the exploitation of digital technologies creates various opportunities in order to integrate the services and products across the organizations and functions cutting the geographic boundaries. Moreover, digital technologies increase the pace of leadership and change the importance of the transformation in various organizations (Singhal, 2020). In addition to this, the digital transformation has revolutionized the way of working of businesses and digital platforms create new way for the operation of organizations and businesses in the ecosystem of business which is leading to change the value of the dynamics of the networks.

The digitalization theory helps the business to collect information about the ongoing trends in the market and also remain focused on increasing the use of new and advanced technologies trending in the market. Collecting the data about the topic, the usage of the digitalization theory has helped the researcher to collect the relevant data and information about the impact of covid-19 on the transformation of the workplaces from physical to digital (Timokhina et al. 2021). On the other hand, the three characteristics of digital technologies such as digital platforms, digital artifacts and digital infrastructures create a lot of opportunities for modular architecture (Hamburg, 2021). It also presents to the companies about the strategic choice of the strategy of digital innovation.

2.6 Literature Gap

The main gap of the study is that the utilization process and also the implication steps of the tools has not been mentioned. In addition to this, there are various digital technologies available which have contributed in the working mode of the employees and the employers. Moreover, the negative impacts of using the digital tool in the business operations are not described in this study (Tosheva, 2020). The one digital tool which has contributed in the remote working of the business operations is discussed but the disadvantages of using this tool has not been illustrated in this study.

3. AIM AND OBJECTIVE

The aim of this research article is to evaluate the use of digital technologies in the workplaces due to the covid-19. In addition to this, the objective of this study is mentioned below:

- To understand the use of digital technologies in business operations
- To analyze the growth of the businesses after the implementation of digital technologies
- To recommend a proper and effective strategy to enhance the business operations and growth
- To understand the acceleration of digitalization because of working from home (Kumar and Kapoor, 2021)

4. METHODOLOGY

4.1 Research Methodology

This part of the research article elaborates the methods and techniques used for the completion of the study. Moreover, this study is also helpful to answer the most common two questions which arise: from where the data has been collected and how that data has been analysed. This research has followed the *positivism research philosophy* in order to collect actual data and information from authenticated sources. According to Kauhik, (2020), the positivism philosophy is advantageous for the researcher to obtain all the relevant data and information from the suitable articles which are taken under observation. In addition to this, as this study is focused on the impacts of covid-19 on the digital transformation in the growth and development of businesses. Furthermore, the researcher has involved the *descriptive design* in order to conduct the systematic discussion regarding the different digital transformations in the business operations due to the covid-19 pandemic.

Roy and Bhusan (2020) mentioned that the use of digital technologies has resulted in the growth and increased production of some of the businesses in India after the lockdown situation. This research design is effective for the conducting systematic analysis of the data in order to investigate and determine the several variables linked

with the topic of the research. Along with that, the *inductive approach* has been adopted by the researcher to analyze the qualitative data and information collected. This approach is effective for the analysis of the qualitative data collected in respect of the observed theories.

4.2 Data collection method

There are various methods available for the collection of data and information from reliable sources and the most utilized methods are primary and secondary data collection methods. In this study, the method utilized by the researcher for the collection of data and information is a *secondary data collection method*. In addition to this, *qualitative* data also has been collected by the researcher for the completion of the research (Sinha and Priyadarshani, 2021). Thus, it can be illustrated that the selection of the reliable data and information from various kinds of secondary sources has been supported for the research study in order to investigate and identify the issues and the implication of the research topic (Kaur, 2021). The secondary data collection method is helpful in order to collect the proper and reliable data about any research topic and in addition to that there are various advantages of using the secondary method for the collection of data.

The first benefit is that this method of data collection is of low cost and sometimes the researchers may collect the information and data by the secondary resources for free. On the other hand, the second benefit of the data collection method is that this method saves time (Lee and Han, 2021). In addition to this, the data has been collected from the journals, articles, research papers and newspapers published after the year 2017. The topic of the research has been searched on Google scholar and out of various results, those results have been collected which contains the name of the authors, journal title, name of the journal, year of publication and the page number.

4.3 Data analysis method

For the data collected by the researcher from the various sources by using the secondary data collection methods, it is required to analyze the collected data. Thus, the collected secondary qualitative data have been analyzed with *thematic analysis* in order to evaluate the impacts of covid-19 on the digital transformation of businesses in India.

5. KEY FINDINGS

The coronavirus pandemic has badly impacted all types of businesses and the impact of COVID-19 started in January 2020 and is increasing day by day in the entire world. Moreover, the global pandemic is coming with its new strains and showing its tremendous effects on the entire population of the world. In addition to this, all the nations of the planet are affected by this virus. According to the reviews of Roy and Bhusan (2020), the second wave of the deadly coronavirus is more dangerous than the first wave which comes at the start of the year 2020. The second wave is coming with more symptoms and infections which increase the number of deaths of human beings in the country and also in the entire world. According to the survey of Statista Research Department, the future status of small and medium enterprises is going to be affected due to the COVID-19.

The below figure illustrates the response of the respondents which determines the condition of the market of Indian workplaces in the time of COVID-19. In contrast, the responses given by the respondents are classified into five categories such as growth, sell, shut down, cannot say and scaling down. In the time of the post-COVID-19, most of the businesses have responded that they have seen growth in their businesses nearly about 13% and they have also seen the sale which has been reduced to 7% in the market of the product and goods (Lee and Han, 2021). In addition to this, most of the businesses are scaling down approximately 61%. Furthermore, many businesses are shut down suddenly due to facing the situation of extreme loss. On the other hand, few businesses cannot say that they are experiencing the situation of loss and growth which is near about 6% of the total Indian workplaces.

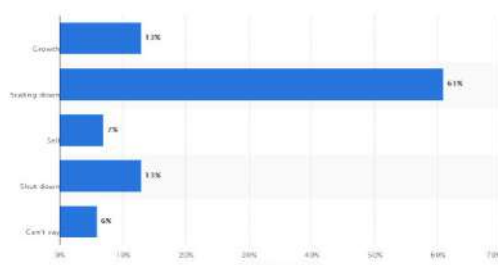


Figure 4: Impact of COVID-19 on the future business and startups
(Source: Statista Research Department, 2021)

Along with that, when the outbreak of the coronavirus started in China and it spread throughout the entire world, the number of patients visiting regular doctors became impossible and risky. In addition to this, the situation of the stuck at home inspires the population of the country and the world to use the digital technologies for their healthcare from that the options of internet-based treatment and diagnosis started (Shah and Manna, 2020). However, the pandemic has surged in the population of the patients to utilize the platforms and the applications for telemedicine across the Asia-pacific places are speeding with the digital tools of health. On the other hand, before the COVID-19 pandemic, telemedicine was at the turning point and most of the customers of the country and the planet are increasing their interest in the preventative health, ownership and conveniences of care (Sinha and Priyadarshani, 2021). As per the survey done by Bain in the year 2019 which is the front line healthcare in the Asia-pacific region said that more than 50% of the patients want to use digital tools for healthcare in the upcoming future (Kapur and Boulton, 2021).

In addition to this, 91% of the consumers have said that if the cost of the digital services for healthcare were covered through the insurance and the healthcare provider then they are ready to utilize the digital tools for the diagnosis and the treatment of their health.

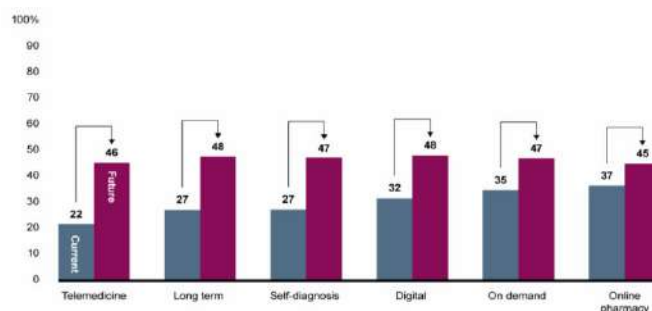


Figure 5: Acceleration of digital health services due to COVID-19
(Source: Jorge *et al.* 2020)

The above figure shows the acceleration of the digital tools for health services due to the impact of COVID-19 in India. The figure consists of two colours: the grey colour indicates the current use of digital tools for healthcare and the purple colour illustrates the use of digital tools for health care in the future. The current percentage use of the digital tool for telemedicine is nearly about 22% but it is expected to be increased to 46% in the future. Moreover, the use of telemedicine for the long term is 27% current but it is also expecting that it will increase to 28% due in the future (Eri *et al.* 2021). On the contrary, the percentage of self-diagnosis is about 27% in the current situation but the percentage of self-diagnosis is going to be improved to 47% in the future.

Apart from this, the number of online pharmacies is also increasing day by day the current percentage of online pharmacies in India is nearly about 37% and it is going to become about 45% in the future. As per the overall statistics and the discussion, it can be evaluated that the number of digital tools in the technologies for the healthcare services is increasing and in the future, the healthcare system of a country may become fully digital. Furthermore, most of the companies are digitizing some of the operations and parts of their businesses in order to protect the employees and serve the consumers effectively due to the mobility restrictions as an outcome of COVID-19. After the first wave of coronavirus, most of the businesses are coming in their previous track and position to come back with new technologies and services. Reversing it, various sectors of the Indian workplace are implementing digital technologies for their operations and tracking of records. The below-given figure explains that the various industries such as banking, entertainment, grocery, utilities, telecom, traveling, insurance and apparel are utilizing digital technologies in their operations.

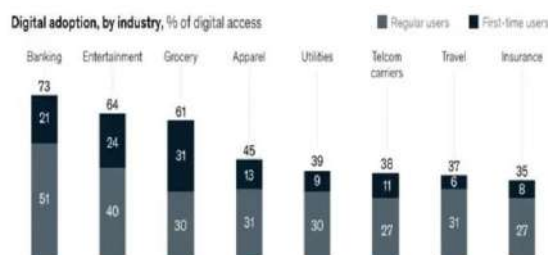


Figure 6: Growth in the adoption of digital technologies in India due to COVID-19
(Source: Muhyiddin and Nugroho, 2021)

From the figure it is visible that due to the impact of COVID-19, there is an increase in the number of users with the use of digital tools, the banking sector has 51% of the regular users which has increased to 73% nowadays. In addition to this, the entertainment sector has 40% percent of the regular users and it has been increased with 24% of the new users in the entertainment industry (Lepore et al. 2021). Furthermore, the grocery industry has 30% of the total users which has become 61% and the apparel industry has increased to 45%. Along with that, with the implementation of digital technologies in the telecom industries, the number of regular users is 27% and 11% of the new users have joined the digital telecom industry which increases the total number of users to 38%. Thus, from the above discussion and data, it can be estimated that with the implementation of digital technologies the number of customers of the business is also increasing.

6. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The outbreak of the coronavirus has changed the lifestyle of the people and also the ways of work operations of businesses in India. Moreover, most of the businesses have transformed their operations from physical to digitals such as meetings, communication, collaboration, launching of products and services and many others. Along with that, the deadly virus has shown several negative effects on businesses but it has also positively impacted some of the businesses. Digital technologies have made operations and various activities easy for all the businesses and populations of the world. Therefore, it is concluded that the utilization of digital technologies has shown that it is beneficial for all the businesses and population of the world in the future.

6.2 Recommendation

Most businesses and organizations must implement digital technology in their businesses as the digital technologies make the various operations of the businesses easy and effectively managed by the employees (Khan et al. 2021). In addition to this, it also increases the capacity of the businesses to function and market their product and services to a large number of customers. On the contrary, digital technologies also help the business to reach out to customers who cannot be reached physically and also bring out potential customers for their businesses.

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Assessment of Flat Foot of School Students in Imphal District

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ABSTRACT

Human body weight is transferred mainly to the foot, which is in contact with the ground. Foot play an important role in our daily activities (movement). Therefore, the present study was to assess the flat foot of school students of Imphal District. For this study, the total number of participants are N=50 (boys N=25, girls N=25) from class VI in the age group 10-13 years who were studying at different schools of Imphal West were selected as subjects. Staheli's planter arch index (SPAI) was used to measure the flat foot. Statistical analysis was used such as mean, standard deviation, paired t- test and independent t- test to compute the difference of flat foot of right and left of boys and girls among the group and difference of right and left flat foot between boys and girls respectively. The level of significance was set at 0.05. The study concludes that there is no significant difference in both boys and girls of 10-12 years but in case of SPAI for both boys and girls foot type is found flat or pes planus.

Keywords: Flat foot, Staheli's planter arch index, movement, body weight and pes planus

INTRODUCTION

Flat feet, also called flat foot, pes planus, pronated foot, and fallen arches, are deformities in human posture. It is characterized by no arch when touched to the ground. Flatfoot mainly occurs in infants and children because they are born in flat foot and very soft. Bones are in growing stage during childhood. Influence of external factors like ground reaction forces can greatly influence the developing foot arch structure (Shanmukha et al. 2018). Foot types that differ from normal are associated with different injury patterns, heredity, laxity of ligaments, tight Achilles tendon, lack of foot exercise. They will be developed according to the growth. Childhood is the formative stage of life towards adulthood, and we are concerned about growth, development, and disease prevention, both physical activity till 12-13 years. The American Academy of Pediatrics recommends the pediatric age up to 21, and in the United Kingdom, pediatrics covers until age 18. There are two deformities flat feet and pes cavus. Flat feet are an alteration of the longitudinal and transverse arch of the foot, which is determined an increased footprint on the ground. Flat feet may affect one of the legs or both. As a result, those with a flat foot experience upsetting during periods of prolongs time (Cavangah 1987).

The arches of the foot play a vital role in daily physical activities when in contact with the individual's surface. The arches present right from birth, although they are masked by excessive amount of fat in their sole, an apparent flat foot is present in many children up to the age of 2 years (Rajendra et al., 2015). A flat foot can be divided into flexible and rigid flat feet. In Flexible flat foot, the arches tend to disappear when body weight is bearing on the feet. On the other hand, there are no arches when moving the feet on the ground in a rigid flat foot.

THE OBJECTIVE OF THE STUDY

The present paper aims at

- finding the difference of flat foot of right and left of boys and girls among the group.
- finding the difference of right flat foot between boys and girls, and left flat foot between boys and girls.

MATERIALS AND METHODS

Material

We used pen, pencil, notebook, scale, plain paper, ink or color, a towel to assess the flat footprint.

Methods

The present study was conducted on 50 selected students who were willing to participate for this test of class VI for both boys and girls in the age group 10-13 years at different schools of Imphal West District. The subjects were instructed to keep their feet on the inked plate in a standing position and then again, the same foot place on the plain paper immediately by making an impression and marked by pencil. The marking lines were recorded by using scale and pencil to calculate the planter arch index.

For calculating the Staheli's planter arch index, a tangential line is drawn to the medial forefoot edge and at the heel region. The mean point of the line is calculated. From this point, a perpendicular line is drawn crossing the

footprint. The same procedure is repeated for the heel tangency point. The width of the central region of the mid footprint is considered as A and the width of the heel region is considered as B.

Staheli's planter arch index (SPAI) was obtained by dividing the A value with the value B. Planter arch index (PI) = A/B.

Planter arch indexes above 1.15 should be regarded as indicative of flat foot.

Statistical techniques

To analyse the data assessment of flat foot of school students in Imphal District, the mean, standard deviation, paired t- test and independent t- test was employed. The level of significance was set at 0.05.

Results:

Table-1: Paired t-test of Boys left and Right flat foot.

Parameters	Mean	N	Standard Deviation	Standard Error Mean	t-value	df	Significance (2 tailed)
Boys Right	0.7768	25	0.10209	0.02042	-1.975	24	0.06
Boys Left	0.8072	25	0.13667	0.02733			

Notes: N= sample size, df= degree of freedom

Table-2: Paired t- test of Girls left and Right flat foot.

Parameters	Mean	N	Standard Deviation	Standard Error Mean	t-value	df	Significance (2 tailed)
Girls Right	0.7892	25	0.15674	0.03135	-1.95	24	0.064
Girls Left	0.8672	25	0.22099	0.0442			

Notes: N= sample size, df= degree of freedom

Table-3: Independent t-test to show gender differences in mean flat foot.

Gender	t-test of Right			t-test for left		
	Mean	df	significance (2 tailed)	Mean	df	significance (2 tailed)
Male	0.7768	48	0.74	0.8072	48	0.25
Female	0.7892			0.8672		

Notes: df= degree of freedom

DISCUSSION

Staheli's planter arch index (SPAI) between 0.5-0.7 was considered as normal foot, and SAI above 0.7 was considered as flat foot or Pes planus and below 0.5 as high arch or pes cavus [reference]. This study aimed to determine the flat foot arch of boys and girls in the Imphal district of the 10-13 years age group using the SAI method.

From table-1, the mean SAI of the boy's right and Left was 0.77 and 0.80, respectively, which has a slight difference in right and left foot. The mean value of Right and Left is greater than 0.7, which is considered flat foot or pes planus type. The significance mean values are calculated using paired t-test in SPSS. In boys, the left foot's SAI values are greater than the right foot. The significance level is greater than 0.05, which is not significant. It can conclude that there is no significant difference between right and left foot.

Form table-2 compared the SAI value of the girl's right and left foot. The mean SAI of girls right and left was 0.78 and 0.86 respectively, which has a slight difference in right and left foot. The mean value of Right and Left is greater than 0.7 and is considered in the flat foot or pes planus type category. The significance mean values are calculated using paired t-test in SPSS. In girls, the left foot's SAI values are greater than the right foot. The significance level is greater than 0.05, which is not significant. It can conclude that there is no significant difference between right and left foot.

Table-3 compared the gender differences in mean SAI of boys' right and girls' right foot, which is not significant. Similarly, the mean SAI of the boy's Left and girl's foot is not significant. The mean SAI of boys' and girls' right foot is 0.77 and 0.78, respectively, which has likely the same mean. In contrast, the mean SAI of boys and girls left is slightly different, i.e., 0.80 and 0.86 respectively.

CONCLUSION

This study concludes that in this age category between 10-13 years, both boys' and girls' feet are not significantly different. In this study, both boys' and girls' SAI foot type is flat or pes planus. There is some

slight difference between the right and left foot of boys, and more difference is found in the right and left foot of girls.

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Comparison of Flexibility Between Volleyball and Basketball National Players of Manipur

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ABSTRACT

The aim of the present study was to find out the comparison of flexibility between volleyball and basketball players of Manipur. In this study, the subjects for data collection were drawn from the CYO, (Chaiba Youth Organisation) Churachandpur District, Manipur and Gahtao Youth Club, Noney District, Manipur. Simple random sampling technique was used to select the subjects. Their age ranged between 18-25 years. The sample consisted of 20 (twenty) male players from CYO, (Chaiba Youth Organisation) Churachandpur District, Manipur and Gatao Youth Club, Noney District, Manipur, ten ($N_V=10$) male players from volleyball and ten ($N_B=10$) male players from basketball. The following variable namely Sit and Reach test was selected as criterion variable. The data were collected during the 2nd week of October, 2021. The data were statistically analysed by using Statistical Package of Social science (SPSS) Version 21, descriptive statistic method, mean, standard deviation and independent 't' test were used in the evaluation of the data and to find out the significance difference between volleyball and basketball players. The level of significance was set at 0.05. However, the results of the study showed that there was insignificance difference between volleyball and basketball players.

Index Terms: Sit and Reach Test, Volleyball, Basketball and flexibility.

INTRODUCTION

Flexibility is the capacity of a joint to move through its full range of motion without undue strain to the articulation and muscle attachments. Flexibility provides higher degree of freedom and ease of movement and gives greater safety from injury. The trunk flexibility was assessed by modified sit and reach test. Shoulder and knee flexibilities were assessed by goniometry (Vandana et al. 2001, pp. 24-29). Flexibility is usually described as a component of general physical fitness. Flexibility has been defined as the ability for making movements through maximum possible amplitude or a range of motion. Flexibility exercise can reduce the perception of pain of ensuring muscular exercise distress based on decreased level of residual muscle activity as the result of static stretching the involved muscle. Used prior to exercise static stretching may enhance performance. Slow stretching also has positive influence on intrinsic muscle mechanical characteristics as a half relaxation time, fast isometric force development and speed of concentric contraction when low loads are to be overcome. The latest research has shown that the strength developed with exercise on rebound movement can be better enhancement with add of flexibility training. It is directly caused by reduction in series elastic components stiffness increasing the utilization of elastic strain energy during rebound exercise movement (Dopsaj, 1994, pp. 51-60). Flexibility can be defined as the ability to execute movements with greater amplitude or range. Stretchability and elasticity qualities of the muscles and ligaments by which can be stretched and regain their normal length without any adverse effect on the concerned tissue. Suppleness denotes the ability of a muscle to remain in a state of low tension thereby allowing for smooth and easy movements of the limbs (Singh, 1997, p.156). Flexibility includes the stretch ability of the muscles and mobility of the joints. Good flexibility allows for an optimum range of movement without much internal resistance, thereby positively affecting speed. Flexibility also enables full utilization of explosive strength. Low flexibility leads to excessive internal resistance, muscle tension and also less than optimum strength application (Singh, 1997, p. 157). Flexibility is the ability to perform a joint action through a range of movements. The main objective of flexibility training is to improve the range of stretch of the antagonist muscles. Flexibility plays a very important part in the preparation of athletes by developing a range of movements to allow technical development and assisting in the prevention of injury. The flexibility exercise may be grouped as static, ballistic and assisted. In both static and ballistic exercise, the athletes are in control of the movements. In assisted the movements are controlled by an external force that is usually a partner (Singh et al., 2008, p.291).

1.1. Statement of the Problem: The statement of the problem was to find out the comparison of flexibility between volleyball and basketball players of Manipur.

1.2. Hypothesis of the Study: It was hypothesized that there might be significant difference between volleyball and basketball players of Manipur.

1.3. Significance of the Study:

- This study will help to the coaches, physical education teachers and players to develop well training programmes related to flexibility.
- This study will also help to know more about flexibility among the volleyball and basketball players.
- The finding of this study will provide criteria for transfer of training in volleyball and basketball players.

2. METHODOLOGY

Selection of the Subjects

The subjects were selected in following basis:

- The players were male only.
- The age of the player was range from 18-25 years for this study.
- The players were participated in the National level in the game of volleyball and basketball.
- The players were selected randomly as subjects from two different clubs i.e. CYO, (Chaiba Youth Organisation) Churachandpur District, Manipur and Gahtao Youth Club, Noney District, Manipur.

2.1. Selection of Variables: The following variables were chosen for this study.

1. Sit and Reach Test

2.2. Test Applied

For the collection of data, the following test has been used.

- Sit and Reach Test

2.3 Procedure: Sit and reach test involves sitting on the floor with legs stretched out straight ahead. Shoes should be removed. The soles of the feet are placed flat against the box. Both knees should be locked and pressed flat to the floor - the tester may assist by holding them down. With the palms facing downwards, and the hands on top of each other or side by side, the subject reaches forward along the measuring line as far as possible. Ensure that the hands remain at the same level, not one reaching further forward than the other. After some practice reaches, the subject reaches out and holds that position for a one-two seconds while the distance is recorded in centimetres. Make sure there are no jerky movements. Each subject is given three trails and the highest score nearest to an inch is recorded with the help of measuring tape in centimetres from the marker to the edge of the step where the subject placed his foot.

2.4 Criterion Measures: The following criterion measures were chosen for the hypothesis.

Flexibility: Flexibility is the ability of the joint or a group of joints and muscles to move through a range of motion effectively. To measure flexibility by using sit and reach test and score was recorded in centimetres.

2.5 Statistical Techniques: To analyse the data on Comparison of flexibility between volleyball and basketball national players of Manipur, the mean, standard deviation and independent t-test was employed. The level of significance was set at 0.05. Data was analyzed by using SPSS Version 21 (Statistical Package for the Social Science).

3 RESULTS AND DISCUSSION

The significant mean difference in flexibility between volleyball and basketball players is presented in Table-I

TABLE-I

Group	Sample Size	Mean	Std. Dev.	SE _M	df	't'-value
Volleyball	10	42.0550	6.07202	1.92014	18	.617
Basketball	10	43.4500	3.76658	1.9110		

Significant at.05 level

$$t_{.05} (18) = 2.10$$

From the finding of the above table, the mean (M) and standard deviation (SD) of flexibility of volleyball players were 42.0550 ± 6.0702 and the mean value of basketball players is 43.4500 ± 3.76658 respectively (N=10) for each group. In addition, the standard errors of the mean of volleyball and basketball players were

also found 1.92014 and 1.9110 respectively. Hence there was found insignificance difference as the value obtained was .617 whereas the tabulated value was 2.10 at 0.05 level of significant. It means that volleyball and basketball players have no difference in flexibility,

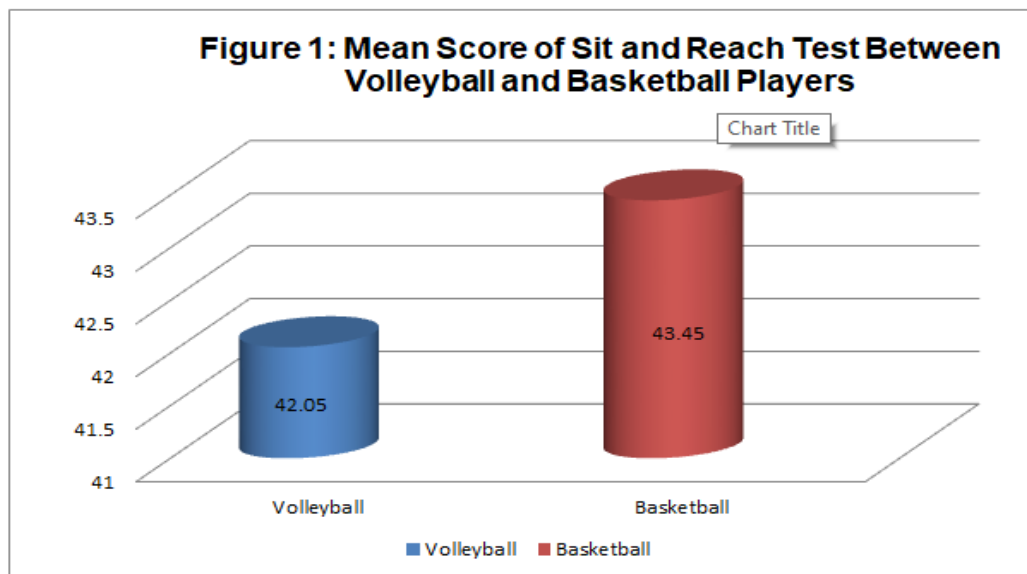


Figure No.1: Graphical representation of mean difference in the sit and reach test between volleyball and basketball players

4 DISCUSSION OF FINDINGS

It is evident from the above table that there is insignificant difference between the volleyball and basketball players in flexibility with regard to comparison of flexibility between volleyball and basketball national players of Manipur.

There is insignificant result in flexibility, the probable reason could be volleyball and basketball players have regular participation in flexibility exercise within training programme.

5 CONCLUSION

Based on the study there would be insignificance difference between the volleyball and basketball players in flexibility with regard to comparison of flexibility between volleyball and basketball national players of Manipur. From the study, it might be concluded that volleyball and basketball players showed adequate flexibility, the main reason for high flexibility in volleyball and basketball players is probably sufficient flexibility exercise within training programme, since the fact that flexibility can be adequately developed by regular application of all methods for flexibility enhancing with 15-20 minutes flexibility exercise per day, 5 times a week.

In view of the above stated, volleyball and basketball players are recommended to perform more extensive and regular flexibility exercises throughout the annual cycle of training programme, as a part of daily standard warming up, as well as obligatory procedure at the end of the training session as a separate flexibility developing training section lasting for at least 10-15 minutes.

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Cryptocurrency in India: A Conceptual Study

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ABSTRACT

Technology has created a significant difference in the lives of the people due to paradigm shift from offline activities to online activities. Cryptocurrency is digital coin money based on the concept of cryptography encryption and electronic connectivity to function. Being a decentralised currency, it also opposes the intervention of central banks and digital currencies by them. It transforms the virtual trade market by introducing a free rein trading mechanism that operates without the involvement and regulation of a third party. Digital currencies in today's scenario become prevalent thus this paper examines the evolution of cryptocurrency its scope and challenges in India as well as how it is a threat to an economy.

Keywords: Cryptocurrency. Digital currency, Blockchain technology

INTRODUCTION

Witnessing the era of digitalisation, we are well versed about the opportunities and advantages which are being available. Digitalisation is the most significant reform at present which not only benefitted production of goods and services but also the financial market of the country. Technology has given us some tremendous inventions in the forms of currency in which cryptocurrency also got the place.

Cryptocurrency is one of the best inventions in the context of financial sector. It is a digital money that was developed with the aim of controlling and protecting its transactions with the user's identity being hidden (Jani, 2018). Cryptocurrency includes crypto and currency in the word were crypto means cryptography and currency. "Cryptography" is a type of electronic medium technology that is used to for the sake of privacy, information obfuscation, and authentication. Currency means money that is in circulation and legally acceptable.



Figure 1

Source: India Briefing

Cryptocurrency has evolved with the motive of being the less expensive, trustworthy and quite efficient with comparison to the other currencies prevailing. The essence of Cryptocurrency is that its locus of control lies in no hands, it's a freely moving currency, though these are issued in some definite quantity. It enables the transmission of digital, cost-free cryptocurrency units, often known as coins, between client programmes over a peer-to-peer network (Vejacka, 2014).

Cryptocurrency does not need an approval from central bank for its issue unlike the country currency and the most interesting thing is that there are intermediaries in the transactions and the whole control of that virtual currency is within the ambit of one self. People can keep a check on its status and regulate the quantity of it by their own. There is no need for an intermediary in this system, and transactions are usually very cheap and simple and quick (Li and Wang, 2016).

Feature of Cryptocurrency

Some of the features which must be consider while studying this digital currency are adopted by (Malik and Rana, 2020)



Figure 2: Characteristics of Cryptocurrency Platform (Malik and Rana 2020)

Background of Cryptocurrency

Satoshi Nakamoto, a pseudonym used by a creator, revolutionised the world of online payments in 2009 by launching the very first decentralised peer-to-peer payment method to the internet with the name Bitcoin. The technology that is used is referred to blockchain technology and this digital currency works in a decentralised way as compared to normal currencies which implies that no competent authority will be able to regulate and control its volume and frequency of being transacted. Many attempts to generate digital money were made in the nineteenth century, but they all failed (Mukhopadhyay et.al. 2016). Satoshi attempted to create a decentralised digital cash system after witnessing all of the failures. File sharing through a network, similar to peer-to-peer. Cryptocurrency is a digital money which can be entertain transactions digitally with no sort of supervision and control on its functioning. The considerable thing is that it avails peer to peer transactions which is not less than a boon in today's economy as it reduces the hectic of actually going out and transacting. Along with that the next important features of ledger which ensures that transactions are transparent and much secure than any other currencies this is so because it store all the required in formation in the form of the ledger, which anyone can see and are able to verify their transactions.

Introduction of cryptocurrency in India

India being a striving country to achieve global targets in economy is enough capable to hold digital currencies. it was 2012 when cryptocurrency is started flourishing in India. The attention on it increases with the passing years. After unexpected move of demonetisation by Indian government, people were very much insecure and investing in cryptocurrency became a smart move for them amidst the chaos. The crash occurred in 2017 after the government raised concerns against the use of the technology and ruled out the possibility of 'Ponzi scheme' fraud (Swetha and Meghashilpa, 2019). But in 2018, there was a drastic change. In the budget speech of 2018-19, Nirmala Sitaraman the Finance Minister of India announced that the government does not consider cryptocurrencies as legal tender. The government also mentioned that they will take all the necessary measures to make sure that the use of cryptocurrencies is eliminated from all activities. Then, a ban was imposed on the use of the same by RBI considering its unregulated setup and risks. On April 2018, the RBI issues a circular suggesting commercial and co-operative banks, payments banks, small finance banks, NBFCs and payment system providers to prevent from virtual currency transaction and giving services to the institutions dealing with them. This way cryptocurrency crash took place in India (Shakya et al., 2021).

It was on march 2020, the honourable supreme court declared the government ban on cryptocurrencies as unlawful as well as emphasised on the April 2018 circular as unconstitutional. The Supreme Court cited the fact that cryptocurrencies are unregulated but not illegal in India which is one of the most important reasons for reversing the ban. In this way the stagnant cryptocurrency market gets revived.

At present, the central government is likely to propose "The Cryptocurrency and Regulation of Official Digital Currency Bill, 2021". The bill aims to outlaw all private cryptocurrencies in India, but it makes some exclusions in order to promote cryptocurrency's technology platform and users. The law attempts to create a mechanism that will make it easier for the Reserve Bank of India to develop an official digital currency. It is one of 26 new bills set to be introduced in the upcoming Parliament session.

According to the Indian government, persons dealing with cryptocurrencies should be cautious and vigilant because there is no legal protection for this type of currency, and the government cannot assist people if they are victims of fraud (Singh and Singh, 2018).

Challenges to cryptocurrency in India

There are many challenges in investing in cryptocurrency some of the aspects are remarked by (Kashyap and Chand, 2018)



Figure 3

- 1. Entrance is wide, but exit is narrow:** Being a novel currency in the market it is very easy to admit in it. This is also because being a digital currency it gains lot of attention. But leaving the cryptocurrency market is not easy.
- 2. Loss of confidence in digital currencies:** The fluctuating nature of the cryptocurrency is subject to a high degree of uncertainty being decentralized currency and no involvement of central bank. Its value is based on the volume of participants and trade which consequently lose the confidence of investors in such currencies leading to collapse of trading activities and sudden drop in value (Thackeray, 2018).
- 3. Intangible and Unsecured:** Cryptocurrency is insecure due to its intangible nature. Investing in these is highly risky because to the lack of intermediaries. There is no involvement of banks or bankers, who operate as intermediaries to resolve cryptocurrency concerns, but banks can provide this level of security (Kashyap and Chand, 2018).
- 4. Cyber/Fraud risk Protection:** Because of its cash currency nature, it is a magnet for the criminal element. Criminals can break the encryption algorithm and steal cryptocurrency from crypto wallets. Because all bitcoin transactions take place via the internet, hackers utilise spoofing/phishing and malware to target users, manage services, and access storage locations (Thackeray, 2018).
- 5. Care and Control:** The intangible character of bitcoin and its function as a digital asset have become the most pressing concerns for cryptocurrency care, management, and custody. Experienced investors will protect their cryptocurrencies, but others who are unaware of security problems are easy targets for fraudsters, and hackers can quickly steal their bitcoin (Kashyap and Chand, 2018).

Scope of Cryptocurrency in India

A person can trade in cryptocurrencies for following benefits as adopted from (Malik and Rana, 2020).

- 1. Fraud-proof:** Currency in cryptocurrency is decentralized neither government nor bank has any control over it, user just own it. All confirmed transactions are stored in public ledger. All identities of coin owners are encrypted to ensure the legitimacy of record keeping.
- 2. Identity Theft:** the public ledger in cryptocurrency is called the blockchain. Blockchain ensure secure the transactions of digital currency by the implementation of encryption algorithms and make the entity virtually nonpackable and void the fraud cases.

3. **Instant Settlement:** after the implementation of blockchain, cryptocurrency get the importance. User just need the smart devices with internet and become the owner of own bank making payments and money transfer.
4. **Accessible:** This virtual kind of bank are easily accessible by the user from any time and from anywhere with the help of internet.
5. **Users become the owner:** User become the owner of this virtual bank and own perform the transactions without the usage of third part.

Is Cryptocurrency a Threat to economy?



Figure 4 Source: news.bitcoin.com

Fiscal Policy of India is framed by Governments and monetary policies by central banks. Cryptocurrency is not regulated by central government being decentralised currency. Central bank has pre-determined mechanism for flow of money in economy along with the power to regulate it. It is a major threat that cryptocurrencies can control the way it is being transferred, its sector wise distribution and can detect its utility. If the cryptocurrency mechanism is entertained in long run, then there will be lack of need for a central government. The reason behind anyone will be able to produce currency irrespective of its quantity required in economy. Another considerable threat is that since user names cannot be identified and only their addresses are mentioned on the network. It is difficult to trace the real identity of individuals or entities behind those addresses that will increase the illegal transactions and consequently more crime which is explicitly harmful for the economy.

CONCLUSION

Cryptocurrency is a new of payment that has grasped the attention of today's investors. Apart from real money, virtual money allows users to conveniently undertake financial transactions such as purchasing, selling, transferring, and exchanging. Virtual money, such as cryptocurrency, is a relatively new in the country's economy but at the same time it can influence the economy as well. The goal of this paper is to give a general understanding of cryptocurrency and its scope, challenges and how it is threat to an economy. Following the rise in popularity of this type of virtual currency, the Indian government is unable to assist citizens if a fraud case arises when utilising cryptocurrencies. Though the government is planning to keep a check on cryptocurrencies with the proposed bill whose affect is yet to be seen.

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Mental Health and Internet Addiction in Adolescents

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ABSTRACT

The present study was taken up with the objectives to investigate the significant difference between Males and Females on their Mental health and to explore the relationship between Mental Health and Internet addiction in adolescents. Seven hundred and sixteen adolescents from various Pre-University colleges from Bengaluru city, Karnataka state were participated in this study by using purposive sampling technique among them three hundred and sixty nine were Males and three hundred and forty five were Females. In the present study the internet addiction questionnaire developed by Young, 1998 and the Mental Health Inventory by Dr. Jagdish and Dr. A.K. Srivastava, (1983) were administered to gather the data. 't'-test and Pearson's correlation were employed to find out the significant gender difference and the relationship between mental health and internet addiction. Results indicated that there is a significant negative correlation between mental health and internet addiction in adolescents.

Key Words: Mental Health, Internet addiction, Adolescents

I. INTRODUCTION

Mental health, in broad terms, may be defined as a blissful state of mind. This does not imply that an individual is free from the shackles of worry, anxiety and negative mood but simply that the individual has adequate coping resources at his or her disposal to deal with the negative thoughts and emotions. Mental health is more than the absence of mental illness, according to the World Health Organization. It involves coping with the normal stresses of everyday life in a state of well-being. People with mental health are able to recognize their own abilities, work productively, and make a meaningful contribution to their communities.

Mental health encompasses not only emotional well-being, but also how individuals think and behave. Life satisfaction, resilience, support, and flexibility have been identified as contributing factors to mental health.

Approximately one in five U.S. adults experiences a mental health problem each year, according to the National Alliance on Mental Illness (NAMI). A number of risk factors contribute to poor mental health. Discrimination, exposure to trauma, family history of mental illness, low income, medical illness, poor access to health services, poor self-esteem, poor social skills, and addiction-substance or internet are among the factors that contribute to poor mental health.

Internet use, especially social media, has dramatically changed the way adolescents communicate, socialize, make and maintain friendships. While there are benefits to live in a digital world, there are also risks involved. Nowadays most of the adolescent's lack social, and they spend the majority of their free time interacting via tGiven the majority of young population and also the large numbering of educated young people who are familiar with the internet, it seems that the internet can be considered as an influential media in our society; in addition, internet penetration in Iran is high and rapidly increasing. However, the most frequent and most vulnerable users of the internet are teenagers and youths who use the internet excessively.

A major public health concern is Internet addiction, especially among adolescents, although the results are not uniform, and several studies have linked IA to outcomes such as depression, anxiety, stress, and social interactions. They are also lost in a world of unrealistic comparisons and cyberbullying, which makes them feel guilty and unworthy.

Purpose of the Study

As technology is becoming more and more advanced, the world is becoming a smaller place. The internet has become a household tool not only for transmitting information but also for communication and entertainment. As people are becoming more and more engrossed in the internet, they seem to be forgetting what it means to be a part of the society. As they get more withdrawn from the external world and engrossed in the virtual world, it impacts their Mental Health, both in positive and negative ways. The purpose of the present study is to explore the relationship between internet addiction and mental health among adolescents.

II. REVIEW OF LITERATURE

Male students were more likely to be addicted to the internet than female students, according to Uneri and Tandur (2010). Internet use, lack of control, and neglect of social life are significantly associated with poor

mental health in adolescents (Yousef et al., 2020). The study also revealed that internet dependency is associated with social dysfunction and severe depression on the mental health subscales. Further, the study revealed a significant correlation between neglect of work in excessive internet users and social dysfunction.

Adolescents who are addicted to the Internet are more likely to develop mental health problems than other adolescents who are not addicted to the Internet. Sadness, feeling down, losing interest in daily activities are just some of the symptoms (Cunningham et al., 2014).

Another study found that the use of social networking websites, particularly Facebook, could increase the self-esteem and well-being of adolescents if the viewers provided positive feedback. Negative feedback lowers an individual's self-esteem, affecting their academic results, health, job performance, and personal relationships. The study also noted that it can cause Facebook Depression (Lauren et al., 2012).

Aman Gupta, Amir Maroof Khan, O.P. Rajoura, and Shruti Srivastava (2018) found that Addiction to the Internet and depression were significantly correlated for adolescents. Similarly, significant positive correlations were found between Internet Addiction and Anxiety and between Stress and Internet Addiction.

III. METHODOLOGY

Aim

To study the relationship between Internet addiction and Mental health in adolescents.

Objectives

- To determine if there is a significant gender difference in Mental health in adolescents
- To determine if there is a significant relationship between Internet Addiction and Mental Health in adolescents

Hypothesis

H₁: There is no significant gender difference in Mental Health in adolescents

H₂: There is no significant relationship between Internet Addiction and Mental Health in adolescent

Variables

- Dependent Variables: Internet Addiction and Mental Health
- Independent Variables: Gender

Research Design and Sampling

Quasi experimental ex post facto design was employed. Seven hundred and sixteen adolescents from various Pre-University colleges (PUC), from Bengaluru city, Karnataka state, were included in this study using Purposive sample technique. The psychometric scales were administered on 369 Males and 345 Females.

Inclusion Criteria

- Adolescents between 18 to 21 years of age.
- Adolescents residing in Urban Bangalore.
- Only Pre-University colleges (PUC) were considered.

Exclusion Criteria:

- Adolescents below 18 years of age.
- Adolescents above 21 years of age.
- Apart from Pre-University colleges students others were excluded.
- Individuals with Mental disabilities
- Individuals who cannot read and write English.

Tools

Internet Addiction Test by Young et. al. (2012)

The IAT is especially designed to be used for the experienced Internet user who puts this technology to use on a frequent basis. The 20-item questionnaire assesses characteristics and behaviors associated with compulsive use of the Internet that include compulsivity, escapism, and dependency. Questions also measure problems related to addictive use in personal, occupational, and social setting and functioning. Questions are randomized and

each statement is weighed along a Likert-scale continuum that ranges from 0 = less extreme behavior to 5 = most extreme behavior for each item. The Cronbach alpha value for the scale was found to be 0.78.

The Mental Health Inventory by Dr. Jagdish and Dr. A.K Srivastava, (1983)

The Mental health inventory has been designed to assess the positive mental health of normal individuals. The salient feature of this scale lies in the inclusion of symptoms of psychological well-being or positive symptoms of mental health along with absence of mental ill-health. The inventory has six subscales namely- Positive self evaluation, perception of reality, integration of personality, autonomy, group oriented attitudes and environmental mastery. The split half-reliability of the inventory was found to be 0.73. The construct validity of the inventory was found to be 0.54 and 0.57 with the General health Questionnaire and the Personal Adjustment scale by Pentonjee (1973) respectively, indicating moderate validity.

Analysis of Data

An Independent Sample t-test was performed to explore the gender difference in Mental Health of Adolescents. Pearson’s bivariate correlation was performed to explore the relationship between Internet Addiction and Mental Health.

IV. RESULTS AND DISCUSSION

Table 1. Independent Sample t-test for gender difference in Mental Health in adolescents (N-Males=369, Females=345)

Variables	Gender	Mean	SD	t	P
Positive Self Evaluation (PSE)	Males	23.81	4.25	-0.85 NS	0.39
	Females	24.08	4.14		
Perception of Reality (PR)	Males	19.79	4.17	-0.61 NS	0.54
	Females	19.98	4.08		
Integration of Personality (IP)	Males	28.41	4.20	0.57 NS	0.56
	Females	28.24	4.07		
Autonomy (AUTNY)	Males	12.98	2.89	-1.46 NS	0.14
	Females	13.32	3.32		
Group Oriented Attitudes (GOA)	Males	24.08	3.24	1.21 NS	0.22
	Females	23.77	3.39		
Environmental Mastery (EM)	Males	24.03	3.48	-0.39 NS	0.69
	Females	24.13	3.61		
Overall Mental Health	Males	133.1	15.12	-0.36 NS	0.71
	Females	133.5	15.70		

NS=Not Significant

The table 1 shows the results for gender difference in Mental Health in adolescents. No significant gender difference was found in any of the sub-areas of mental health namely, Positive self-evaluation (t= -0.85), Perception of reality (t= -0.61), Integration of personality (t= 0.57), Autonomy (t= -1.46), Group oriented attitudes (t= 0.22), Environmental Mastery (t= -0.39). No significant gender difference was found in the overall Mental Health of adolescents (t= -0.36). The obtained results fail to reject the null hypothesis which states that there is a gender difference in Mental health in adolescents.

Table 2: Pearson's correlation for significance of relationship between Internet Addiction and Mental Health in adolescents.

		PSE	PR	IP	AUTNY	GOA	EM	Overall
I A (Internet Addiction)	Pearson Correlation	-0.29**	-0.24**	-0.26**	0.06	-0.17**	-0.18**	-0.28**
	Sig. (2-tailed)	0.00	0.00	0.00	0.64	0.00	0.00	0.00
	N	714	714	714	714	714	714	714

**Significant at 0.01 level

The obtained results reveal that, among adolescents, there is a significant negative correlation between Positive Self Evaluation and Internet Addiction ($r = -0.29$, $P = 0.00$). The person's correlation coefficient for the relationship between Perception of reality and Internet Addiction was found to be -0.24 ($P = 0.00$). It can thus be said that there is a significant negative relationship between Perception of reality and Internet Addiction. A significant negative relationship was also found between Integration of Personality and internet Addiction ($r = -0.26$, $P = 0.00$). The results also reveal a significant negative correlation between Group Oriented Attitudes and Internet Addiction ($r = -0.17$, $P = 0.00$). A significant negative relationship was observed between Environmental Mastery and Internet Addiction ($r = -0.18$, $P = 0.00$).

A significant negative correlation was obtained between Overall Mental Health and Internet Addiction in Adolescents ($r = -0.28$, $P = 0.00$). The obtained result successfully rejects the null hypothesis which states that there is no significant relationship between Internet Addiction and Mental Health in adolescents.

DISCUSSION

The aim of the study was to explore the gender difference in Mental Health in adolescents. The obtained results revealed that there is no significant gender difference in Mental Health in adolescents.

"Gender-based differences may emanate from a biomedical (genetic, hormonal, anatomical, physiological); psychosocial (personality, coping, symptom reporting); epidemiological (population-based risk factors); or even a more global perspective. The latter analyses large-scale cultural, social, economic, and political processes that ultimately produce differential health risks for women and men. Rarely does biology act alone to determine health inequities. Social determinants, including gender, interact with each other and exacerbate biological vulnerabilities", Afifi (2014).

Absence of discrimination on the basis of a person's sex in opportunities, and the allocation of resources or benefits, or access to services, is gender equality. As civilization progresses we are slowly, but steadily walking towards a society where both genders are treated equally. Since adolescents from both genders share similar experiences at home, in school and in their external environment, the impact of these factors on their mental health remains constant. This can be viewed as a contributing factor to the observed lack of gender difference in overall mental health of adolescents.

The obtained results reveal that there is a significant negative correlation between the following domains of Mental Health, namely, Positive Self Evaluations (PSE), Integration of Personality (IP), Perception of Reality (PR), Group Oriented Attitudes (GOA) and Environmental Mastery (EM). A significant negative correlation was also obtained between the overall mental health of adolescents and Internet Addiction.

In studies of students indicating excessive use of internet and mental health (Kraut et al., 1998; Chou and Hsiao, 2000; Chen and Peng, 2008; Douglas et al., 2008; Ko et al., 2005, 2012; Eastin, 2005; Azadeh et al., 2012; Engelberg and Sjoberg, 2004) results indicated that the level of depression, stress, suicide intention, hyperactivity, fear, social fear, aggression, violence and antisocial behaviors occur more in addicted students.

Serkan and Volkan (2011), revealed that general self-esteem, social self-esteem, family-home self-esteem and total self-esteem were significantly and negatively correlated with Internet addiction. In an independent study, Mahadevaswamy and D'souza, (2017) revealed that as the levels of internet addiction increased, total psychological wellbeing scores decreased linearly and significantly. It was also found that as the levels of internet addiction increased, wellbeing also decreased in specific components of autonomy, environmental mastery, and purpose in life.

V. CONCLUSION

Evidences are mounting that excessive use of the internet has a negative impact on mental health of adolescents. Excessive use of the internet has negative implications such as sadness, feeling down, having a loss of interest

in daily activities, distraction from normal exercises and other physical play as well as social interaction with friends. Adolescents who exhibit excessive use of internet, are more likely to suffer from emotional and mental ill-health, depression and/or social anxiety.

The results of the present fails to reject the null hypothesis which states that there is no significant gender difference in Mental Health of Adolescents. The results successfully rejects the null hypothesis which states that there is no significant relationship between Mental Health and internet Addiction in Adolescents.

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Perfect Matching of Dendrimer based on Geometric Multiplicity

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ABSTRACT

Matching Theory is one of the important concepts of Graph Theory. Many Matching Theory concept has been dealt in [1, 2, 3, 4]. The technique of maximum matching on directed graphs have been studied in [1]. In this paper, a new approach for finding perfect matching of an undirected Dendrimer sparse graph based on largest geometric multiplicity of its Eigen values is studied. The adjacency matrix of an undirected Dendrimer graph is a sparse graph and it is related with the exact controllability network for finding the maximum matched nodes and the corresponding match edges using largest geometric multiplicity of Eigen values. The growth of the Dendrimer from core molecule is explained for first and second generation and it is extended to n_i - generation.

Keywords: Graph Theory, Matching, Maximum Matching, Geometric Multiplicity, sparse graph, Dendrimer graph, Molecular graph.

AMS Classification Key: 05C, 05C70, 911368, 15A18.

INTRODUCTION

Matching theory is used not only to study the structure of a graph it also has a relation with chemical graph theory which is a branch of Mathematical chemistry. In this graph theory, it deal with molecular graph constructed by molecules and molecular compounds where the vertices correspond to the atoms and edges correspond to the chemical bond between the atoms. The molecular graph has a core molecule with branching groups to which other branching molecules are added in layers and it forms a spherical shape known as Dendrimers and each new layer is called a generation.

Dendrimers are hyperbranched with multivalent functional end groups and it is used in exploring drug delivery like anticancer, antiviral, antimalarial etc. There are many different types of Dendrimers containing different core molecules for drug delivery but among that poly (propyleneimine)-PPI Dendrimer has been most explored Dendrimer.

In this paper a new method is obtained to find the n_i - generation PPI Dendrimer through matching of an undirected PPI Dendrimer graph which is a sparse graph based on Geometric multiplicity of its Eigen values.

In an undirected graph the maximum set of edges without common nodes is known as maximum matching. Maximum Matching nodes can be obtained using the largest geometric multiplicity through the transpose of its adjacency matrix. The matching edges corresponding to the matching nodes are obtained through fundamental transformation. The maximum matching of an undirected sparse graph is discussed under this topic separately. The basic idea of this method is obtained from the exact controllability for Sparse Network. The Definitions and working rules are discussed before solving the problem.

2. PRELIMINARIES

2.1. Definition (Sparse graph): A graph is called sparse if the number of edges is much less than the possible number of edges.

$$\frac{n(n-1)}{2}$$

Note: An Undirected graph can have at most $\frac{n(n-1)}{2}$ edges.

2.2. Largest Geometric Multiplicity

For an undirected graph the largest geometric multiplicity $\mu(\lambda_j)$ of the Eigen value λ_j of A_j is obtained by

$$\mu(\lambda_j) = \dim V_{\lambda_j} = N - \text{rank} \{ \lambda_j I_N - A \}$$

Where $\lambda_j (j = 1, 2, 3, \dots, N)$ represent the distinct Eigen values of A and I_N is the unit matrix with the same as A .

$$ND = \max \{ \mu(\lambda_j) \}.$$

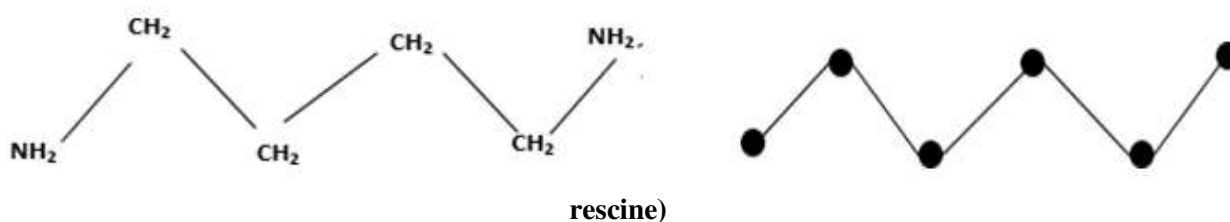
3. MAXIMUM MATCHING OF AN UNDIRECTED GRAPH BASED ON LARGEST GEOMETRIC MULTIPLICITY

From the condition explained in [2] for any undirected graph in general if $\mu(\lambda_j)$ is the geometric multiplicity of the Eigen values λ_j of A and let λ_m be the Eigen value associated with the largest geometric multiplicity $\mu(\lambda_m)$. Let matrix A' be the column canonical form of matrix $\lambda_m I_N - A$. Then Linearly independent rows in A' are matched nodes and linearly dependent rows are Unmatched nodes.

Theorem 3.1 The n_i - Generation PPI Dendrimer constructed by matching is a sparse graph and perfectly matched based on Geometric multiplicity of its Eigen values.

Proof: Consider a Dendrimer grown outward from a multifunctional core molecule Fig.1.

Fig.1. Core Molecule (Put



The core molecule reacts with monomer molecules containing one reactive and two dormant groups which gives the first Generation Dendrimer.

Case (i): First Generation Dendrimer ($n_i = 1$ PPI Dendrimer)

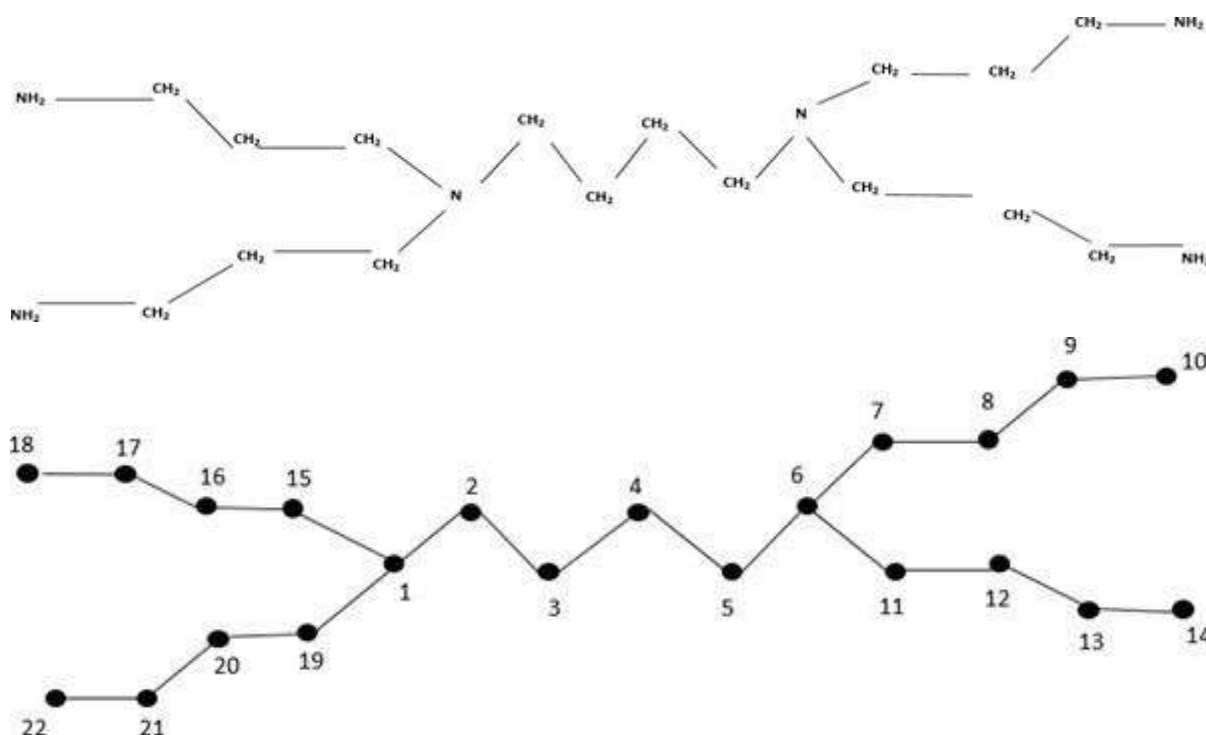


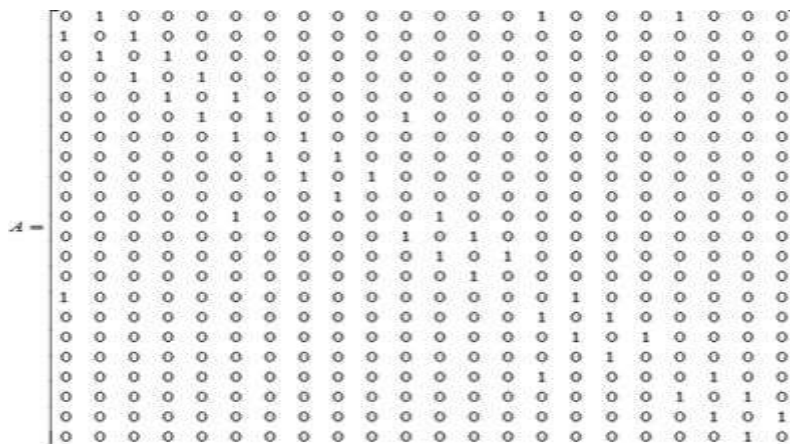
Fig.2. First Generation PPI Dendrimer

The first generation PPI Dendrimer is constructed by the first additional branch from the core molecule. From Fig.2 it is known that first generation Dendrimer has 2 interior tertiary amines (N) and 4 primary amine endgroups (NH_2).

Considering the Dendrimer as molecular graph it has a sparse graph with 22 vertices, 21 edges and molecular formula $\text{C}_{16}\text{H}_{40}\text{N}_6$.

The Adjacency matrix of the sparse graph is, $A \in R_{N \times N}$ of a graph (V, E) with vertices $V = \{v_1, v_2, \dots, v_N\}$ is given by

$$a_{ij} = \begin{cases} 1, & \text{if } (v_i, v_j) \in E \\ 0, & \text{otherwise} \end{cases}$$



Then the expected Eigen values λ_j ($j=1, 2, 3 \dots 22$) of the Adjacency matrix A will be zero since all the rows of the matrix A is linearly independent.

$$E(\lambda) = \frac{1}{22} \sum_{j=1}^{22} \lambda_j = \frac{1}{22} \sum_{j=1}^{22} a_{jj} = 0$$

Largest Multiplicity of a Sparse Graph

If the rows are linearly independent then by (2.2) the Geometric Multiplicity (λ_j) corresponding to the Eigen values $\lambda_j = 0$ is also zero.

$$rank \{ \lambda_j I_{22} - A \} = (-A) = r(A) = 22$$

(Number of non-zero rows is 22)

$$\text{Therefore, } \mu(\lambda_j) = 22 - rank \{ \lambda_j I_{22} - A \} = 22 - 22 = 0$$

All the 22 nodes are matched nodes, since according to maximum matching of an undirected graph the largest Geometric multiplicity $\mu(\lambda_j)$ is related to unmatched nodes and if it is zero means all the nodes are matched.

(i.e.) All nodes are perfectly matched.

Perfectly Matched Edges

The Perfectly Matched Edges for the 22 matched nodes are 11 given in red lines. It is given in a way that no two edges share a node. Fig.3 shows the perfectly matched graph for an undirected sparse graph with 22 nodes and 21 edges.

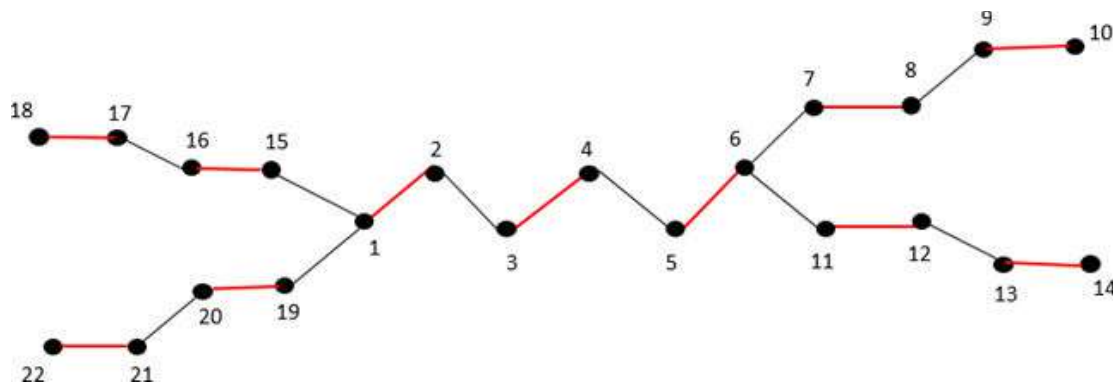


Fig.3. Perfectly matched First generation DendrimerCase (ii): Second Generation Dendrimer ($n_i = 2$ PPI Dendrimer)

The molecule of the four end groups in first generation gets activated for reactions with more monomers to form more branches. The additional branch formed by the 4 end group molecule of first generation reacting with monomers containing one reactive and two dormant groups forms the second generation PPI Dendrimer.

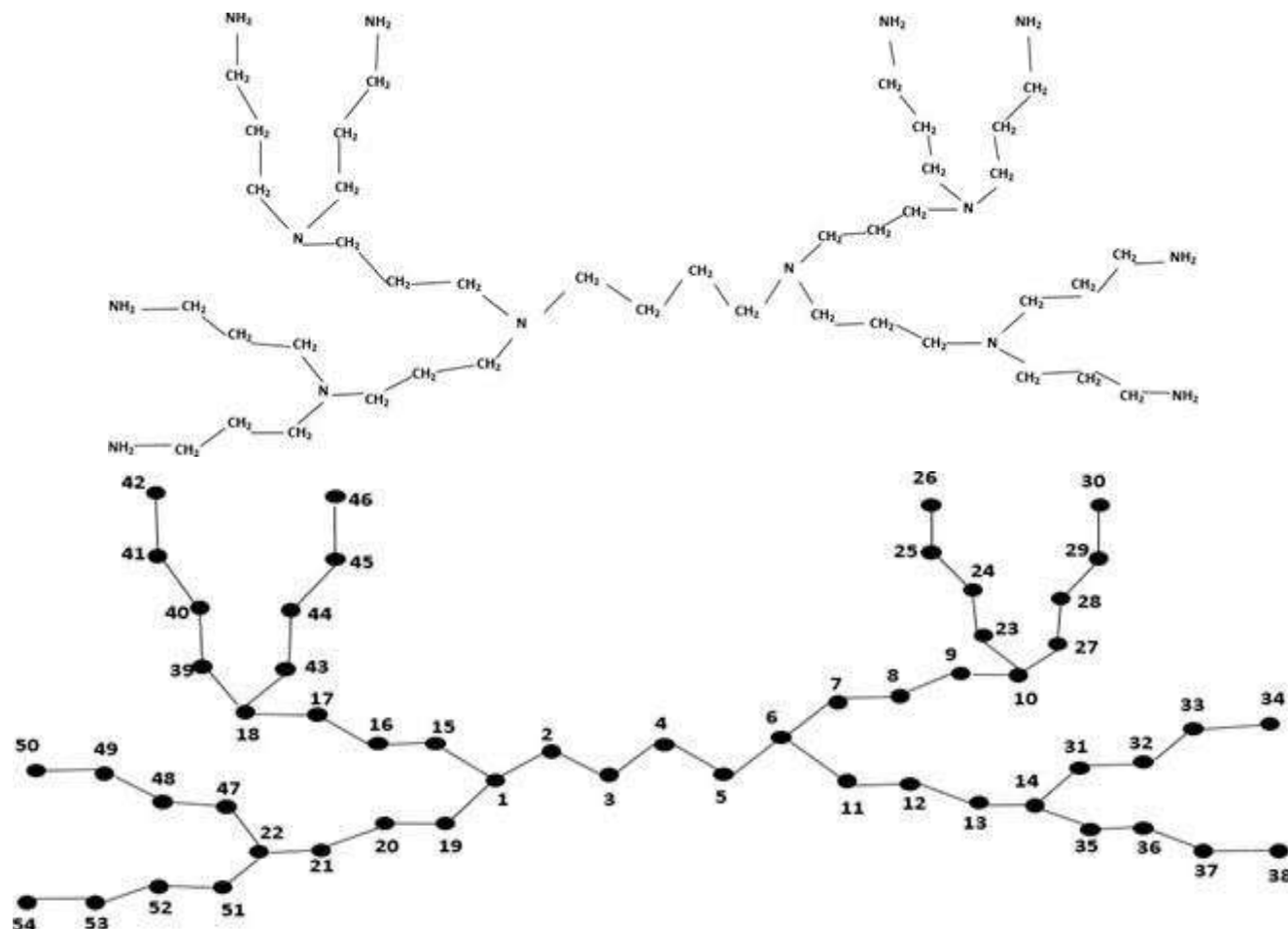


Fig.4. Second Generation Dendrimer

From Fig.4 it is known that second generation Dendrimer has 6 interior tertiary amines (N) and 8 primary amine endgroups (NH₂). Now considering as a molecular graph it has sparse graph with 54 vertices, 53 edges and molecular formula C₄₀H₉₆N₁₄.

The Adjacency matrix A consist of 54 rows and 54 columns in which all rows will be linearly independent. Then the expected Eigen values λ_j ($j=1, 2, 3 \dots 54$) of the Adjacency matrix A will be zero since all the rows of the matrix A is linearly independent.

$$E(\lambda) = \frac{1}{54} \sum_{j=1}^{54} \lambda_j = \frac{1}{54} \sum_{j=1}^{54} a_{jj} = 0$$

All the 54 nodes are matched nodes, since according to maximum matching of an undirected graph the largest Geometric multiplicity $\mu(\lambda_j)$ is related to unmatched nodes and if it is zero means all the nodes are matched.

(i.e.) All nodes are perfectly matched.

Perfectly Matched Edges

The Perfectly Matched Edges for the 54 matched nodes are 27 given in red lines. It is given in a way that no two edges share a node. Fig.6 shows the perfectly matched graph for an undirected sparse graph with 54 nodes and 53 edges.

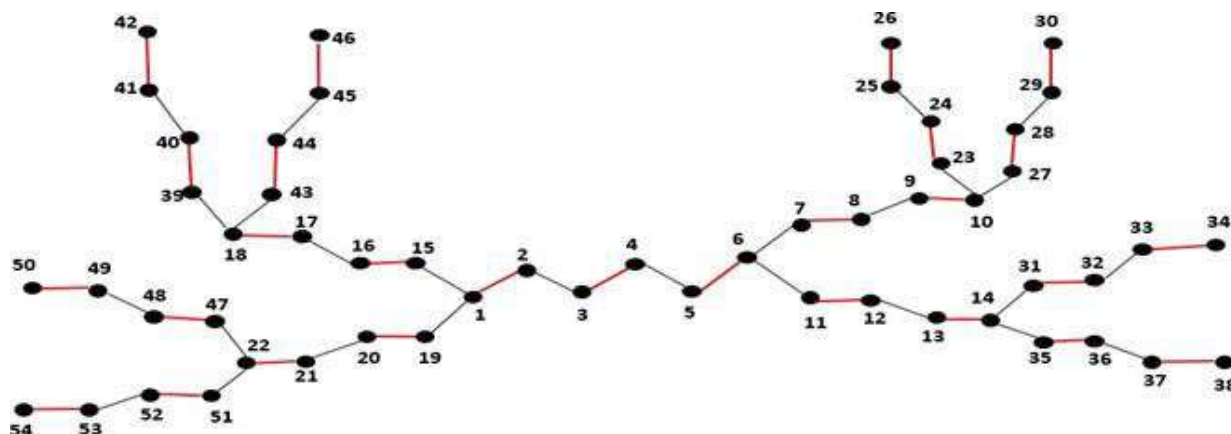


Fig.5 perfectly matched second Generation Dendrimer

Case (iii) In general, the n_i - Generation PPI Dendrimer is constructed by $n_i = 1, 2, 3, \dots, N$ additional branches from the core molecule with interior tertiary amines $N_{n_i} = N_{n_{i-1}} + (NH_2)_{n_{i-1}}$ and primary amine endgroups $(NH_2)_{n_i} = 2(NH_2)_{n_{i-1}}$, where $(NH_2)_1 = 4$, $N_1 = 2$, $n_i \geq 2$. Thus, the PPI Dendrimer forms a spherical shape with n_i - branches.

Considering the n_i - Generation PPI Dendrimer as molecular graph it has a sparse graph with vertices $V_{n_i} = C_{n_i} + (NH_2)_{n_i} + N_{n_i}$ where $C_{n_i} = 2C_{n_{i-1}} + 8$, $C_1 = 16$, $n_i \geq 2$, edges $E_{n_i} = V_{n_i} - 1$ and the molecular weight $C_{C_{n_i}} H_{H_{n_i}} N_{N_{n_i} + (NH_2)_{n_i}}$ where $H_{n_i} = 2C_{n_i} + 2(NH_2)_{n_i}$ for all $n_i \geq 1$

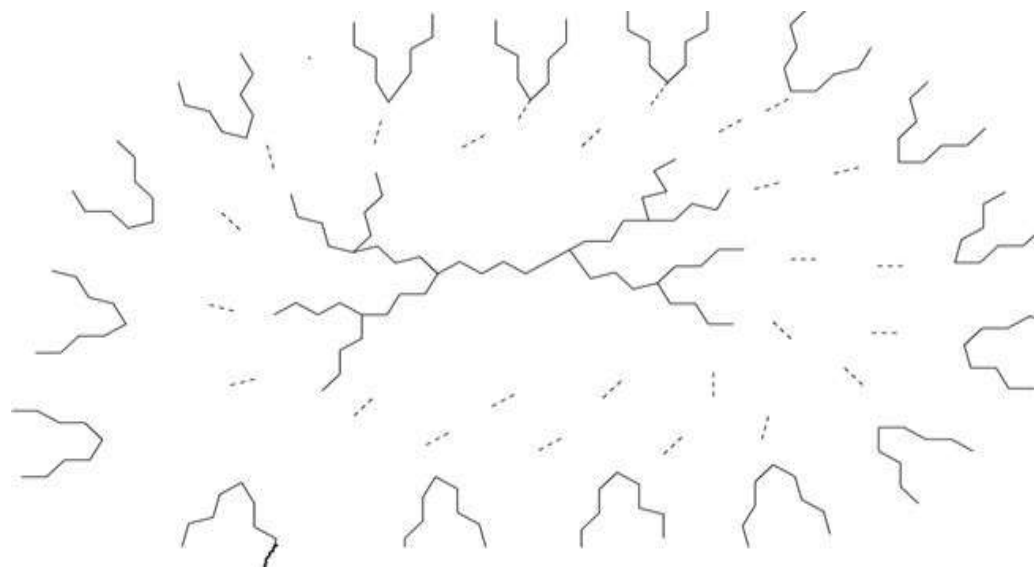


Fig.6. n_i -Generation Dendrimer

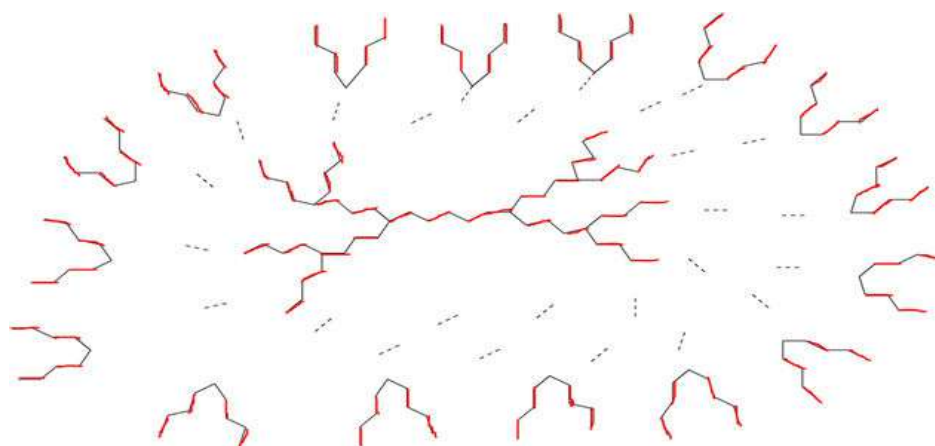


Fig.7 perfectly matched n_i - Generation Dendrimer

4. CONCLUSION

In this topic the new method for finding maximum matched nodes of an undirected Dendrimer sparse graph based on largest geometric multiplicity of Eigen values which has a relation with exact controllability network is proved through Adjacency matrix of its molecular graph. The new method is proved by a theorem for constructing n_i - Generation PPI Dendrimer through matching based on largest geometric multiplicity of its Eigen values. The first and second generation from the core molecule is explained with the number of interior tertiary amines (N) and primary amine endgroups (NH_2) presented and it is extended to n_i - Generation by obtaining a recurrence relation for N_{n_i} and (NH_2). This recurrence relation is used to find the vertices, edges E_{n_i} and the corresponding matched edges for forming spherical shape PPI n_i

- Generation Dendrimer. In future, this concept can be expanded for some other Dendrimer graph.

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A Study of Land Consumption on Land by Builders & Developers to Loss of on Irrigation Sector

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ABSTRACT

Land is a crucial natural resource and an important determinant of a country's socioeconomic and ecological health. Given the finite supply of land resource, sustainable use and management of land resources is a necessity for the wellbeing of people of a country. Land consumption as part of human resource consumption is the conversion of land with healthy soil and intact habitats into areas for industrial agriculture, traffic (road building) and especially. The paper Study the Land Consumption by Builders & Developers to loss of on Irrigation Sector.

Keywords: Land, Socioeconomic, Soil, Agriculture land

INTRODUCTION

Trends of Land-Use Change in India

Land is a crucial natural resource and an important determinant of a country's socioeconomic and ecological health. Given the finite supply of land resource, sustainable use and management of land resources is a necessity for the wellbeing of people of a country. Land-use change has broad lines of impact, with a potential for influencing economic growth, quality of life, management of environmental resources, and national food supply. A country's socioeconomic priorities at any given time shape the drivers of the land-use change.

India, as a developing country, is pushing its industrial and service sector to create favorable conditions for production and consumption of goods and services. Urban regions, as widely recognized, are favorite spots for the consumption and production of a large number of these goods and services. Although the causal relationship of economic growth with that of urbanization is not well established, it is the backdrop for any nation's economic growth (Tolley 1987). It is the very reason for which urbanization has become a major policy guide map for India and many other developing countries¹. With rising rate of urbanization, more changes in land-use are taking place to supplement evolving demands and expectations. This chapter looks at some of the changes in land-use by looking at land-use statistics at the national level and in major metro-politan regions to assess the direction and scale of these changes that have come about as a result of refreshed urbanization focus in country's development strategy. In the first section of the chapter, land-use changes that occurred in the period from 1950 to 2010 are mapped with the five-year plan budget priorities for different sectors.

The conversion of undeveloped land into built-up urban areas, or to industrial sites and transport infrastructure is an underrated, yet increasing problem worldwide. Termed land consumption or land take, it results in the loss of multifunctional, fertile soils and in the deterioration of biodiversity and ecosystem services. Moreover, the exceeding growth of the built environment poses further challenges, e.g., related to health, housing, transport, or energy provision and related carbon emissions, as well as to public services provision. Steering cities toward well-balanced compactness is, therefore, an important strategy to level their environmental footprint, to support culturally and aesthetically attractive downtown areas, and to secure adequate public infrastructure at viable costs. UN Sustainable Development Goal calling for inclusive, safe, resilient, and sustainable cities, covers the spatial aspect of urbanization by its indicator of land consumption (SDG indicator 11.3.1: "Ratio of land consumption rate to population growth rate"). The indicator postulates that where rates of land conversions due to urban development are disproportionately high compared to population dynamics, such a "growth turns out to violate every premise of sustainability that an urban area could be judged by".

Land consumption as part of human resource consumption is the conversion of land with healthy soil and intact habitats into areas for industrial agriculture, traffic (road building) and especially. More formally, the reasearch has identified three land consuming activities:

1. The expansion of built-up area which can be directly measured;
2. The absolute extent of land that is subject to exploitation by agriculture, forestry or other economic activities; and

3. The over-intensive exploitation of land that is used for agriculture and forestry. In all of those respects, land consumption is equivalent to typical land use in industrialized regions and civilizations.

Conversion and expansion of agriculture land and forest areas changes in their natural limits. Thousands of millions of tons of soil is lost annually due to large scale deforestation and poor/land management records chain reaction in the board areas.

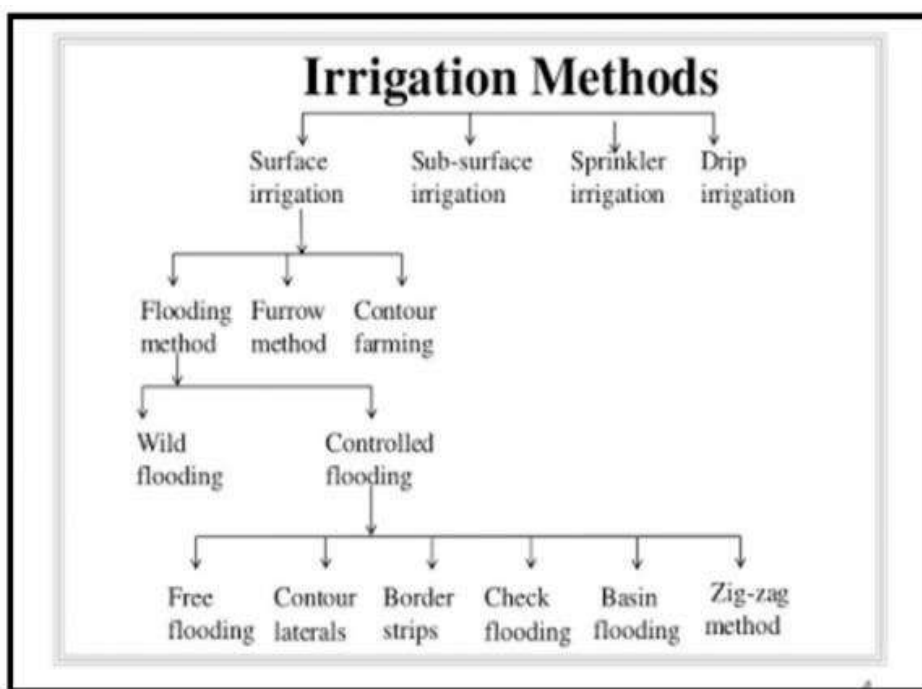
Real estate is the second largest employer after agriculture in India. It is estimated to grow at 30 percent over the next decade. But it will be the hardly affect the agriculture sector, it will consume large amount agriculture land. Land consumption destroy agriculture's future.

Never the less such effects may be as harmful to a site as direct loss. Disturbance and Fragmentation Construction needs land and the use of land can have direct impacts in terms of destruction of habitats and more subtle effects on biodiversity such as disturbance and fragmentation.

Globally, the construction industry is arguably one of the most resource-intensive and environmentally damaging industries in the world. They have exerted adverse impacts on the local environment, including land degradation, increased flooding, and modified climate change. Conversion of farmland and forests by builders to urban development reduces the amount of land available for food and timber production. Soil erosion, salinization, desertification and other soil deprecations associated with agricultural production and deforestation reduce land quality and agricultural productivity.

One of the major problems facing agriculture is the loss of agriculture land, because as more land is lost, it will become more difficult to produce the amount of food needed the growing human population. If this land is lost, people may find it more difficult to produce, and prices may also rise.

Urban land use change caused by many driving forces that control by various environmental and socioeconomic variables. High growth rate of the residential land use creates an immense pressure over agricultural land in the urban fringes and the agricultural land is decreasing in a rapid manner. Research aims to assess the peri-urban and urban land use change in residential land and its impact on socio economic status of the farmer like how much agricultural land has been grabbed by the residential land use change. Socioeconomic impacts of the peri-urban and urban land use land cover change on the life of the farmer. Geographic information system have been used for mapping the spatio-temporal change of urban and peri-urban land in residential land and secondary data collected by the different sources. A questioner was developed to calculate the impact of urban and peri-urban land use change on Socio economic status of the farmer by survey. So in this way present research helps to highlight the impact of urban and peri-urban land use change on socioeconomic status of the farmer. It also elaborates Spatio-temporal loss of agricultural land by residential land use over the years and its impacts on the farmer.



Our built environment and its interactions with the natural environment are complex and have a massive impact on the world around us. Hence sustainability is a complex concept which encompasses not just energy but all the resources needed to support human activity. A large part of building sustainably is concerned with addressing the global warming that is driving climate change; using energy conservation and techniques such as life-cycle assessment to maintain a balance between capital cost and long-term asset value. It is also about enhancing biodiversity, creating spaces that are healthy, economically viable and sensitive to social needs. Rather than constantly battling against the natural environment, we need to start respecting natural systems and learning from ecological processes: creating a better balance between human need and the wider environment.

We have to save our environment from the builders by giving limits on construction business.

What is Irrigation?

Irrigation is the process of applying water to the crops artificially to fulfil their water requirements. Nutrients may also be provided to the crops through irrigation. The various sources of water for irrigation are wells, ponds, lakes, canals, tube-wells and even dams. Irrigation offers moisture required for growth and development, germination and other related functions.

The frequency, rate, amount and time of irrigation are different for different crops and also vary according to the types of soil and seasons. For example, summer crops require a higher amount of water as compared to winter crops.

Let us have a look at different types of irrigation and the methods used for irrigation.

Importance of Irrigation

The importance of irrigation can be explained in the following points:

1. Insufficient and uncertain rainfall adversely affects agriculture. Droughts and famines are caused due to low rainfall. Irrigation helps to increase productivity even in low rainfall.
2. The productivity on irrigated land is higher as compared to the un-irrigated land.
3. Multiple cropping is not possible in India because the rainy season is specific in most of the regions. However, the climate supports cultivation throughout the year. Irrigation facilities make it possible to grow more than one crop in most of the areas of the country.
4. Irrigation has helped to bring most of the fallow land under cultivation.
5. Irrigation has stabilized the output and yield levels.
6. Irrigation increases the availability of water supply, which in turn increases the income of the farmers.

Irrigation should be optimum because even over-irrigation can spoil the crop production. Excess water leads to waterlogging, hinder germination, increased salt concentration and uprooting because roots can't withstand standing water. Thus the proper method is to be used for the best cultivation.

Review of literature on subject:

The Construction industry in India consists of the Real estate as well as the Urban development segment. The Real estate segment covers residential, office, retail, hotels and leisure parks, among others. While Urban development segment broadly consists of sub-segments such as Water supply, Sanitation, Urban transport, Schools, and Healthcare. Indian real estate attracted \$5 billion institutional investments in 2020.

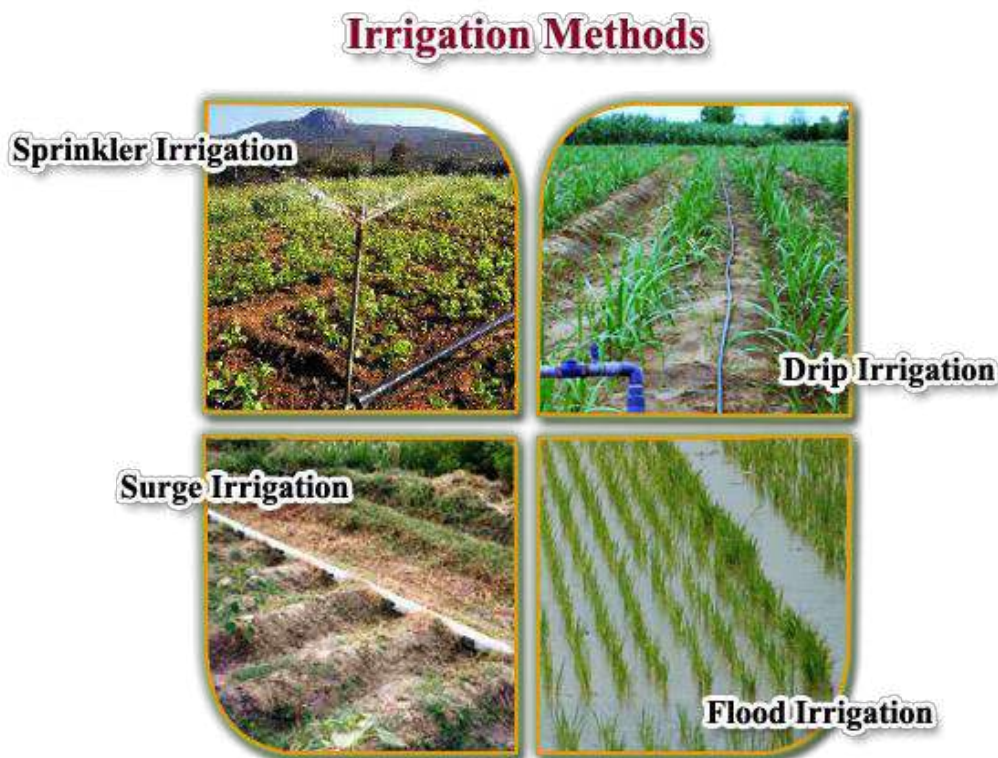
International status:

According to new research by construction blog Bimhow, the construction sector contributes to 23 per cent of air pollution, 50 per cent of the climatic change, 40 per cent of drinking water pollution, and 50 per cent of landfill waste. In separate research by the US Green Building Council (USGBC), the construction industry accounts for 40 per cent of worldwide energy usage, with estimations that by 2030, emissions from commercial buildings will grow by 1.8 per cent.

National status:

Nagpur is situated in the heart of India impregnated with prodigious natural resources. The effects of urbanization and climate change are converging in dangerous ways

Types of Irrigation:



Irrigation

- Irrigation is the artificial application of water to the soil or agricultural field. It is the replacement or supplementation of rainwater with another source of water. It is used in dry areas and during periods of inadequate rainfall.
- The main idea behind irrigation systems is to assist in the growth of agricultural crops and plants by maintaining with the minimum amount of water required, suppressing weed growth in grain fields, preventing soil consolidation etc.

Well and Tube Well Irrigation

- Wells are mainly found in U.P., Bihar, Tamil Nadu, etc. There are various types of wells – shallow wells, deep wells, tube wells, artesian wells, etc. From the shallow wells water is not always available as the level of water goes down during the dry months. Deep wells are more suitable for the purpose of irrigation as water from them is available throughout the year.
- At places where ground water is available, a tube-well can be installed near the agricultural area. A deep tube well worked by electricity, can irrigate a much larger area (about 400 hectares) than a surface well (half hectares). Tube wells are mostly used in U.P., Haryana, Punjab, Bihar and Gujarat.
- **Merits:** Well is simplest, cheapest and independent source of irrigation and can be used as and when the necessity arises. Several chemicals such as nitrate, chloride, sulphate, etc. found in well water add to the fertility of soil. More reliable during periods of drought when surface water dries up.
- **Demerits:** Only limited area can be irrigated. In the event of a drought, the ground water level falls and enough water is not available. Tubewells can draw a lot of groundwater from its neighbouring areas and make the ground dry and unfit for agriculture.

Canal Irrigation

- Canals can be an effective source of irrigation in areas of low level relief, deep fertile soils, perennial source of water and extensive command area. Therefore, the main concentration of canal irrigation is in the northern plain of India, especially the areas comprising Uttar Pradesh, Haryana and Punjab.
- The digging of canals in rocky and uneven areas is difficult and uneconomic. Thus, canals are practically absent from the Peninsular plateau area. However, the coastal and the delta regions in South India do have some canals for irrigation.



- **Two types:** *Inundation canals*, which are taken out from the rivers without any regulating system like weirs etc. at their head. Such canals provide irrigation mainly in the rainy season when the river is in flood and there is excess water. **Perennial Canals** are those which are taken off from perennial rivers by constructing a barrage across the river. Most of the canals in India are perennial.
- **Merits:** Most of the canals provide perennial irrigation and supply water as and when needed. This saves the crops from drought conditions and helps in increasing the farm production.
- **Demerits:** Many canals overflow during the rainy season and flood the surrounding areas. Canal irrigation is suitable in plain areas only.

Tank Irrigation



- A tank is developed by constructing a small bund of earth or stones built across a stream. The water impounded by the bund is used for irrigation and other purposes. Tank comprises an important source of irrigation in the Karnataka Plateau, MP, Maharashtra, Odisha, Kerala Bundelkhand area of UP, Rajasthan and Gujarat.
- **Merits:** Most of the tanks are natural and do not involve heavy cost for their construction and have longer life span. In many tanks, fishing is also carried on, which supplements both the food resources and income of the farmer.
- **Demerits:** Many tanks dry up during the dry season and fail to provide irrigation when it is required. Lifting of water from tanks and carrying it to the fields is a strenuous and costly exercise.

Drip Irrigation



- In drip irrigation, water is applied near the plant root through emitters or drippers, on or below the soil surface, at a low rate varying from 2-20 liters per hour. The soil moisture is kept at an optimum level with frequent irrigations.
- Among all irrigation methods, drip irrigation is the most efficient and can be practiced for a large variety of crops, especially in vegetables, orchard crops, flowers and plantation crops.
- **Merits:** Fertilizer and nutrient loss is minimized due to localized application and reduced leaching. Field leveling is not necessary. Recycled non-potable water can be used. Water application efficiency increases. Soil erosion and weed growth is lessened.
- **Demerits:** Initial cost can be more; can result in clogging, wastage of water, time and harvest, if not installed properly.

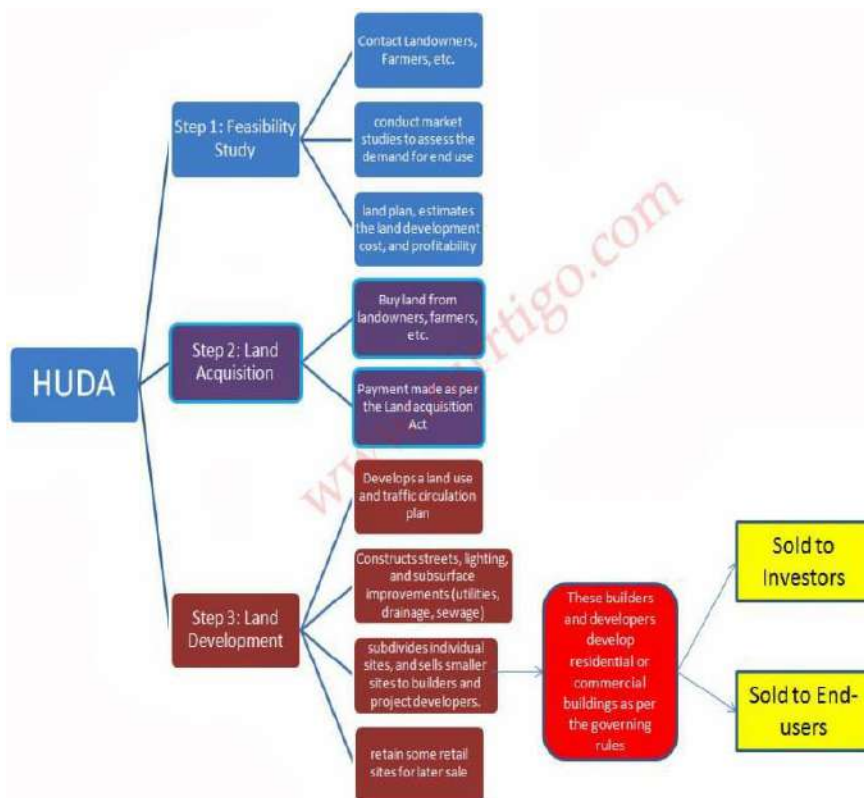
Sprinkler Irrigation



- In this method, water is sprayed into the air and allowed to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water under pressure through small orifices or nozzles. The sprinkler irrigation system is a very suitable method for irrigation on uneven lands and on shallow soils.
- Nearly all crops are suitable for sprinkler irrigation systems except crops like paddy, jute, etc. The dry crops, vegetables, flowering crops, orchards, plantation crops like tea, coffee are all suitable and can be irrigated through sprinklers.
- **Merits:** Suitable to all types of soil except heavy clay. Water saving. Increase in yield. Saves land as no bunds etc. are required.
- **Demerits:** Higher initial cost. Under high wind conditions and high temperature distribution and application efficiency is poor.

land consumption on land by builders & Developers :

Land is a crucial natural resource and an important determinant of a country's socio-economic and ecological health. Given the finite supply of land resource, sustainable use and management of land resources is a necessity for the well-being of people of a country. Land-use change has broad lines of impact, with a potential for influencing economic growth, quality of life, management of environmental resources, and national food supply. A country's socioeconomic priorities at any given time shape the drivers of the land-use change. India, as a developing country, is pushing its industrial and service sector to create favorable conditions for production and consumption of goods and services. Urban regions, as widely recognized, are favorite spots for the consumption and production of a large number of these goods and services. Although the causal relationship of economic growth with that of urbanization is not well established, it is the backdrop for any nation's economic growth (Tolley, 1987). It is the very reason for which urbanization has become a major policy guide map for India and many other developing countries. With rising rate of urbanization, more changes in land-use are taking place to supplement evolving demands and expectations. This chapter looks at some of the changes in land-use by looking at land-use statistics at the national level and in major metropolitan regions to assess the direction and scale of these changes that have come about as a result of refreshed urbanization focus in country's development strategy.



Authority and Yamuna Expressway Industrial Development Authority for plots to be allocated in the future will also be allowed at 3.5, unless there are restrictions on height.

Where such restrictions due to the upcoming airport are in place, the permissible FAR will be three, including a purchasable FAR of one, given that the road along the plot is more than 24 mtr.

The Greater Noida Authority can also allow an FAR of three in those sectors where the nature of the industry is such that it will not require an FAR of more than three.

Another major change in the existing policy will be the permission for mixed land use on an industrial plot with minimum area of 25 acre.

Land development puts more emphasis on the expected economic development as a result of the process; "land conversion" tries to focus on the general physical and biological aspects of the land use change. "Land improvement" in the economic sense can often lead to land degradation from the ecological perspective. Land development and the change in land value does not usually take into account changes in the ecology of the developed area. While conversion of (rural) land with a vegetation carpet to building land may result in a rise in economic growth and rising land prices, the irreversibility of lost flora and fauna because of habitat destruction, the loss of ecosystem services and resulting decline in environmental value is only considered *a priori* in environmental full-cost accounting.

Conversion to building land



Motorway construction in Ireland

Conversion to building land is as a rule associated with road building, which in itself already brings topsoil abrasion, soil compaction and modification of the soil's chemical composition through soil stabilization, creation of impervious surfaces and, subsequently, (polluted) surface runoff water.



Building construction

Construction activity often effectively seals off a larger part of the soil from rainfall and the nutrient cycle, so that the soil below buildings and roads is effectively "consumed" and made infertile.

With the notable exception of attempts at rooftop gardening and hanging gardens in green buildings (possibly as constituents of green urbanism), vegetative cover of higher plants is lost to concrete and asphalt surfaces, complementary interspersed garden and park areas notwithstanding.

Conversion to farmland

In Argentina and Bolivia, the Chaco thorn forest (A) is being felled at a rate considered among the highest in the world (B), to give way to soybean cultivation (C)

New creation of farmland (or 'agricultural land conversion') will rely on the conversion and development of previous forests, savannas or grassland. Recreation of farmland from wasteland, deserts or previous impervious surfaces is considerably less frequent because of the degraded or missing fertile soil in the latter. Starting from forests, land is made arable by assarting or slash-and-burn. Agricultural development furthermore includes:

- Hydrological measures (land levelling, drainage, irrigation, sometimes landslide and flood control)
- Soil improvement (fertilization, establishment of a productive chemical balance).
- Road construction

Significance of the study

This study has been undertaken to explore the various aspect of farmers problems not only from builders and land point of view in the Nagpur but also to understand perception of traders and impact on consumer. This will help to understand the pros and cons of the farmers for trade and consumer in Nagpur region. The implication of the will be useful for policy makers to consider the findings for further improvement in the existing rule of association.

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A Step towards Enhancing the Energy Efficiency in Cloud Computing

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ABSTRACT

Cloud computing and requirement of its services are rapidly increasing. Cloud service providers are providing different services through the data center. The data centers are remotely placed having thousands of servers, high power cooling system and the other system. These data center are consuming large amount of power, resulting emission of carbon dioxide. To reduce the carbon dioxide emission, so that the effect of global warming will reduce is the primary concern of these data center. Cloud computing is the layered architecture and at each layer there is a scope of improvement. We propose the efficient VM scheduling algorithm for execution of cloudlets. The objective here is to reduce the power consumption and it is possible if the time required for execution of task is less. We present evaluation results showing that hybrid VM scheduling algorithm brings sustainable energy saving and helps to reduce the emission of CO₂.

Keywords: Cloud computing, Data Center, Cloud Service Providers, Database Server, VM scheduling, Global warming, cloudlets

INTRODUCTION

Cloud and its services becomes popularized day by day. Everybody is using cloud for different purposes such as storing large amount of data for long period, accessing different heavy software, collaborative work etc. It provides many services at no cost or negligible cost, and that depends upon usage. It provide the services through the data center which are remotely situated. To provide the services, data center uses the distributed processing system, where there are centralized server. The clients are connected through the internet and accessing all types of services remotely. Two different models are used- service model and deployment model. Service models are further classified depending upon the services provided as SaaS (Software as a service), PaaS (Platform as a service) and IaaS (infrastructure as a service). The deployment model derives the location of the data center. Therefore, the deployment models are public, private and hybrid. As the services are easily available and anywhere, the demand of cloud services is increasing. To fulfil the demand and to provide the best service, the number of data centers are increasing or they are increasing their capacity. Data centers uses thousands of computing devises, which emits large amount of heat. So it requires high power cooling system. Over all the data center requires enormous amount of electricity and it emits huge amount of carbon dioxide. CO₂ is one of the major component of global warming. It means data center are one of the component, which are polluting the environment. Hence, the data center has to take some precautions to reduce the consumption of the electricity and emission of CO₂. Good quality resources and proper efficient use of resources will help to reduce the energy consumption and also it increases the lifetime of resources.

Data centers uses virtualization technology to provide the services. Virtualization technique helps to reduces the number of devices used and to minimize the power consumption. In virtualization technique, several servers are consolidated in one physical node. The one node manages these virtual machines (VM). It allocates the task to VMs and VMs are completing the task and behaves just as the individual machine. This technique helps to reduce the number of resources, its cost, and amount of energy and provides on demand services to customers. Because of increasing number of data centers, the cloud service providers have to provide reliable quality of service (QoS) without violating the rules of SLA (service level agreement).

In this work we tried to compare some VM scheduling techniques and proposed a new technique hybrid for VM allocation which helps to reduce the power consumption. In the existing system configuration, if more number of task are executed in less amount of time then naturally the power requirement is less. The primary motive is to find out how efficient the cloud computing is and how more efficient it can be made by making changes to its VM scheduling policies and/or implementing new ones. A lot of research has been done and still going on in this context. The proposed system in contrast to previous work can

efficiently handles the dynamic work load and strictly follows the SLA. The hybrid algorithm is independent of type of workload and does not require any prior knowledge of VM allocation and execution of task.

VM Scheduling Algorithms

The cloud service providers are managing the data center and through which it provides the different services. The data center have many host (server) and each host creates one or more virtual machines. The cloud service

center has to fix the policy. The policy specifies the operation and life cycle of VM. Because of which construction and destruction of VMs is possible. As per policy, the virtual machine instances are created by considering host characteristics such as configuration, memory, storage, software requirement and so on. The host allocates the task to VMs. The virtual machines executes the allocated task (cloudlets). Different scheduling algorithms are used for completing the execution. For this research the algorithm such as FCFS, SJF and RR are considered and compared with the new proposed hybrid algorithm in terms of CPU power required and time required to execute the allocated task.

Algorithm Description –

First Come First Serve (FCFS): As name suggest, simple rule is used in this. The process, which occurs first for execution, will be selected and executed first. It just check the arrival time of the process. The queue technique is used, where occurring processes are kept and selected for processing which enters first in the queue. FCFS uses non-pre-emptive scheduling algorithm technique. This is the simplest form of scheduling technique among all as it very easy to implement because the OS considers only time stamp. The processes occurs for execution are entered into the queue, the PCB (process control block) select the process, which is at the front end of the queue after completion of running process. When any process completed its execution then it is deleted from the queue. The technique here is simple but it is very slow process and the problem of starvation may occur. The average waiting time is more because it considers only arriving time not the burst time. So even if the process is small it has to wait till all previous processes completed its execution.

Shortest Job First (SJF): In SJF, the shortest job means the process having smallest burst time is executed first. The processes which are in queue are compared according to its burst time and the smallest process is selected for processing. If the burst time of two or many processes are same then among that processes, the arrival time is considered for selection. Here non-pre-emptive version is considered for comparison. Hence when the running process executed completely then only execution of next process will start. The major part here is to find out the process having shortest time. As context switching is not required here, it gives good result. The average time is less. It uses greedy approach so always gives the optimal results. The time consumption may increase only in case of any small process occurs for execution when the execution of larger process is going on.

Round Robin (RR) Scheduling: Fixed time slot also called as time quantum is allocated to each process. The processes are executed for that time quantum only and then next process starts executing. If the process not completed then it again enters in the ready queue with the remaining burst time. This process continues till all the processes completed its execution. Mainly RR is used in time sharing system. It uses circular queue and each process gets equal opportunity. If the process completed its execution then it is removed from the queue otherwise it is removed from the beginning and added again from trailing. And waits for its turn and the process continues. The time quantum allocated to any process for execution is n units. The n is in millisecond or smaller than that depending upon the system calibre. When the value of n elapses then the next process is selected for the execution. This is the pre-emptive process, so after time i.e n is over, the running process paused and the next successive process starts its execution. The process which is paused, is added to the ready queue at the end again for the remaining execution. So the main factor here is the time slice. If the value of n is very large then the algorithm behaves as the FCFS and waiting time of other processes increases. The n should be the moderate and to decide the value of n , the processes in the ready queue has to consider. The time quantum has the greater impact on the performance of the algorithm. If it is too large then it affects badly and it is known as convey effect.

If it is too small then more context switching is required and also affects the performance. Hence n should be chosen wisely. As in RR equal preference is given to all processes there is no problem or less chance of starvation.

Proposed VM scheduling Algorithm (Hybrid):

The Hybrid which is the combination of FCFS and SJF scheduling algorithms. The non-pre-emptive version is proposed here, when the execution of a process completed then only next process is selected from the ready queue for execution. Each process have different burst time and arrival time. The algorithm works as- at the starting the process which comes first in ready queue is selected for the execution. When the execution of first process is going on then till that period whatever processes occur in the ready queue are sorted according to the burst time and saved in ready queue. After completion of first process the next process is selected from the sorted ready queue for execution. The process of sorting and modifying the ready queue is going on continuously and will continue till all the processes over. This policy gives the benefits of both scheduling

algorithms that is FCFS and SJF. The average waiting time is less and gives the optimal results. So definitely it will help to reduce the time of processing and save the power.

Hybrid (SJFCFS) Policy Pseudo code Start Let there are n processes in readyQueue of CPU do

Read burstTime of readyQueue[j]th process

Find waiting Time of readyQueue[j]th process

For j=2 to n

Execute readyQueue[j]th process

Set waiting Time of readyQueue[j+1]th process to sum of waiting Time of readyQueue[j-1]th process and burstTime of readyQueue[j-1]th process

Next j

Set waiting Time of readyQueue[j]th process to zero

Stop

Scenario

To prove the efficiency and to validate of cloud computing based system, a simulator which is web application developed by using CloudSim 3.0. Some inputs such as number of data center, cloudlets, no. of VMs etc has to provide to the web application. And the most important VM policy has to specify. The application gives the result showing memory occupied, its bandwidth, disk space used and so on. Also it shows the execution at each VM and waiting time, turnaround time, total CPU time required. The performance of these VM scheduling policies are analysed by running the code multiple times.

Implementation

The complete system is implemented by using JAVA programming J2EE version 8. JSP with HTML 5 is used for web component designing and for all back end programming. For implementation of algorithms CloudSim framework is used which provides many libraries and classes. The detail summary of implementation technologies used is as follows:

Platform- J2EE 8 on Windows X86 release 10.

Integrated Development Environment- Eclipse 2019

Web Component- Java Server Pages with HTML5 standards Web Server- Apache Tomcat Server 8.5

CloudSim Framework 3.0

The system works as- First it takes login credentials from user for authentication purpose. If username and password are correct then only it goes further and displays another page where user has to enter all the details of data center. The details contain no. of data center, host, no. of virtual machines and no. of cloudlets per VM and type of VM scheduling algorithm. The system is very much user friendly as all the validations have been added, so that user can't enter wrong irrelevant information. After entering all information, the system summarizes all this information in proper format. It takes user confirmation and then displays all statistics showing virtual machine no. with cloudlets executed at that VM. Also it displays memory consumption and other details such as arrival time, burst time, average turnaround time. Following pseudocode shows the system implementation.

Pseudo code

Login to the application

while(true)

Enter the configurations for virtual machine, host count, cloudlet count and scheduling algorithm

Store the result for analysis

Exit

Evaluation

The results of current simulated system are summarized in table 1. Keeping all the inputs same except VM scheduling policy, takes multiple runs. The VM count and cloudlet counts are kept as 3 and the results are summarized in tabular format. Looking at the readings, the judgement and comparison about the policies and energy(power) efficiency can be predicted so well. The result shows that the average CPU time required for

hybrid is only 43.2 whereas for FCFS and SJF it is 51 and for RR it is very high that is 95. The average CPU power is also less for hybrid as compare to FCFS and SJF but it shows that average CPU power required for RR is 1.712 which is less than hybrid. But the time required for RR is nearly double, also in RR context switching is more. Hence because of time the power consumption is more for RR. The hybrid policy which is proposed here gives the best result in terms of CPU time and power.

Table 1: Comparative table of average CPU time and CPU power of FCFS, RR, SJF and Hybrid

VM Scheduling Policy	Average CPU time	Average CPU power
FCFS	51	3.87
RR	95	1.712
SJF	51	5.49
Hybrid (SJFCFS)	43.2	2.828

CONCLUSION

In this work, we have proposed the hybrid (SJFCFS) VM scheduling algorithm for energy efficiency. The result shows that the time required for hybrid is less as compare to other VM scheduling. If the time is less, then naturally power consumption is less and it is energy efficient and can be easily apply in real world data center. So the use of hybrid policy at data center makes it energy efficient and helps to emit less CO₂ and reduces the effect of global warming. As the GUI based system is easy and user friendly, it is easy to do analysis and can expand further. For further research different strategies can apply and check for VM scheduling to improve more at data center. Also at different level researcher have lot of scope to improve and reduce the carbon dioxide footprint.

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A Study of the Impact of Gst on the Financial Performance of Selected FMCG Companies

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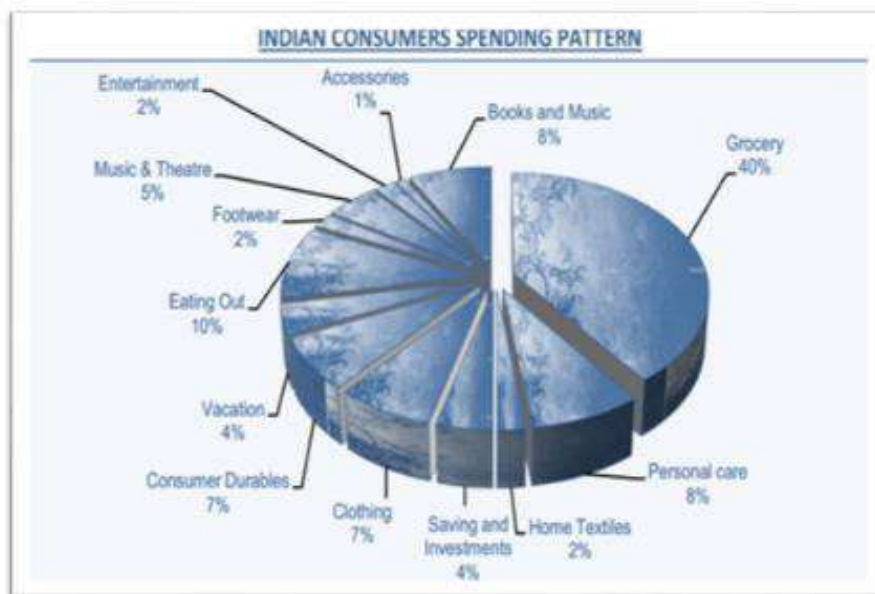
ABSTRACT

India being an emerging economy, GST is an important step in the indirect tax reforms and is an innovative approach towards the development of the economy. The Main Purpose of this study is to examine the impact of Goods and service tax on the Fast-moving consumer goods Industry. The other purposes of the study are to analyse the financial performance of selected leading three FMCG companies before and after GST implementation period to generalize the impact of goods and services tax on this whole FMCG sector and subsequent implications for industry stakeholders. The data required for this study is collected through authentic secondary sources of BSE. Three companies HUL, ITC and NESTLE are taken on their market capitalisation. Financial performance of these would be affected due to GST. And to analyse and interpret the financial position of the firm an inter-company comparison is done on the basis of the Techniques of Financial Statement Analysis (FSA) namely Ratio analysis and Trend Analysis. Thus, to summarise, implementation of GST has a mixed impact on FMCG industry. While removal of cascading effect under GST as compared to pre-GST regime is beneficial to all the FMCG companies, changes in GST rates is very fruitful for some companies but not for all. It will take some time to reflect results because it involves multiple stakeholders and change in traditional approach. However, in the long run, it would definitely reduce costs and improve operational efficiency of FMCG companies, and ultimately, consumer would be benefited surely.

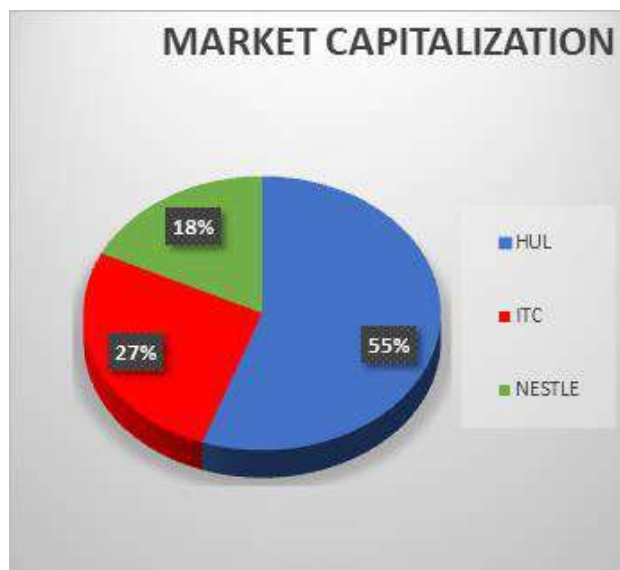
Keywords: Goods and Service Tax (GST), Financial Performance, Fast Moving Consumer Goods (FMCG) Companies

INTRODUCTION

India is a country of over 1 billion people with a fast growing middle-class, and with the right product, you can target this market and make a ton of money. FMCG is the French word for “fast moving consumer goods”. Our entire life depends on FMCG (Fast Moving Consumer Goods) to meet our basic needs.



Our country has a varied agro-climatic condition which enables to offer extended raw material base suitable for many FMCG sub sections like food processing industries etc. India is the one of the major producers of livestock milk, sugarcane, coconut, spices and cashew and is the second largest producer of rice, wheat and fruits & vegetables. Similarly, India has an abundant supply of caustic soda and soda ash, the chief raw materials required in the production of soaps and detergents, which enables the household section of the industry to excel and grow. The accessibility of these raw materials gives India the locational advantage.



This research aims to analyse and compare the top **FMCG** (FAST MOVING CONSUMABLE GOODS) companies listed in FMCG INDEX in terms of their Profitability, Return on Equity and their comparison in terms of their Market Capitalization in BSE. I have taken three companies of FMCG sector, because these are quite familiar to the researcher and are famous in the Indian Market. The companies are:

FMCG Companies	Market Capitalization
➤ HINDUSTAN UNILEVER LTD	Rs. 5, 45,762.50 cr.
➤ ITC LTD	Rs. 2, 61,993.75 cr.
➤ NESTLE INDIA LTD	Rs. 1,68,800.78 cr.

Hindustan Unilever Limited (HUL)

- HUL is one of the oldest FMCG companies in India. It is a subsidiary of the Anglo-Dutch company Unilever. The company was founded in 1933 and is headquartered in Mumbai.
- HUL has been serving more than 2 billion consumers for more than 87 years. HUL has more than 35 brands in 20 categories such as soap, detergents, skin care, cosmetics, tea, toothpaste. The brands include well-known names such as Surf, Excel, Dove, Lux, Lifebuoy, Clinic Plus, Wheel, Sunsilk, Knorr, Axe, etc.
- In April 2020, HUL also completed a merger with GlaxoSmithKline Consumer Healthcare (GSKCH India) for Rs 3,045 crore. In addition to Horlicks, brands such as Boost, Maltova and Viva are also part of GlaxoSmithKline Consumer, which has now been acquired by HUL.

ITC Limited

- ITC Ltd has been operating in the Indian market for more than 110 years and also known for guaranteeing certain production and packaging standards. They have extensive distribution channels in India. This allowed them to penetrate even the most rural areas with a few retail outlets.
- Some of their products include Bingo, Sunfeast, Aashirvaad, Fiamma Di Wills, Vivel, Savlon (hand soaps and cleaners), Papercraft and Classmate. ITC has a 77% monopoly in the Indian cigarette market and offers brands such as Wills Navy Cut, Gold Flake Kings, Silk Cut, India Kings, Bristol, Gold Flake Super Star, Gold Flake Premium Lights, Classic Menthol, etc.
- In FY20, ITC posted a net profit after tax of 15 300 million rupees.

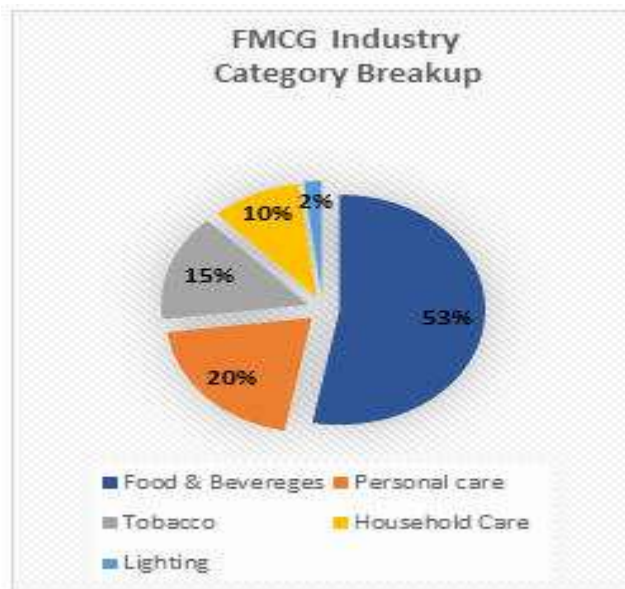
Nestlé India

- Nestlé is a multinational food and beverage company based in Switzerland. The company has existed worldwide for more than 150 years. The history of Nestlé in India dates back to 1912, when the company started its operations as Nestle Anglo-Swiss Condensed Milk Company.
- Nestlé sells many products including beverages, bottled water, milkshakes, breakfast cereals, prepared foods, performance, dietary products, etc. Some of the 2,000 brands it currently owns include Nescafe, Maggi, Milky Bar, Kit Kat, Bar One, Milkmaid, Nestea, etc.

- In addition, Nestlé Cerelac has an undisputed 96.5% market share among infants 6 months and older as a supplement to breast milk, although this is an open market.

Impact of GST on FMCG sector in India

Goods and Services tax is just a three years old tax system for India and has made a tremendous impact on the consumers. (Kothiya, 2017) wrote that soon after the implementation of GST, the prices of essential items have gone up despite placing them under lowest slab. Further they also indicated that GST has brought a change in consumer spending and lifestyle. FMCG industry is the fourth largest sector of the Indian economy (Indian Brand Equity Foundation, 2020).



No doubt, GST has brought several non-tax payers into the Tax bracket. More or less of the FMCG sectors have been touched by this new regime. FMCG sector is the fourth biggest economy in India, which is sectioned into three categories as Food and Beverages, Household and Personal Care and Health Care, and their rates getting accounted are 19%, 50% and 31% respectively.

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OBJECTIVES

- To analyse the ratio, thereby to know the companies' respective positions in the market.
- To study the impact of GST on the companies in the FMCG Industry in India.
- To analyse the Financial Performance of the Companies before and after implementation of GST.

- To analyse the Trends of three leading FMCG companies to know the overall impact of GST on the Industry.
- To Study the Whether the FMCG Sector is having positive or negative Impact of GST.

RESEARCH METHODOLOGY

The process of research is divided into two stages. Firstly, three FMCG companies are taken according to their market capitalization as per FMCG INDEX from an authentic source of BSE. Secondly, an inter-company comparison is done on the basis of the Techniques of Financial Statement Analysis (FSA) namely Ratio analysis and Trend Analysis. Thus, the findings of the research are to check that whether the GST has been affected FMCG sector companies in a positive or negative way and they are still efficient even after GST implementation.

Research Design: Descriptive research design which is based on secondary data.

Sample Size: Sample size used is three companies for analysis.

Collection of Data: Secondary data.

Research Tool: Analysis is done through Ratio analysis and Trend Analysis

Limitations:

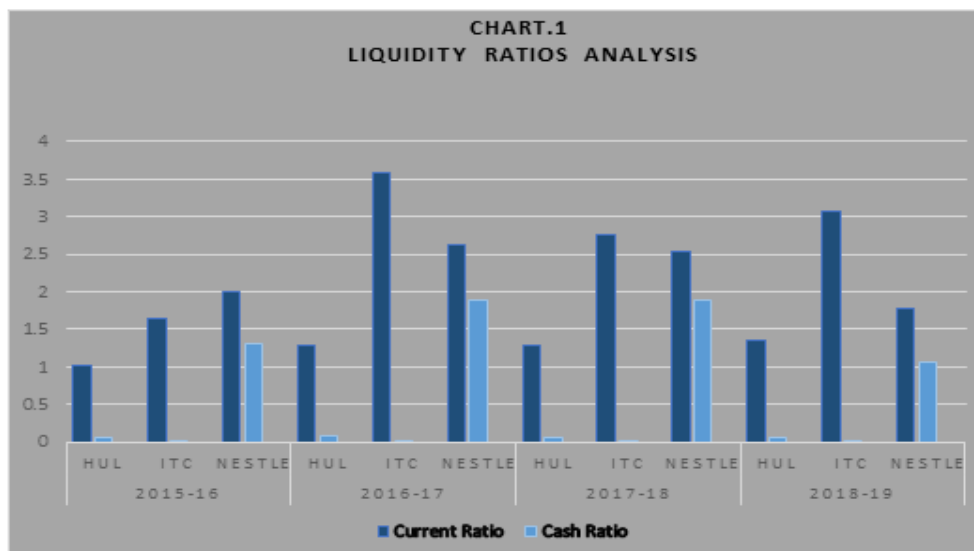
- This research relies on secondary data. No primary data is involved in this research.
- The sample selected is based on the availability of data regarding the financial statements of the companies available online.
- The period taken under consideration is for 4 years only. The data could be taken for more years to get more precise results.
- One of the limiting factor is that I have taken only leading three FMCG Companies for analysis due to time constraints. It could be for more Companies to compare and analyse performance in a better way.

DATA ANALYSIS

Table.1 Liquidity Ratios Calculation												
Particulars	2015-16			2016-17			2017-18			2018-19		
	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE
Current Ratio	1.03	1.65	2.01	1.30	3.59	2.64	1.29	2.77	2.55	1.36	3.07	1.78
Cash Ratio	0.06	0.005	1.31	0.08	0.02	1.90	0.07	0.01	1.90	0.07	0.02	1.07

[Source: Own Calculations Based on Secondary data from Companies published Financial Statements]

Table.1 shows the Calculations of two main Liquidity ratios viz., Current Ratio which depicts Companies ability to pay-off its short-term obligations with current assets; and Cash Ratio which measures ability to repay short term debt with cash or easily marketable securities which is near to cash. Data showing is of all 3 leading FMCG Companies i.e. HUL, ITC and Nestle for last four years out of which two before GST and rest for After GST Implementation.

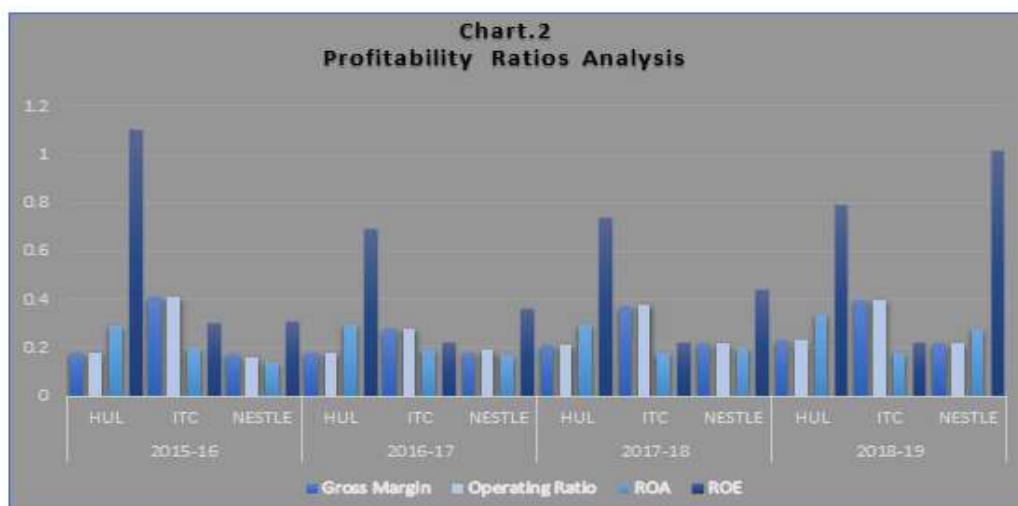


[Source: Own Calculations Based on Secondary data from Companies published Financial Statements]

Particulars	2015-16			2016-17			2017-18			2018-19		
	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE
Gross Margin(%)	18	41	17	18	28	18	21	37	22	23	40	22
Operating Ratio(%)	18	41	16	18	28	19	21	38	22	23	40	22
ROA(%)	29	20	14	30	19	17	30	18	20	34	18	28
ROE(%)	110	30	31	69	22	36	74	22	44	79	22	102

Table.2 showing the calculations of Ratios for all 3 leading FMCG Companies i.e. HUL, ITC and Nestle for four years since 205-16 to 2018-19 before GST and After GST Implementation. Data shows mainly four types of Profitability Ratios which are as :

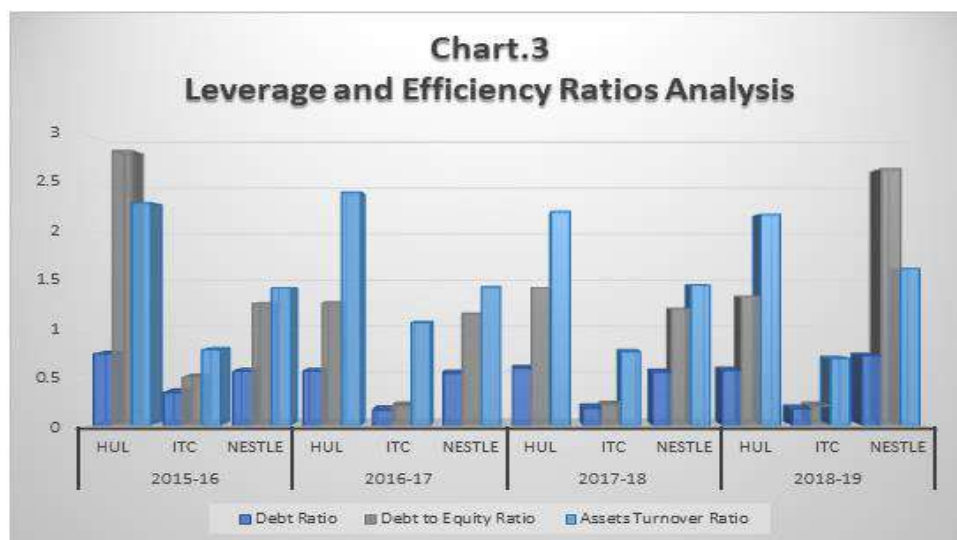
- (1) Gross Margin is an indicator of whether Sales of the company are good enough to run an operation sufficiently.
- (2) Operating Ratio is a measure of efficiency used by Management to check performance.
- (3) Return on Assets, in terms of profitability, is an indicator of how well a company utilizes its assets.
- (4) Return on Equity is an important measure of how well a company generating Profits.



[Source: Own Calculations Based on Secondary data from Companies published Financial Statements]

Table. 3 Leverage and Efficiency Ratios Calculation												
Particulars	2015-16			2016-17			2017-18			2018-19		
	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE	HUL	ITC	NESTLE
Debt Ratio	0.74	0.34	0.56	0.56	0.16	0.54	0.59	0.18	0.55	0.57	0.17	0.72
Interest Coverage Ratio	397.4	301	417.03	291.73	675.80	24.74	370.25	195.15	25.70	308.1	536.64	24.57
Debt to Equity Ratio	2.84	0.50	1.26	1.27	0.20	1.15	1.42	0.21	1.20	1.33	0.20	2.65
Assets	2.30	0.78	1.42	2.41	1.06	1.43	2.21	0.76	1.45	2.18	0.69	1.62

Calculations of Leverage and Efficiency Ratios for leading 3 FMCG Companies i.e., HUL, ITC and Nestle for period of four years before and after implantation GST is given in above Table.3 Main Ratios covered here are: Debt Ratio can be used to evaluate the amount of leverage used by a company and Debt to equity ratio can be used to evaluate how much leverage a company is using. While ICR is used to determine how easily a company can pay its interest on its outstanding debt. And ATR measures a company's ability to generate sales from its assets.



FINDINGS:

- 1) **Current Ratio** for HUL is quite stable during 4 years period which shows not as such any impact of GST and Company is ideally able to manage its debt and obligations well. While Current Ratio of ITC and Nestle is somehow fluctuating and has a negative trend after GST implementation. However, ITC was managed to cover its debts and obligations with its current assets in 2018-19 but in comparison Nestle was still not managed to cover its negative trends. Perhaps it's taking on too much debt or cash balance is depleted; any of these reasons could be a solvency issue if it worsens.
- 2) **Cash Ratio** of HUL and ITC is showing a stability in trend during 4 years even after GST law implemented but Nestle is Showing down trends in 2018-19 still ratio is more than 1 which is quite stable situation for the company to manage its debt with cash but at the same time current ratio of Nestle is also decreased which is not acceptable. And For HUL and ITC it is not up to the mark as lower than 1 but in comparison Current Ratios are higher which is an indicator of better utilized their cash for lying assets.
- 3) **Gross Margin** of HUL and Nestle showing relatively stable trends than ITC, which is very fluctuating during the period of 2015-16 to 2018-19. It clearly shows that might be GST and also any other reasons are responsible for such a great fluctuation as it was shown before and after GST, too. Because a sudden decrease of 13% in a year has drawn attention.
- 4) **Operating Ratio** has shown the impact of GST on the FMCG Sector as trends depicts the picture of high operating Ratio after 2016-17 which not a good sign as it shows inefficiency of management to cover its costs by sales revenue. Operating margin is comparatively high which indicates company is not healthy

financially. As seen, ITC has highest operating margins. However, ITC being a conglomerate, majority of margins are contributed by its cigarette business rather than FMCG business.

- 5) **Return on Assets** showing positive trends for HUL and Nestle while Negative for ITC during 2015-2018. HUL and Nestle both showing good performance in 2018-19 with 4% and 8% increase than in 2017-18. In comparison to HUL and Nestle, ITC could do better to convert its investment into profits.
- 6) **Return on Equity** is sustainable and increasing over time of Nestle company from 2015-16 to 2018-19 can mean a company is good at generating shareholder value by reinvesting its earning wisely. While HUL's returns are good enough in 2015-16 but there was sudden drop of 41% in very next period 2016-17 is not a good indicator however company can manage to stabilize it till 2018-19. But ITC showing declining returns can mean management is making poor decision on reinvesting capital.
- 7) **Debt ratio** of HUL and ITC shows great results. Bothe companies' ratio shows decline of 0.17 from 2015-16 to 2018-19 which shows lower the debt amount and higher the assets. While Nestle showing upward trend during 4 year period but still it was quite acceptable as it is less than 100% which quite a good proportion.
- 8) The high **debt to equity ratio** indicates that a company may not be able to generate enough cash to satisfy its debt obligations. Which is clearly seen in the case of Nestle after GST Implementation and in HUL before GST in 2015-16. However, low debt-to-equity ratios may also indicate that a company is not taking advantage of the increased profits that financial leverage may bring. HUL thenafter maintaining are good amount of debt-to-equity ratio and that of ITC is too low during the 4 years.
- 9) Overall, FMCG companies have good **Interest coverage ratio**. Usually, interest coverage ratio above 2.5 x is healthy. And so, with the case of all of 3 companies even after GST they are maintaining good debt position. And currently they are enough liquid to meet its debts. After see this might be possible that HUL and ITC became zero debt companies after 2018-19.
- 10) **Assets Turnover ratio** of HUL and Nestle are fair enough and that of ITC is too low. Higher total asset turnover ratios mean the company is using its assets more efficiently. Lower ratios mean that the company isn't using its assets efficiently and most likely have major production problems. However there has been definitely an impact of GST on the all the 3 companies as seen in the graph.

CONCLUSION

Sales and Net Profit Growth on the basis of 5 years CAGR presents the situation of Peaks and Valleys. Several Factors like Demonetization, GST introduction and Covid-19 Pandemic, etc. has played crucial role in this volatility.

• Positive Impacts:

1. **Reduced Logistics cost:** Due to subsumption of taxes like VAT, Entry tax and OCTROI, logistics tax has decreased significantly. Previously, the distribution costs were around 2 to 7% of the total cost, but now it has now dropped to 1.5%.
2. **Warehouse:** Earlier, the warehouses were set up on at those states where the effective tax were low, and this also affected the transport costs for the distributors and the manufacturers. However, With the introduction of GST in the country, the FMCG companies can set up their warehouses anywhere, in any state.
3. **Foreign Investment** As the GST has reduced its export cost and production cost both. The implementation of GST has lowered almost all taxes and made it easier for manufacturers and business owners to sell in the global and international market without any hassle.
4. **Business Cost** GST have changed VAT. Now if you are a business owner, you don't have to pay the different amount of taxes in every state.

• Negative Impacts:

- 1) **Transitional credits;** Previously FMCG companies had to set up units in different states to receive area-based exemptions in taxes but after GST came into the picture there is a ambiguity regarding tax refunds.
- 2) **Frequently changing rates;** The lack of clarity in tax rates and schemes has led to immense confusion for various FMCG goods' treatment.

- 3) **Issues of Anti-profiteering** Because of transitional credits and rates changing frequently, companies are not able to pass the benefits to the end-consumers directly as there is so much confusions are there how to determine the profits of Manufacturers in FMCG sector. Overall, the GST has impacted in a very positive way for companies, as they have made the supply chain management to run smoothly and effectively, in regards to timely payment of tax, correct claims of input credit, and CST removal too and reduced the TAC burden of manufacturers in a good scale.

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A Study on Modeling and Analysis of Modern Software Development Process for Internet-of-Things

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ABSTRACT

In recent years Internet-of-Things has rapidly captured the market at a very fast pace. It has greatly improved every sphere of our life through intelligent sensors and smart devices which can exchange data over the internet. Developing an application for IOT devices is not an easy task as the software development approach will not remain the same as implemented for traditional software like desktop and web based applications. We require a suitable software engineering approach and a dedicated Internet-of-Things Application Development Lifecycle for developing IOT applications. In this paper we study the characteristics of IOT application development and a systematic life cycle model is proposed for the Internet-of-Things Application Development.

Keywords: software development approach, Internet-of-Things Application Development, IOT applications, software engineering approach, Internet-of-Things Application Development Lifecycle.

1. INTRODUCTION

The explosion of Internet-connected devices with computing capabilities, also known as the Internet-of-Things (IoT) has made software development more complex. IoT has the ability to interconnect innumerable devices and services that has increased the complexity and may lower the success rate of software project development. IOT software have the characteristic of being used on a large scale, rapidly changing features, constituting varied components and applicable to diverse fields. Together, they pose increasingly new challenges on how to design, develop and maintain them. There are various software process models available like Waterfall, Iterative, Incremental, RAD, Prototype, Spiral, Agile etc. Choosing a particular model depends on the type of software that we are developing as well as the development environment. In this paper, software engineering issues for IOT Application Development has been discussed and Phases of Internet-of-Things Application Development Lifecycle has been proposed.

2. INTERNET-OF-THINGS

The Internet of Things is a network of objects that use sensors and application programming interfaces (APIs) to exchange information over the web. The IoT depends on an entire host of technologies – like Big Data management tools, predictive analytics, AI and machine learning, the cloud, and radio-frequency identification (RFID).

3. IOT APPLICATION DEVELOPMENT CHALLENGES

- **Security & Privacy**-These applications are backed by a network that connects the hardware and software components and involves a huge amount of data traveling through a number of connected devices. This huge online data online is vulnerable to cyber-attacks and hacking.
- **Connectivity**-IOT application development requires real-time transmission of data. So good connectivity is an essential requirement for IoT devices to perform well.
- **Cross-Platform Compatibility**-It is a challenge for IoT application developers to ensure that device and IoT platform delivers the best performance despite technological changes of the future.
- **Data Collection & Processing**-Since IoT application involves a huge amount of data, data collection & processing is a big challenge for developers.
- **Lack of Skill Set** -IoT is a diverse field and requires good knowledge of software and hardware implementations.

4. WHAT IS SDLC?

For the success of any software project i.e. quality and timeliness, we need to adhere to a systematic approach to develop the software. This systematic approach is known as SDLC which stands for Software Development Lifecycle or System Development Lifecycle. SW development is a complex task in itself. SDLC has various phases like requirements gathering, analysis, design, implementation, and testing which Software developers need to adhere to. There are various software development approaches like Waterfall Model, Iterative Model, RAD Model etc., and each one has its own strength and weakness and may prove to be better in one situation

than in another. Apart from the traditional approaches new methodologies like Agile have also emerged. The challenge is to decide which model to select in a given software development scenario.

5. PHASES INVOLVED IN SDLC MODEL

By and large every software development life cycle model has the following phases:

- 1) Requirement Gathering and Analysis-Information is collected from the customer to understand the problem.
- 2) Design- In this phase, developers chalk out a plan to find out the solution to the problem based on the requirements gathered and a software architecture is proposed.
- 3) Implementation-Coding the planned solution. The Software design is modified into source code.
- 4) Testing-Entire program is tested once the coding is complete. In this phase, the developed software is tested thoroughly and any defects found are rectified.
- 5) Deployment-Once the product is tested, it is deployed in the target environment.
- 6) Maintenance-After deployment maintenance of the product is very important i.e. to rectify any issues related to the functioning of the software as well as any enhancement or modifications.

6. GENERAL SOFTWARE PROCESS MODELS

There are a number of software process models used for developing software. Developers adopt the best-suited model for their project and development environment. Following broad types of process models are considered:

1) Waterfall Model-In this model the phases are distinct and sequential like Requirements, Analysis & Design etc. This model is rigid as each phase must be completed before the next phase can begin and no overlapping is allowed between the phases.

2) Iterative Model-In iterative development software is designed, developed and tested in repeated cycles. With each iteration, additional features can be added by undergoing through the same phases in each cycle.

3) Incremental Model- In this approach software is built and delivered in pieces. Each increment represents a complete subset of functionality. The process finishes when it satisfies all of users' requirements.

4) Rapid application development (RAD)-RAD approach gives more emphasis on process rather than planning. In contrast to the waterfall model, which requires the specification to be defined before development phase, RAD approach lays more emphasis on the necessity of adjusting requirements according to the customer's feedback as the project progresses. Prototypes are often used in this approach.

5) Agile Model-Agile processes are iterative in nature. While traditional methodologies emphasize detailed planning, modeling and documentation, agile methodologies aim at rapid development and delivery of software and satisfying frequently changing client requirements. Instead of redundant documentation, Agile model focuses on quick software development. Customers and developers continuously interact with each other. It encourages continuous improvement, rapid and flexible response to change. In practice developers use a mix of above methodologies or their own customized approach.

7. SOFTWARE ENGINEERING ISSUES FOR IOT APPLICATION DEVELOPMENT

Many of the IOT applications are in critical sectors. Often, unskilled programmers develop IoT systems in an uncontrolled fashion and release into the market, possibly endangering lives. We need to train these new generation of IoT software developers. A set of best practices is required to meet the challenges of software engineering for the IoT.

8. PROPOSED PHASES OF IOT APPLICATION DEVELOPMENT LIFECYCLE

- **Planning and Brainstorming** The first phase is the most important where we have to focus upon some important aspects like the objective behind developing the application, intended users, security issues etc. Time estimation, technical feasibility analysis and cost benefit analysis is also done in this phase.
- **Requirements Gathering** In this phase we understand the user requirements and uncover usability issues. Feedback from team members and users is very important in this phase.
- **Design** We must design our app keeping in mind that IOT applications are critical. We need to define the hardware and software features, user interaction, networking, integration with other services, database designing etc.

- **Development** This phase involves construction of hardware device as well as software development involving SDLC phases such as planning, analysis, design, implementation and testing.
- **Manufacture** This phase involves the mass production of hardware devices.
- **Installation and deployment** This phase involves installation, set-up, deployment of software, networking and security aspects and integration of services to interconnect the devices for proper communication.
- **Testing** The application should receive positive user feedback the very first time it is launched, otherwise it loses popularity. Testing is done to verify correctness, functionality and usability before releasing application publicly.
- **Release** The app should be released progressively i.e. to selective users first, in order to rectify any technical issues before releasing the app publicly.
- **Maintenance** This phase involves the maintenance of all IoT and connected devices including physical and network security of the device, configuration, software updates management and much more. IoT device lifecycle management.
- **Termination** This phase involves physical removal of old devices, disconnecting them from network, uninstalling older versions of software, server shutdown as well as recycling hardware to protect our resources.

9. CONCLUSION AND FUTURE WORK

As it is clearly evident from the study above, SDLC phases undergo minor changes when the type and nature of application change. In this paper software development challenges for IOT Applications were examined. IOT Application development is different from traditional software development. Agile model is best suited one. IOT Application Development Lifecycle has been proposed to help developers in developing best quality IOT applications. Future researches could also focus on developing modelling techniques to ease development tasks of IoT systems.

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A Study on the Work Life Balance of Nurses in the Pandemic

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ABSTRACT

Objective: The study aims to understand the perception of work life balance of nurses in this crucial period of Pandemic. The front line workers battling against Covid 19 who risked their life for the cure of their patients is studied in the research paper. To analyse the various source of support and factor affecting the work life balance of nurses working in the pandemic.

Method: A sample of 100 nurses across India was taken for the study. A structured questionnaire was given online through google form to assess and understand their personal and professional life phenomena. The questionnaire was completed by registered and intern nurses after being posted on nurses Facebook Telegram and WhatsApp Group

Results: The study indicates that the mean score for Work Life Balance of the Nurses is 57.57 percent. There is a Positive relationship between the Family Support and Work Life Balance, and Management support and Work Life Balance. The p-value suggests that, as the Family support to the Nurses increases, there is a certain significant increase in their Work Life Balance quotient. Also, as the Management support increases, there is a certain significant increase in their Work Life Balance quotient.

Keywords: Work Life Balaces, Nurses, Pandemic, Covid-19, Health Care Worker

INTRODUCTION

The touch of the angel” the front line workers risking their life to battle the Pandemic is one of the toughest times of the era. The COVID-19 pandemic is a public health challenge that puts health systems in a highly vulnerable situation. The hand who are working knws the dilemma of the risk of contraction, but the calling of the duty and the responsibility of the profession is on the other hand. Vitale et al., (2021).The study showed that the rapid rise in the patients and the death toll emotionally exhausted the nurses, The challenges of overcrowding patients and lack of resources were so grave that the ground reality was frightening. The biggest objective in this crucial time was the highest level of care and to keep all the things in control. González-Gil, M. T. et al Nurses working in the the critical care units in the hospitals (CCUs) and hospital emergency services (HESs) have provided utmost care to patients with COVID-19 under pressure and uncertainty. The study also revealed that there were lack of communication and they couldn't vent their emotions.

The Work and Life balance is a very important that every member of the family and the management of the health care centre understands the elevated work load handled by the health care practitioner.

OBJECTIVES OF THE STUDY:-

- 1) To analyse the various source of support and factor affecting the work life balance of nurses working in the pandemic
- 2) To analyse the general perception of the nurses towards their personal and professional life
- 3) To provide suggestions to overcome work-life balance related problems of nursing staff Hypothesis

Nurses with higher level of experience have a better work life balance

A strong family support helps in managing work life effectively.

REVIEW OF LITERATURE

Goyal, (2014), Work life balance is a burning issue in clinics and private hospitals it is affecting the efficiency of nurses and doctors. The main focus of the study is nurses and doctors working in private hospitals and clinics. A sample of 134 nurses and doctors was taken. The purpose of this study is to discover factors that help nurses and doctors maintain work-life balance. Analyze the data with the help of factor analysis and one-way analysis of variance. The study found that work-life balance policies and practices provided by hospitals will help nurses and female doctors reach their full potential. Furthermore, successful work-life balance in private clinics and hospitals will make nurses and doctors more loyal and efficient, which will make them fully satisfied with their work. In this article, the topic of work-life balance is discussed in terms of demographic changes.

Tanaka et al., (2020) Purpose To describe the current status of the reconciliation gap between emergency care workers and assess its relationship with quality of life (QoL). Background According to reports, nurses who spend more time at work than in their personal lives have a lower quality of life. In order to capture the ideal work-life balance gap between nurses of different backgrounds, it is necessary to examine the time spent on work, family, and private life. Methods This cross-sectional study included 228 nurses from 3 Japanese intensive care hospitals. Results the job gap and family gap scores of nurses living alone were significantly higher and lower than those of nurses living with their families. Also, as the gap between work-life balances for nurses increased, quality of life scores decreased. Conclusion Compared to nurses living with their families, nurses living alone have a higher workload. On the contrary, living with the family can protect the family life of the nurse. The work-life balance gap is related to quality of life. Impact on Nursing Management Resolving the gap between the true ideal ratios in work-life balance is important for improving nurses' quality of life and work-life balance. Flexible work options and policy changes can also improve your work-life balance and quality of life.

Kim, and Kim, (2016). This study tried to find out the work family experiences of married nurses. The respondents of this research were seven registered nurses and were in different stages of their family life cycle. Data was collected by a detail interview and analysed using methodology by Colaizzi (1978). The results showed the truth behind work and parenting, external and internal conflict, difficulty of compatibility, growing desire and efforts of compatibility. The study highlights the importance of continued support of government policies and the family is important to maintain the work and family issues

Kim et al., (2018). The study was to understand the issues of conflict experienced by the three shift working nurses in advanced general hospitals who were rearing young children. Data were analysed by Colaizzi's phenomenological methodology. Eighteen themes were drawn from 256 experience's. The striking revelation of the study was the regret that they couldn't satisfy their wish, fail to care for kids. Body and mind were broken. The suggestion was to have a 24 hours care centre for three hours shift. The conflict of work and home can be sorted so that nurses can manage the continuous shift timing better

METHODOLOGY:

Information required for the study on "Work Life Balance of Nurses in Healthcare sector during Pandemic" is collected through a structured Questionnaire. Responses from 100 nurse respondents are collected, Demographics data and responses on various statements from the respondents are classified, rated and presented in the tables as follows:

Demographics:

Demographics	Frequency	Percent	
Age group	Less than 25 years	24	24.0
	25 to 35 years	53	53.0
	36 to 45 years	14	14.0
	Above 45 years	9	9.0
Marital Status	Married	65	65.0
	Unmarried	33	33.0
	Widow	2	2.0
Type of Hospital	Government	42	42.0
	Private	58	58.0
Duration of Working Experience	Less than 2 years	37	37.0
	2 to 5 years	26	26.0
	6 to 10 years	14	14.0
	11 to 15 years	10	10.0
	Above 15 years	13	13.0

The above table indicates that out of 100 nurses, 24 are aged below 25 years, 53 nurses are aged between 25 to 35 years, 14 nurses are aged between 36 to 45 years and 9 nurses are aged above 45 years. Out of these, 65 nurses are married, 33 are unmarried and 2 are widowers. Among these 100 nurses 42 work in Government hospitals, while 58 work in Private hospitals. Also, among these 100 nurses, 37 have working experience of less than 2 years, 26 have working experience of 2 to 5 years, 14 have working experience of 6 to 10 years, 10 have working experience of 11 to 15 years and 13 nurses have an experience of more than 15 years.

Time Management:

To evaluate the Time management by the Nurses, 5 statements from question 11 of the Questionnaire are considered. Responses on the same are recorded, classified and presented in the following table:

Sr. no	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I am required to work in rotational shift	4	5	13	45	33
2	I have lunch on time	14	23	28	25	10
3	I have two consecutive shifts usually	6	24	24	36	10
4	My duty time is usually extended	6	19	26	25	21
5	I do get time to take little break to unwind when work gets stressful	9	19	22	30	20

The above responses are rated as follows:

Strongly Disagree	=	1
Disagree	=	2
Neutral	=	3
Agree	=	4
Strongly Agree	=	5

Using these rating, the mean score for Time management by Nurses is calculated using the formula as follows:

$$\text{Mean Time management} = \frac{\text{Total score of rating of respondent (for 5 statements)} \times 100}{\text{Maximum rating (25)}}$$

The mean Score for Time management by Nurses is calculated for each respondent and subsequently for all 100 Nurse respondents and is represented in the table below:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Mean Sore-Time management	100	36	88	62.76	10.260
Valid N (listwise)	100				

The above table indicates that the mean score for Time management by Nurses is 62.76 percent. Corresponding standard deviation is 10.26, suggesting that there is moderate variation in the responses.

Family Support:

To evaluate the Family support to the Nurses, 7 statements from question 12 of the Questionnaire are considered. Responses on the same are recorded, classified and presented in the following table:

Sr. no	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	My spouses/family members understand and respect the nature of my job	1	1	12	34	52
2	I am expected to cook for all family members daily	8	23	21	27	21
3	My child understands and does manages his academic studies	9	15	27	32	17
4	Able to manage household chores and professional role because of rotational shifts	3	16	23	42	16

5	Ever miss out any quality time with my family/friends because of work pressure	3	7	21	36	33
6	I usually miss the social rituals because of work	2	3	18	41	36
7	My family helps me to cope up with household chores during rotational shifts	3	7	13	47	30

The above responses are rated as follows:

Strongly Disagree	=	1
Disagree	=	2
Neutral	=	3
Agree	=	4
Strongly Agree	=	5

Using these rating, the mean score for Family support to Nurses is calculated using the formula as follows:

$$\text{Mean Family Support} = \frac{\text{Total score of rating of respondent (for 7 statements)} \times 100}{\text{Maximum rating (35)}}$$

The mean Score for Family support to Nurses is calculated for each respondent and subsequently for all 100 Nurse respondents and is represented in the table below:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Mean Score - Family Support	100	25.7	85.7	62.543	9.8801
Valid N (listwise)	100				

The above table indicates that the mean score for Family support to Nurses is 62.54 percent. Corresponding standard deviation is 9.88, suggesting that there is low variation in the responses.

Management Support:

To evaluate the Management support to the Nurses, 5 statements from question 13 of the Questionnaire are considered. Responses on the same are recorded, classified and presented in the following table:

Sr. no	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	There is a proper canteen facility in my hospital	10	15	8	42	25
2	There is flexibility in the shifts	7	16	27	37	13
3	There is enough cooperation extended from the head nurse	6	13	18	42	21
4	There is enough cooperation extended by the co-worker	2	7	23	51	17
5	There is enough consideration while applying for leaves	6	16	24	37	17

The above responses are rated as follows:

Strongly Disagree	=	1
Disagree	=	2
Neutral	=	3
Agree	=	4
Strongly Agree	=	5

Using these rating, the mean score for Management support to Nurses is calculated using the formula as follows:

$$\text{Mean Management support} = \frac{\text{Total score of rating of respondent (for 5 statements)} \times 100}{\text{Maximum rating (25)}}$$

The mean Score for Management support to Nurses is calculated for each respondent and subsequently for all 100 Nurse respondents and is represented in the table below:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Mean Score - Management Support	100	20.0	100.0	70.640	17.0297
Valid N (listwise)	100				

The above table indicates that the mean score for Management support to Nurses is 70.64 percent. Corresponding standard deviation is 17.02, suggesting that there is high variation in the responses.

Work Life Balance:

To evaluate the Work Life Balance of the Nurses, 6 statements from question 14 of the Questionnaire are considered. Responses on the same are recorded, classified and presented in the following table:

Sr. no	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I have enough time for my family	8	30	30	27	5
2	I have time to attend family functions	14	33	28	20	5
3	I have time to perform rituals	7	41	29	17	6
4	I have time for pursuing my hobbies	11	39	28	18	4
5	I feel that I have an enriched work and personal fulfilled life	8	24	27	34	7
6	I am able to relax and handle the work at the best mindset	7	21	26	37	9

The above responses are rated as follows:

- Strongly Disagree = 1
 Disagree = 2
 Neutral = 3
 Agree = 4
 Strongly Agree = 5

Using these rating, the mean score for Work Life Balance of the Nurses is calculated using the formula as follows:

$$\text{Mean Management support} = \frac{\text{Total score of rating of respondent (for 5 statements)} \times 100}{\text{Maximum rating (25)}}$$

The mean Score for Work Life Balance of the Nurses is calculated for each respondent and subsequently for all 100 Nurse respondents and is represented in the table below:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Mean Score-Work Life Balance	100	20	100	57.57	18.003
Valid N (listwise)	100				

The above table indicates that the mean score for Work Life Balance of the Nurses is 57.57 percent. Corresponding standard deviation is 18.00, suggesting that there is high variation in the responses.

CRONBACH'S ALPHA TEST:

Test of reliability of scale: This test is used for validation of Likert scale used in the questionnaire.

To validate the scale in this study Cronbach Alpha test is applied. Test is applied for all respective respondents for various variables. Following table represents the results of the test:

Variable Name	No. of subgroups	Cronbach's Alpha	Result
Family support	7	0.720	Scale is reliable and accepted
Management support	5	0.818	Scale is reliable and accepted
Work Life Balance	6	0.921	Scale is reliable and accepted

Above results indicate that all the Cronbach Alpha values for all the three variables is more than the required value of 0.700. Hence the test is accepted. Conclusion is **scale is reliable and accepted**.

Hypothesis Testing:

Null Hypothesis H₀₁: There is no significant difference in the Work Life Balance of the Nurses across their work experience.

Null Hypothesis H₀₁: There is a significant difference in the Work Life Balance of the Nurses across their work experience.

To test the above Null Hypothesis ANOVA is obtained and F-test is applied. Results are shown in the table below:

ANOVA					
Mean Score-Work Life Balance					
	Sum of Squares	df	Mean Square	F	p-value
Between Groups	1179.070	4	294.768	.906	.464
Within Groups	30906.076	95	325.327		
Total	32085.146	99			

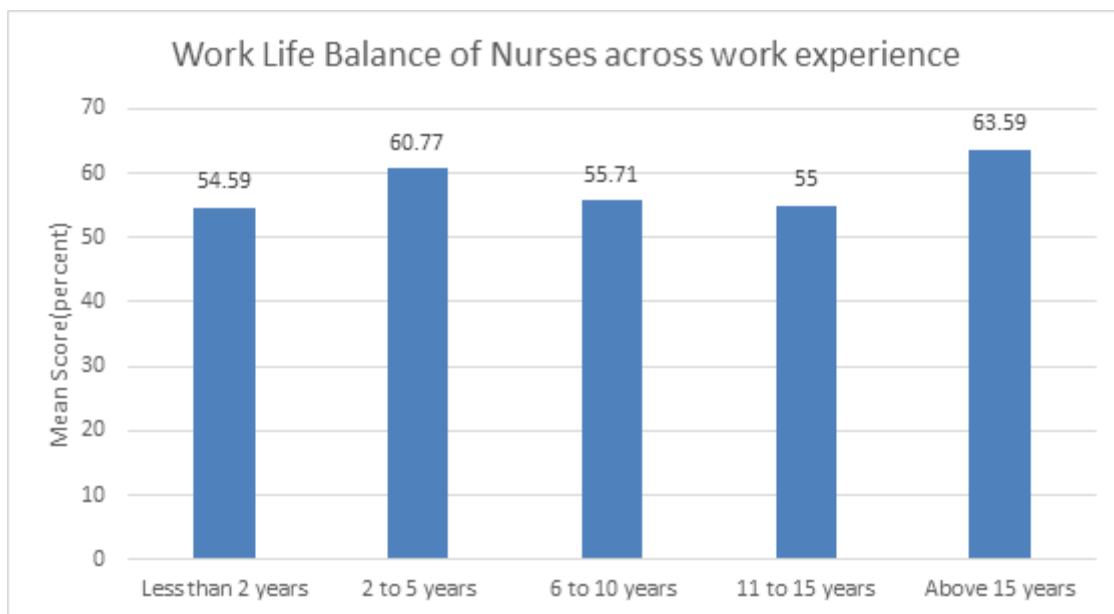
Interpretation: The above results indicate that calculated p-value is 0.464. It is more than 0.05. Therefore F-test is accepted. Hence Null hypothesis is accepted and Alternate hypothesis is rejected.

Conclusion: There is no significant difference in the Work Life Balance of the Nurses across their work experience.

Finding is that difference in the Mean Work Life Balance of the Nurses is highly insignificant across their work experience. It is highly similar across all the respondents irrespective of their work experience. This can be observed in the following table:

Report			
Mean Score-Work Life Balance			
Duration of working in hospital	N	Mean	Std. Deviation
Less than 2 years	37	54.59	17.040
2 to 5 years	26	60.77	18.361
6 to 10 years	14	55.71	19.101
11 to 15 years	10	55.00	21.444
Above 15 years	13	63.59	16.185
Total	100	57.57	18.003

The above table indicates that the Mean Work Life Balance of the Nurses is highest at 63.59 percent for the Nurses who have more than 15 years of working experience, while it is lowest at 54.59 percent for the Nurses who have less than 2 years of working experience. This difference is not significant according to the F-test. This verifies our findings. The above information can be represented in the following Bar chart as follows:



Null Hypothesis H₀₂: There is no significant impact of Family support and Management support on the Work Life Balance of the Nurses across their work experience.

Null Hypothesis H₀₂: There is a significant impact of Family support and Management support on the Work Life Balance of the Nurses across their work experience.

To test the above Null Hypothesis, Pearson Correlation is applied and the p-value is calculated. Results are shown in the table below:

Relationship	Pearson Correlation	p-value	Result
Family Support – Work Life Balance	0.430	0.000	Significant
Management Support – Work Life Balance	0.420	0.000	Significant

Interpretation: The above table shows that the calculated Pearson correlation coefficient between Family Support and Work Life Balance, and Management support and Work Life Balance is 0.430 and 0.420 respectively. The calculated p-value is 0.000 for both relationships. This is less than 0.05. Therefore, the test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

Conclusion: There is a significant impact of Family support and Management support on the Work Life Balance of the Nurses across their work experience.

Finding is that there is a Positive relationship between the Family Support and Work Life Balance, and Management support and Work Life Balance. The p-value suggests that, as the Family support to the Nurses increases, there is a certain significant increase in their Work Life Balance quotient. Also, as the Management support increases, there is a certain significant increase in their Work Life Balance quotient.

Null Hypothesis H_{03A}: There is no significant factor affecting the Time management by the Nurses working in the hospitals.

Alternate Hypothesis H_{13A}: There is a significant factor affecting the Time management by the Nurses working in the hospitals.

To test the above Null Hypothesis, Friedman's test is applied and p-value is calculated. Results are shown in the table below:

Test Statistics ^a	
N	100
Chi-Square	83.459
df	4
p-value	.000
a. Friedman Test	

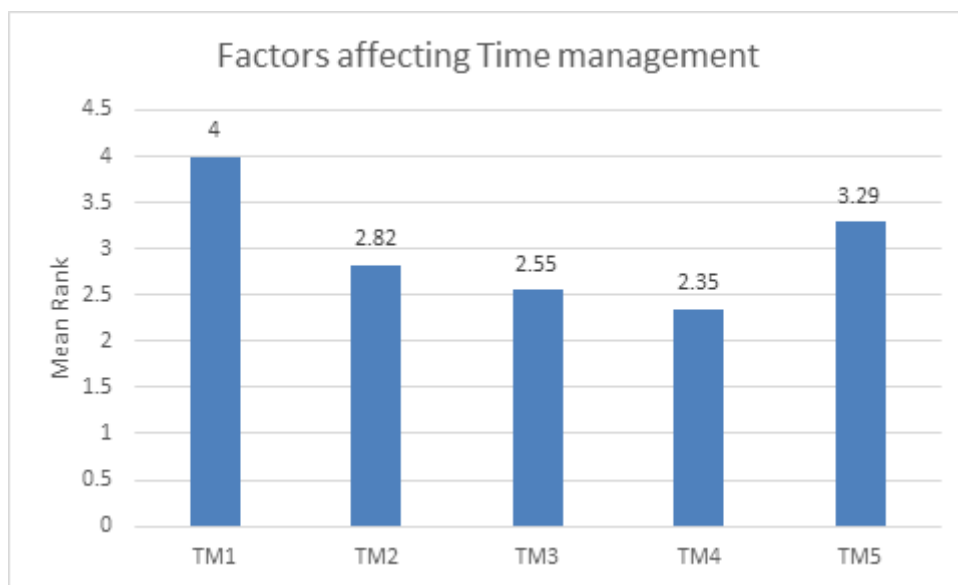
Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, Friedman's test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is rejected.

Conclusion: There is a significant factor affecting the Time management by the Nurses working in the hospitals.

Finding is that the factor affecting the Time management by the Nurses working in the hospitals is significantly different. It is observed that there is a significant difference in the mean rank of the most important and the least important factor affecting the Time management by the Nurses working in the hospitals. This can be observed in the following table:

Ranks		
Sr.no	Factors affecting Time Management	Mean Rank
TM1	I am required to work in the rotational shift	4.00
TM2	I have lunch on time	2.82
TM3	I have two consecutive shifts usually	2.55
TM4	My duty time is usually extended	2.35
TM5	I do get time to take little break when the work gets stressful to unwind	3.29

The above table indicates that the factor "I am required to work in rotational shift" is the most important factor affecting the Time management by the Nurses as it has the highest rank of 4.00, while the factor "My duty time is usually extended" is the least important factor affecting the Time management by the Nurses as it has the lowest rank of 2.35. This can also be graphically represented in the following Bar chart:



Null Hypothesis H_{03B} : There is no significant factor affecting the Family support to the Nurses working in the hospitals.

Alternate Hypothesis H_{13B} : There is a significant factor affecting the Family support to the Nurses working in the hospitals.

To test the above Null Hypothesis, Friedman's test is applied and p-value is calculated. Results are shown in the table below:

Test Statistics ^a	
N	100
Chi-Square	272.347
Df	6
p-value	.000
a. Friedman Test	

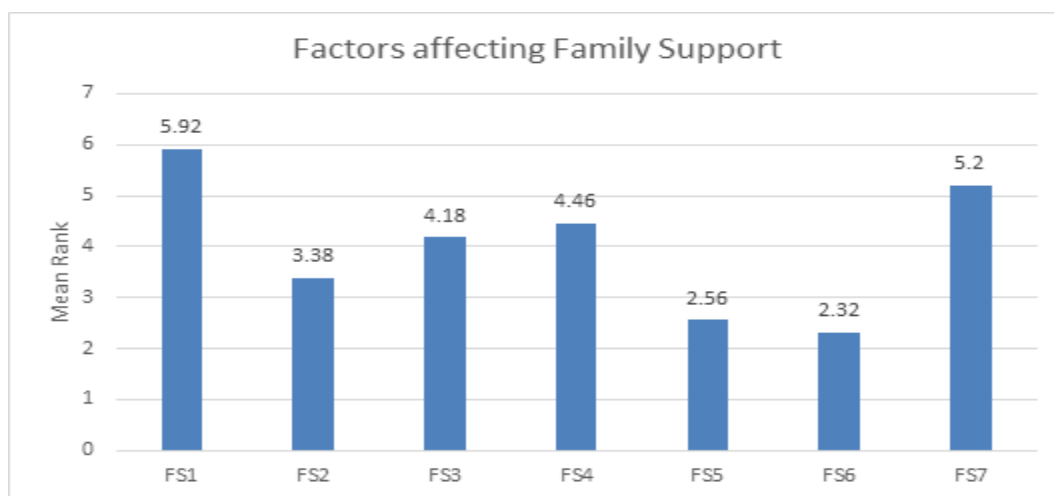
Interpretation: The above results indicate that calculated p-value is 0.000. It is less than 0.05. Therefore, Friedman’s test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is rejected.

Conclusion: There is a significant factor affecting the Family support to the Nurses working in the hospitals.

Finding is that the factor affecting the Family support to the Nurses working in the hospitals is significantly different. It is observed that there is a significant difference in the mean rank of the most important and the least important factor affecting the Family support to the Nurses working in the hospitals. This can be observed in the following table:

Ranks		
Sr.no	Factors affecting Family support	Mean Rank
FS1	My spouse or my family members understand and respect the nature of my job	5.92
FS2	I am expected to cook for all the family member daily	3.38
FS3	My child understands and does manage his academic studies.	4.18
FS4	Able to manage the household chores and the professional roles because of the rotational shifts	4.46
FS5	Ever miss out any quality time with my family or friends because of pressure of work	2.56
FS6	I usually miss the social rituals because of work	2.32
FS7	My family helps me to cope up with household chores during rotational shifts	5.20

The above table indicates that the factor “My spouse or my family members understand and respect the nature of my job” is the most important factor affecting the Family support to the Nurses as it has the highest rank of 5.92, while the factor “I usually miss the social rituals because of work” is the least important factor affecting the Family support to the Nurses as it has the lowest rank of 2.32. This can also be graphically represented in the following Bar chart:



Null Hypothesis H_{03C}: There is no significant factor affecting the Management support to the Nurses working in the hospitals.

Alternate Hypothesis H_{13C}: There is a significant factor affecting the Management support to the Nurses working in the hospitals.

To test the above Null Hypothesis, Friedman’s test is applied and p-value is calculated. Results are shown in the table below:

Test Statistics ^a	
N	100
Chi-Square	17.308
df	4
p-value	.002
a. Friedman Test	

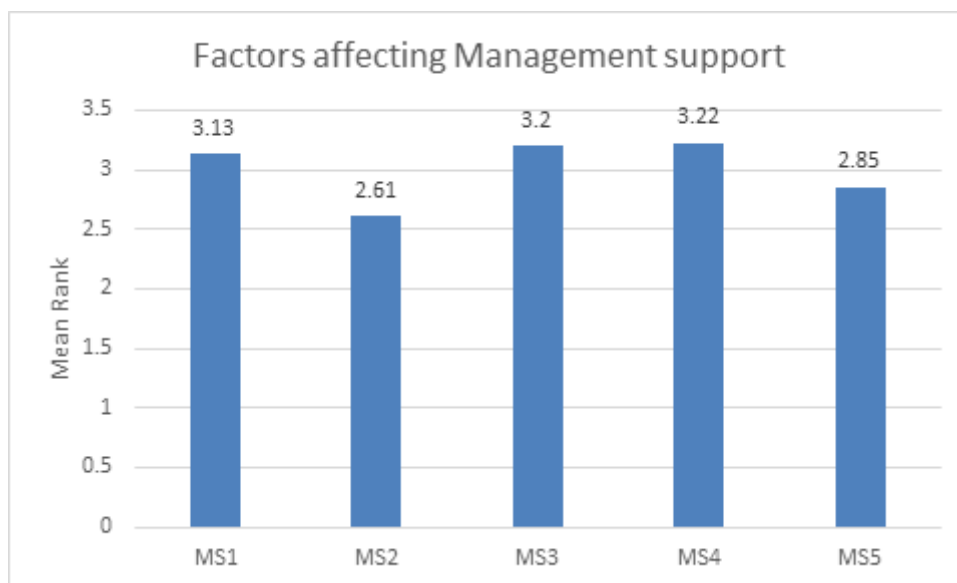
Interpretation: The above results indicate that calculated p-value is 0.002. It is less than 0.05. Therefore, Friedman's test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is rejected.

Conclusion: There is a significant factor affecting the Management support to the Nurses working in the hospitals.

Finding is that the factor affecting the Management support to the Nurses working in the hospitals is significantly different. It is observed that there is a significant difference in the mean rank of the most important and the least important factor affecting the Management support to the Nurses working in the hospitals. This can be observed in the following table:

Sr.no	Ranks	
	Factors affecting Management support	Mean Rank
MS1	There is a proper canteen facilities in my hospital	3.13
MS2	There is flexibility in the shifts	2.61
MS3	There is enough cooperation extended from the head nurse	3.20
MS4	There is enough cooperation extended by the co-worker	3.22
MS5	There is enough consideration while applying for leaves	2.85

The above table indicates that the factor "There is enough cooperation extended by the co-worker" is the most important factor affecting the Management support to the Nurses as it has the highest rank of 3.22, while the factor "There is flexibility in the shifts" is the least important factor affecting the Management support to the Nurses as it has the lowest rank of 2.61. This can also be graphically represented in the following Bar chart:



Limitations of the study: The study is restricted to the stress level of nurses which is basically trying to limit to the stress at work. We acknowledge several limitations. The sampling method used is convenient sampling on online platform which basically depends on the interpretation of the Nurses understanding and their emotional frame work of the mind.

SUGGESTIONS AND CONCLUSION

The suggestions given were at two levels one from the point of you of the expectations of the nurse towards the management recruiting more registered nurses with a better pay pack with allowances and incentives. Enough of work force and the shift timings to be respected and not extended so that work and life aspects can be balanced. Flexibility in shifts to be given to the nurses and for nurses who have kids less than five years to have a dare care centre and the shift to be kept at a flexible way. Energy booster programme and some extracurricular activities to be done to keep the morale always engaging

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Adoption of Environmental Innovation Practices – A Study of MSMEs in India

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ABSTRACT

Organisations' compliance to environmental sustainability can be assessed through the environmental impact of their operations and more. Studies have shown the influence of stakeholders on firms' environmental behavior. The present study aims to assess the prognosticators of the environmental innovation practices of MSMEs based on the Theory of Planned Behavior through the development of a modelling framework. The implications of the study have been discussed.

Keywords: Environmental innovation practices, stakeholders, MSMEs, Firm benefit expectations, environmental behaviour

1. INTRODUCTION

The emerging economies of the east have undergone severe environmental deterioration pertaining to rapid fossil-fuel based market driven economic development. Industrial entities are driven to adopt sustainable practices to balance the pace of economic growth simultaneously solving environmental problems. For any organization, the quintessential requirement for survival is to sustain competition through continuous and enhanced profitability and market share augmentation. Organisations' compliance to environmental sustainability can be assessed through the environmental impact of their operations, choice of inputs, energy usage, policy design, optimizing product lifecycle management, engagement in better environmental management programmes, treatment of industrial waste generated during the process of production and more. Recent researches provide evidence of firms increasing environmental responsiveness through improved environmental performances. Studies have shown active influence of stakeholders like investors, industrial associations and employees on firms' environmental behavior. The study aims to develop a comprehensive framework on how the classified factors may determine firms' environmental practices based on the application of Theory of Planned Behaviour.

2. ANALYSIS FRAMEWORK

Previous studies have explored the internal and external determinant factors of corporate green management, eventually external regulatory drivers, market participants and surrounding community pressure play active role for firms' environmental measures (Agan et al., 2013; Biswas and Roy, 2016). Besides external forces, firms' environmental measures are significantly determined by firms' ownership characteristics, size and financial status. It is worthwhile mentioning that pro-active environmental management or green management is an evolving concept in the context of emerging economies. Internal and external factors both concurrently impacts environmental management adoption. A conceptual framework is needed to enhance understanding and analysis of enterprises' willingness to adoption of Environmental innovation practices (Agan et al., 2013; Cuerva et al., 2014).

In the past few decades significant environmental losses have been incurred by the pursuit of economic growth and development. India has witnessed significant decline in environmental quality, natural resources degradation and overexploitation of ecosystem exploitation, loss of biodiversity, enhanced fossil fuel emissions, with vast rise in air and water pollution. The country's prevailing environmental regulations with lenient enforcement norms have been unable to arrest the rate of environmental deterioration countered by urbanization, economic and population growth and change in consumer preferences and lifestyles. Stringer environmental regulations are therefore highly desirable. The environmental problems in emerging economies such as India present serious legislative, scientific, operational, engineering, managerial and strategic challenges which could be dealt in by improved practices and process at the individual firm level. Therefore, interactive and participatory approaches are preferred over ineffective command-control and coercive approaches.

A conceptual framework to enhance understanding and analysis of enterprises' behavioural intention to adopt environmental innovation practices and their subsequent impact on firms' environmental and economic performance is thereby needed. The Theory of Planned Behaviour (TPB) extends the Theory of Reasoned Action by taking personal determinants into consideration that can contribute towards improving the prediction of firms' intention to develop green innovation practices (Ajzen, 1985; Zhang et al., 2013). This paper applies the Theory of Planned Behaviour to examine the factors that determine an enterprise's willingness to engage in

environmental innovation practices. This paper tries to provide a deeper insight of the prognosticating factors of environmental innovation practices implementation and their impact on a firm's financial and environmental performance in the backdrop of an emerging economy.

Environmental degradation endangers firms' resource needs which can be substantiated by pro-active environmental strategy adoption, application of innovative environmental practices aimed at improving firms' market evaluation, access to new green markets, creation of green image or adoption of cost-reduction strategies may engender positive effects on business performance (Zhang et al., 2013; Salvado, 2014; Biswas and Roy, 2016; Biswas, 2019).

2.1. Environmental Innovation

Environmental Innovation refers to those certain innovations and measures whose effects consist in optimized material and energy usage per unit of output and reduction in production of externalities such as air, water and noise pollution and discharge of harmful effluents and wastes or enhanced product life, end-of-pipe innovations, redesigning of production processes or services, investment in green strategy aimed towards reduction in production of externalities and use of input simultaneously thereby generating competitive edges for a firm with augmentation of its earning capacity (Zhang et al., 2013; Salvado, 2014; Biswas and Roy, 2016; Biswas, 2019). Environmental Innovations are expected to positively affect profitability, however when introduced as a part of stringent regulatory framework is often perceived as a threat by firms.

2.2. Model based on the Theory of Planned Behaviour

According to the Theory of Planned Behaviour, individual's behavior in most situations can be predicted in terms of attitudes, intentions, subjective norms and behavioral control (Zhang et al., 2013). The major determinants of behavioral intention are attitude towards such behavior, perceived social pressure, perceived behavioural control and firms' benefit expectations (Ajzen, 1991; Montalvo, 2003; Zhang et al., 2013).

2.2.1. Attitude towards the behavior (ATB)

The attitude of an individual varies with their outcome prediction or evaluation, thus influencing their behavioural intention. The probable reason to engage in green innovation practices is mitigation of pollution, affluent discharge and environmental impact with maximization of economic benefits simultaneously (Agan et al., 2013; Zhang et al., 2013).

2.2.2. Stakeholders' pressure (SP)

Theory of Planned Behaviour have postulated Stakeholders' pressure as the second determinant of behavioral intention. Stakeholders' pressure can be defined as the perceived social pressure which may affect performance or non-performance of certain behavior pertaining to the pressure of external stakeholders on adoption practices (Zhang et al., 2013). The main sources of such Stakeholders' pressure are regulatory norms, environmental regulations, industrial standards, market position, market forces, customer expectations, perceptions and demands, public concerns and overall stakeholders' influence. However, the subjective importance of such social pressure on enterprise's behavioural intention depends on managerial perception of relative importance of such influence (Montalvo, 2003; Zhang et al., 2013). Governmental regulations have been considered as the main antecedent for companies' environmental management or environmental innovation practices to reduce environmental impact. Customers' perceptions, expectations, beliefs and habits were also found to impact firms' compliance of environmental standards and adoption or development of green practices (Biswas and Roy, 2016).

2.2.3. Firms' Benefit Expectations (FBE)

Apart from consideration of social pressures in the form of customer influence or regulatory forces on firms, a company can itself initiate green practices at their conviction which are often triggered by expected performance benefits such as higher profitability, enhanced market share, improved market position, corporate green image creation, green branding, improved market standing, decisive role in environmental or industrial consortium and more. Perceived benefits in the form of cost efficiency, increased customer satisfaction, increased market share with new market opportunities, improved firm image and higher profitability can motivate firms to implement innovative environmental practices which in course impact firms' performance positively (Li, 2014; Long et al., 2017).

2.3. Environmental innovation practices and firm performance

Innovative environment friendly designs minimize product or material usage with improved processes facilitating production, efficiency and profitability. A positive relationship has been found between green design, green manufacturing, green investments, green marketing and green disposal including design for the

environment and firm performance. Environmental innovation practices adoption leads to a win-win situation characterized by both immediate and long-term environmental and financial benefits.

Some empirical results have revealed that environmental performance and financial performance are positively linked (Li, 2014; Long et. al., 2017; Biswas, 2019). From the view point of cost analysis, it helps in cost reduction through optimum and reduced resource use, waste management measures and cutting environmental liability costs by enhanced environmental compliance. Further benefits such as savings in cost, increased customer satisfaction, unexplored market opportunities and higher profits can motivate firms to implement green processes and practices through a vicious cycle. Environmental innovation practices shall facilitate sharing of intellectual property across firms at cross country level as well.

3. RESEARCH METHODOLOGY

3.1. Data collection

Under the supervision of the authors, the data for the study was collected by students of post-graduate and graduate courses as a part of term project. The students were instructed to collect data from small and mid-size manufacturing companies through the use of structured questionnaires to be filled by employees of such concerns. The survey resulted in 268 appropriate and usable responses. The respondents of the survey consisted of owners, directors, managers, engineers and other personnel.

3.2. Questionnaire design

The questionnaire used in the study comprised of two sections: the first included items designed to assess salient belief - attitude, stakeholders' pressure and firms' benefit expectations and willingness to adopt green innovation practices, and the second consisted of items assessing financial and environmental performance of a firm. The measurement items were adapted from an elicitation study and review of literature (Agan et.al, 2013; Zhang et al., 2013; Li, 2014; Long et. al, 2017). The items of all the constructs were measured using a 5-point Likert scale.

3.3. Model development

Firms' willingness to adopt environmental innovation practices (EIP) can be explained as a function of the management's attitude towards the development of environmental innovation practices (ATT), the perceived Stakeholders' pressure towards adoption of such practices (PSP) and the benefit expectations (FBE).

The hypotheses bring into focus the coherence of the model.

The model represents a two-layer system of hypotheses intending to link the determinants attitude, Stakeholders' pressure and firms' benefit expectations to willingness to adopt environmental innovation practices and then linking firms' environmental and economic performance to the adoption of environmental innovation practices.

AMOS 20.0 was used to analyse the collected data. After assessment of the adequacy of the measurement model, the Structural model with Structural Equation Modeling (SEM) was utilized to find the best-fitted model and to test causal relationships.

4. RESULTS AND ANALYSIS

4.1. Psychometric properties

The analysis demonstrated that all items had acceptable measurement properties. The psychometric properties of all the measurement items are reported in Table 1. All the factor loadings being ≥ 0.50 , and significant p-values at 0.01 level ensures convergent validity (Fornell and Larcker, 1981). Further acceptable reliability is being substantiated by the composite reliability values greater than 0.70 for all the constructs. An assessment of construct reliability was conducted with all the Cronbach's alpha values above 0.50. A Confirmatory Factor analysis (CFA) was applied to assess construct validity. The model fit indices as reported in Table 2 suggests that the measurement model is acceptable (Biswas and Roy, 2015; Biswas, 2017).

4.2. Data screening and measurement model and structural Model

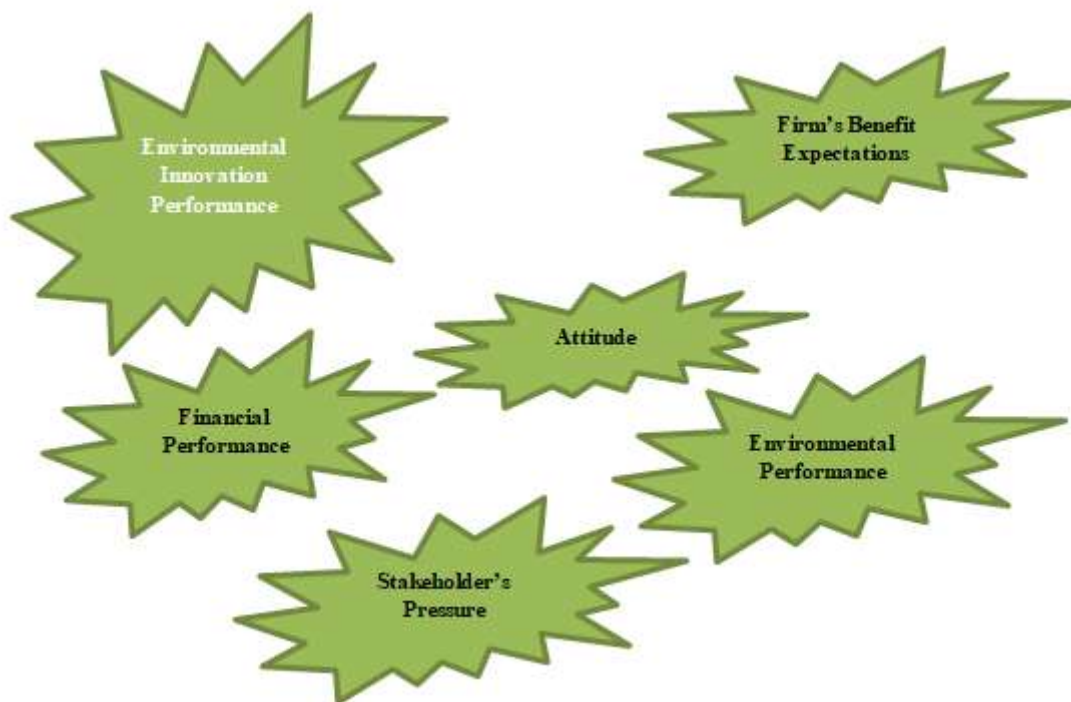
Structural equation modeling has been applied to test all relationships between latent variables and observed variables, and also to assess the relationships among multiple latent variables simultaneously. With the help of Maximum likelihood estimation, the significance of all the hypotheses had been supported. The goodness of fit indices was higher than the threshold values which makes the model acceptance inevitable.

Table 1: The constructs and their psychometric properties

Constructs	Standardised factor loading	Cronbach's Alpha	AVE	CR
Environmental Innovation Practices (EIP)		0.59	0.49	0.89
EIP1	0.80			
EIP2	0.65			
EIP3	0.67			
Firm's Benefit Expectations (FBE)		0.86	0.57	0.97
FBE1	0.67			
FBE2	0.63			
FBE3	0.79			
FBE4	0.81			
FBE5	0.89			
FBE6	0.78			
Financial Performance (FP)		0.67	0.53	0.92
FP1	0.69			
FP2	0.72			
FP3	0.81			
Attitude (ATT)		0.97	0.90	0.98
ATT1	0.97			
ATT2	0.96			
ATT3	0.92			
Environmental Performance (EP)		0.64	0.50	0.91
EP1	0.68			
EP2	0.86			
EP3	0.59			
Social Pressure (SP)		0.77	0.62	0.93
SP1	0.82			
SP2	0.72			
SP4	0.83			

Table 2 Model fit indices for the overall model

Index	Measurement model Value	Structural model Value	Recommended Value*
χ^2 /d.f.	1.44	1.68	<3
RMSEA	0.05	0.06	<0.10
CFI	0.95	0.92	≥ 0.90
IFI	0.95	0.93	≥ 0.90
GFI	0.89	0.84	≥ 0.90



5. DISCUSSION AND CONCLUSION

The study shows the positive and congruent impact of firms' attitude, benefit expectations and stakeholders pressure in adoption of environmental innovation practices which in turn facilitates environmental and economic performance. Our findings have several implications for MSMEs, their business customers, and for general public policy. Government policy should not only guide MSMEs on environmental issues and impose stringer norms but also should foster environmental management programmes designed for MSMEs for better growth and prosperity. Training programs for officials and incubation centres on adoption of improved technology, optimisation of production process, green production, sustainable practices are indispensable (Biswas and Sikdar, 2020). Memorandum of understanding with foreign industrial and small and medium industries consortium shall nurture exchange of ideas, technology and intellectual property developed through innovative practices. Firms' positive attitude, conscious stakeholders pressure and firms' benefit expectations shall facilitate the adoption of environmental innovation practices which shall bring a transcendence in the market share and image perception of MSMEs across the globe and help in building a brand value for such concerns. Environmental innovation practices shall endeavour in sharing of intellectual property such as patents, product design, trademarks, distinct competencies through licensing agreements among firms at country and cross country level and shall lead to a vicious cycle of innovation and effective adoption and improvisation for firms.

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Green HRM: A New Approach to Sustainable Environment

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ABSTRACT

The ever changing business environment and globalization has resulted in a relentless strain on organisations to continuously change their structure and process to sustain. In addition, organisations have recognized the need to implement new creative practices especially in Human Resource Management (HRM). One creative practice is of involving green effects in HRM called as Green Human Resource Management (Green HRM). Green HRM is a framework that helps create awareness about an organization's green culture and its impact on sustainability of the environment. Organisations need to recognize, accept and incorporate environmentally sustainable developments in various HRM practices in areas like recruiting, training, performance appraisal, compensation, etc. Green HRM is the benchmarking method that most organisations are now following. This paper focuses primarily on the numerous Green HR practices adopted widely by companies and describes a simplified meaning of Green HRM. The study also addresses the significance and the various challenges for going green. Finally this paper proposes potentially prominent HR initiatives for Green organizations.

Keywords: HRM practices, Green Human Resource Management, Environmentally Sustainable, Green HRM

INTRODUCTION

With the ever changing business environment and globalization, organisations are facing an increased pressure to continuously change their structure and process in order to endure and sustain. Organisations, now, are concern for the environment and are integrating and implementing new practices and processes for its sustainability. Rapid advances in technology and the drive to maintain a competitive advantage have pushed companies to be more agile and innovative in their approach. In addition, the organizations have recognized the need to implement new creative practices especially in human resource management (HRM). Human resource is vital and the only living resource in any company. One creative practice is, involving green effects in HRM called as Green Human Resource Management (Green HRM).

LITERATURE REVIEW

Green HRM means reducing unnecessary travel by resolving the company's carbon footprint by cutting down on paper usage. Green HRM is about applying the idea of sustainability to the company and its workforce, holistically. In various researches, it has been found that the HR department is gradually greening the processes in many organizations to gain competitive edge over others. (Aravamudhan, 2012).

Green management is characterized as the process by which companies handle the environment by designing techniques for environmental management (Lee, 2009), in which companies need to manage economic growth and protect the natural environment for prosperity for future generations (Daily and Huang, 2001).

A study done by Deepika and Karpangam (2016) on Green HRM found that organization which initiated Green HRM showed improved efficiency, better safety & security of workers, increased efficiency and other physical benefits as well.

Mandip (2012); in a study found that, given its significance to workers, employers and other, stakeholders, there are few studies that consider HRM's role in achieving environmental sustainability in organizations. Green HR has two important characteristics in it: environmentally sound HR activities and information resource protection.

Cherian and Jacob (2012); in their study suggested that Green HRM practices are critical in fostering employee trust and in reimbursing both businesses and employees. Green HRM concept includes enhancement and retention of human resources, enhancement of public image, and recruitment of better workers, improvement of efficiency & sustainability, profitability and overall performance and reduction of the company's carbon footprint

OBJECTIVES OF THE STUDY

The purpose of the study is:

1. To understand the concept of Green HRM
2. To elaborate the significance of Green HRM to an organisation

3. To study the green functionalities of HRM and its impact on the environment.
4. To identify the challenges facing Green HRM practices
5. To suggest ways and means of Green initiatives for HRM

METHODOLOGY

A systematic analysis of the review of literature was performed using an archival approach to achieve the objectives mentioned above. This paper uses various techniques to review papers from different databases, websites, journals, blogs, and other accessible sources with the subject "Green HRM" or "Environmental HRM." Therefore, the study for this paper is a desk analysis rather than a survey, questionnaire or any other means of investigations. Archival approach in this study provides insight into Green HRM activities by bringing available research studies together. Subsequently, a systematic examination of the collected literature was carried out in detail.

Green HRM:-

Green HRM is characterized as an array of policies, procedures, practices and systems that promote employees green actions to create an environmentally friendly, resource-efficient and socially responsible workplace. Green HRM uses human resources management strategies to promote the efficient use of available resources within the organization and these tools are mainly environmentally sustainable. Green HRM is primarily responsible for building green workforce that recognizes, appreciates and implements green initiative and supports its green goals in the HRM recruitment, training, compensation, growth and advancement of human resource. Green HRM provides a forum where high job satisfaction and greater engagement are felt by the workforce, thus, resulting in high productivity. It also allows organisations to use the carbon footprints in the following forms such as electronic filing, carpooling, work sharing, video conferencing and online training, recycling and reducing unwanted materials. Green HRM is environmentally friendly HR initiatives to minimize costs, boost efficiencies, reduce carbon emissions, increase employee awareness and promote a green work life balance.

Green HRM and Sustainability:-

Organisations are sticking to the green practices in their efforts to strengthen up their reputation, intensify employee morale and cut their costs drastically. Considering that organization's activity depends crucially on the active participation of the human resource management, there is an increasing need for the integration of green ideas into HRM practices. Green HRM seeks to develop, improve and maintain green ideas within each employee of the organization so that the optimum contribution can be made to each of these jobs. By integrating its operations, practices, and policies with a focus on environmental sustainable goals, HRM may become a catalyst for sustainability inside the organisation. Green HRM has been developed to improve employees green habits, attitudes and knowledge; it inspires employees to think green, and provides employees with opportunities to develop awareness and skills relevant to environmental sustainability. Green HRM includes incorporating the environmental sustainability priorities of the organization into HR recruiting, selection, training and growth processes, performance management and appraisal, incentives and recognition etc.

Some Green HRM practices are listed hereunder:-

Green Recruitment and Selection:

Green recruitment implies that the organization's recruitment process should be paperless with no, or rather less environmental effects. It is a program where the emphasis should be placed on environmental significance and making it a key component within the organization. Today, organizations concentrate on various employees hiring websites that reduce the expense of Resume printing and courier charges and thereby leading to less paper usage. Companies need to provide job description that represents the sustainability agenda, on their website. Thereby, individuals who are keen on working with an environmentally friendly company would be able to access. Upon approval of the application through the websites, interviews can either be through telephone or via videoconferencing. The recruitment process should involve those who are familiar with sustainable environment. Recruitment and selection should be of those individuals who have prior experiences and awareness of green environment practices.

Green Induction:

Induction programs should be structured in such a way that new employees are integrated more engaged and embeds them into the green initiative of the organization. In this way, in addition to presenting the company's history, culture, values, philosophy, departments and so on, these programs will also highlight the environmental concerns of the company. It is critical that the new employees recognize their environmental

duty. Organization will only achieve environmental sustainability with the support of employees. In this process the Green HRM induction program will be very cooperative and encourage them to engage in green interpersonal citizenship behavior.

Green Training and Development:

Green training and development is a practice that concentrates on development of employee's knowledge, skills, beliefs, attitude and knowledge on environmental issues. It will be very difficult to achieve an organisations targeted environmental efficiency without proper education, training and development. Organisations should take a responsible approach towards environmental issues and improve energy efficiency and waste management know-hows. The training and development plans for employees should address social and environmental problems at all levels of management. Online as well as web-based training programs and interactive workshops should be used widely as teaching tools not only for the training in environment management but also for other operational fields. Training is a crucial method for organization to educate employees on Green practices, policies and procedures. All of which would lead to decreased waste, better resource management and energy conservation.

Green Performance Management and Appraisal:

Performance Management (PM) is the mechanism by which employees are motivated to develop their technical skills in a better way to meet the organizational goals and objectives. Green targets should be included in key performance areas (KPA) of performance management systems. Green performance appraisal can be important as its perceived value increases when a behavior is assessed to judge a person, and attempts to comply with the same increase. When taking into account the employee's appraisal in the company, it is necessary to think about Green Goals, Green initiatives, Green activities and employee accountability as well as green results conclusion. But performance appraisal approach should also include Green goal as one of the employee's main presentation area.

Green Compensation and Reward System:

Compensation and reward are the key Green HRM practices which reward employees for their successful performance. Compensation packages should be designed to recognize employees 'acquisitions of green knowledge and accomplishments. Monetary, non-monetary, and appreciation related bonuses can be used for employee green achievements. Monetary incentives and rewards should include salary increases; cash incentives and bonuses whilst non-monetary rewards may include sabbaticals, extra leaves, holidays and gifts for employees and members of their families. Appreciation-based awards can highlight employees green achievements through broad exposure, public recognition, and acknowledgement of their green initiatives by top management of the company. Nowadays, organizations are designing compensation and rewards programs to encourage environmentally sustainable activities performed by their employees.

SIGNIFICANCE OF GREEN HRM:-

Green HRM has its prime significance in achieving wider objectives such as cost reduction, corporate social responsibility, talent development and management and obtaining a competitive edge. Besides, it can help attract and retain employees thus reducing workforce turnover. Green HRM can increase a company's brand image in the marketplace and can potentially boost sales. It can increase the efficiency of the overall organization both internally and externally; can increase the participation of stakeholders. Green HRM can decrease a company's total costs as it is more effective in electricity, water and raw materials use. This stimulates creativity as employees are focused on improving the carbon footprint of their company and this further promotes the growth of business. Organizations adopting environmentally sustainable human resource practices can immensely benefit. Therefore, it is suggested that organizations should give more priority to greening every HRM feature.

Challenges in Green HRM:-

In addition to this significance, HRM may face several challenges for implementing Green HRM practice in organisations. Changing employee behavior in a short span of time and even persuading employees to adjust their attitudes towards environmental concerns is difficult. HR professionals may face challenges in delivering critical green systems, green procedures, green strategies and green thinking in order to enable the development of future green leaders. It can be challenging to select and recruit green employees with quality talent. Also, not every employee is inspired to engage in the promotion of organization's green HRM activities. It needs high initial investment and a considerably slower rate of return. The successes of green HR practices conducted are hard to calculate. The entire cycle of transformation is a slow and burdensome process.

CONCLUSION AND SUGGESTIONS:-

Based on the above information, it can be inferred that organisations can boost their environmental performance more sustainably by recognizing and increasing the reach and depth of green HRM activities. Green HRM helps both the organisation and the employee. Green HRM activities are important for developing, implementing and sustaining employee's creative behaviors related to the environment combined with the right mindset of greening. We can conclude that green HRM practices are more effective instruments for greening organizations and their operations. Green behavior, green efficiency, green attitudes, and green competencies can be influenced and reshaped by adopting Green HRM practices. Green HRM is responsible for building green consciousness among the new as well as existing employees working for the company, empowering the employees to help the company minimize the causes of environmental destruction through green activism, green initiatives and practices, and preserving the resources for future generations. Green HRM will build motivation, desire and dedication to employees to contribute their ideas and support for recognition and adoption of Green HRM practices. Green HRM activities result in enhanced efficiencies, responsible resource usage, less waste, improved job-related attitude, improved work as well as private life, reduced costs and improved employee retention that allows the company to minimize employee carbon footprints. Therefore, it is proposed that organizations need to prioritize each of the Green HRM functions.

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Nepotism Guarantees Viewer's Attention? A Comparative Study of Contemporary Hindi Cinema

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ABSTRACT

Nepotism is the act of using one's authority and power to offer a favour to a family member or close acquaintances. This issue prevails in our society for ages. It resurjects in some or other form in politics, religion, business or any other industry. The Hindi film industry is thus another victim of the same. On the one hand, it provides ready-made talent to the industry, whereas on the other hand, it eliminates opportunities for so-called "outsiders" or talents who don't have any cinema background. This paper attempts to study the impact of nepotism on cinema audiences for the selected films. Paper provides a comparative study between audience reaction towards films acted by nepotistic lead actors and non-nepotistic lead actors.

Keywords: Nepotism, Hindi Film Industry, Audience, Film Revenue, Box Office

1. INTRODUCTION

Nepotism originated from a Latin word 'nepos' which means a 'male cousin' or a 'grandson'. The cynical meaning of the word comes from the period of Renaissance, where the popes assign the nephews to the highest positions overlooking their qualifications. (Khatri Wen, n.d.) , some Catholic popes and bishops – who had taken vows of chastity usually had no legitimate offspring and gave their nephews such positions of preference as were often accorded by fathers to sons. Several popes elevated nephews and other relatives to the cardinality. Several popes elevated nephews and other relatives to the cardinality. Often, such appointments were a means of continuing a papal "dynasty".

Nepotism is a phenomenon that is particularly prevalent in countries with strong traditional ties and relationships and in which the market mechanism is not well developed, as well as in families in developed countries.(Asunakutlu et al., 2010)

Humans and, according to some scientists, animals have an inherent instinct called "kin selection." Nepotism is sensible to conduct according to biological/ecological perspectives. Nepotism is defined as a deliberate practice in these techniques.

In literature, relative favoritism is called as 'nepotism,' friends and acquaintances favoritism is called as 'cronyism' and political favoritism is called as 'patronage' (Aktan and Çoban, 2008).

The question of nepotism has been debated for years, but Sushant's untimely death was a pivotal event since it not only pushed the issue to the forefront, but it also sparked protests and a boycott campaign against specific actors and producers. Despite the fact that the nepotism issue had not been proven, it was nonetheless tantalizing.



Karan Johar, Saif Ali Khan, and Kangana Ranaut Still from Koffee with Karan show (2017)

Karan Johar, an Indian director and producer, hosts the renowned Indian chat programme Koffee with Karan, which airs on Star World. The show's structure is that the director invites Bollywood superstars to participate in a series of questions about their professional and personal lives, followed by a Rapid Fire competition and the signing of a coffee cup.

The show's 16th episode of season five, in which Indian actress Kangana Ranaut made her debut, aired on February 19, 2017. The interview was going well until a rapid-fire question was asked to the actress, who responded that it was Karan himself who gave her an unnecessary demeanour in the profession. She went on to say that if her biopic is created, he will play the role of "Stereotypical Bollywood behemoth who is very snobbish and absolutely intolerant of outsiders, the flag bearer of nepotism, the movie mafia," if it is ever made.

This statement became the highlight of Season 5, and the media began criticizing it, as well as soliciting the opinions of other actors about the interview. Even Karan Johar was surprised by how much attention the interview received from the media. Influencers and YouTubers cranked out a lot of content, which was published in multiple publications and blogs.

After the sad death of late actor Sushant Singh Raj, the interview was once again in the spotlight. Needless to say, the significance of this literature is self-evident since it was the first time an established actress went on record to acknowledge that she wrestled with it and surmounted it through pure determination. Many more actors and actresses were motivated by this conversation to open up about their experiences and the pervasive culture.

2. REVIEW OF RELATED LITERATURE

Nepotism has been criticized since ancient times by several philosophers, including Aristotle, Valluvar, and Confucius. In the second book of the Kural literature, which forms a manual for governments and corporations, Valluvar suggests nepotism and favouritism thus: "If you choose an unfit person for your job just because you love and you like him, he will lead you to endless follies." According to him, nepotism is both evil and unwise. (Bellow, 2003)

During the 18th century, numerous high-ranking government officials mimicked the Sultan's lifestyle. They lived in enormous mansions and employed hundreds of employees. They would hire young and brilliant Ottomans in order to bolster their influence. Then force them to marry a member of the family in order to become related to them. Making the grand vizier the bridegroom was a comparable application. If a young talented person is able to capture the attention of a high-ranking official, he will be appointed to key roles. This application was so frequent in the 18th century that historians coined the term "becoming bridegroom" to describe the process of finding a guardian and moving up the ladder. (Findley, 1996)

Valluvar's conviction was not just words of wisdom recent studies show that nepotism has resulted in bias decision-making, unfair treatment and companies perform in losses in the long term. It makes people feel demotivated, lacking in confidence, and alienated hinders competition and innovation. (Malik, 2018)

Another such example is Indonesia's crumbling economy, and the biggest reason for that is nepotism. There is no doubt that it seems next to impossible to shake the long-standing institution, be it a religion, an empire, government, or human behaviour but the fact that change is inevitable still stands true to its words, our ever-changing society is living proof of the fact.

Political parties in India have mastered this art and thus injected the venom of corruption to sustain the nepotism flag. (Singh, 2002)

When we dug deeper, we found numerous books and journals written on the history of the practice and its origins and studies done in various fields such as Business Management, Corporate Industry, and Politics. However, it was hard to locate any study focused exclusively on the practice of nepotism in Hindi cinema or entertainment. This research will be significant in the realm of entertainment and the Bollywood industry

3. RESEARCH METHODOLOGY

The research was carried out by the mixed method of qualitative and quantitative analysis of content, and a descriptive study was conducted to find empirical data. Two survey forms were circulated, out of which two forms comprised of 10 movies each, and participants were asked to rate each movie based on eight Films attributes i.e Direction, Cinematography, Sound, Visual Design, Narration, Acting, Theme, and Editing which is considered as audience reception. Each form received 50 responses adding up to the sample size of 100. The Major population was from the Gujrat region for empirical research.

A test of normality was conducted to ascertain normal distribution of data.

A paired t-test was conducted between results of audience reception of nepotistic and non-nepotistic films.

3.1 Objective:

To find out a difference in audience receptions for cinema that has nepotistic lead and non-nepotistic lead actors.

3.2 Hypothesis:

H0. There is no impact of nepotism over audience reception of films.

H1. There is an impact of nepotism over audience reception of films.

3.3 Pilot Study

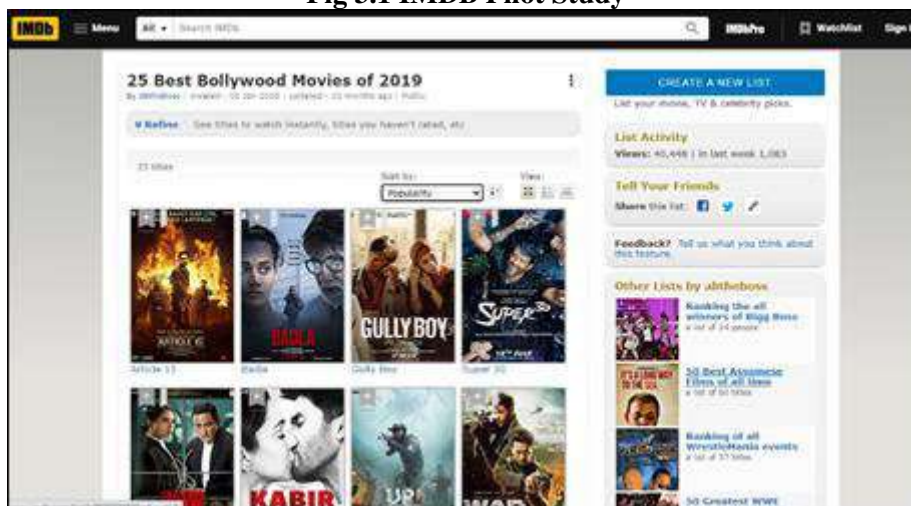
A small scale preliminary test was conducted via IMDB a film rating platform, to choose 20 most-watched Hindi films between 2015-2020 that were further bifurcated into two categories:

10 Most watched Movies starring Nepotistic actors

10 Most watched Movies starring Non-Nepotistic actors.

It helped in repressing the probability of getting Neutral or no responses on the films and encourage the probability of getting more opinionated responses from the subjects.

Fig 3.1 IMDB Pilot Study



Selected Movies according to the Pilot study results:

Sr No.	Nepotistic Movies	Non- Nepotistic Movies
1	Gully Boy	Article 15
2	URI: THE SURGICAL STRIKE	Chhichhore
3	SUPER 30	Raat Akeli Hai
4	KABIR SINGH	Panga
5	Bharat	Angrezi Medium
6	War	Dil Bechara
7	Kalank	Shubh Mangal Zyada Savdhaan
8	Tanhaji	Thappad
9	Gunjan Saxena	Chhallang
10	Student Of The Year 2	Mission Mangal

A Pilot Study carried with the help of IMDB (a film rating website) which helped the researcher to choose the most-watched Hindi films. Based on the study, a structured questionnaire was created using the Likert Scale.

4. DATA ANALYSIS AND INTERPRETATION:

4.1 Film Rating Survey Analysis:

The survey comprised 20 films rated based on eight film attributes i.e Direction, Cinematography, Sound, Visual Design, Narration, Acting, Theme, and Editing.

Following is the representation of the Likert scale that was used in the survey:

Highly Satisfied	Satisfied	Neutral	Dissatisfied	Highly Dissatisfied
2	1	0	-1	-2

Table 4.1 Descriptive Statistics

Through the Descriptive analysis model, we can understand the rate at which the audience admires a Film. According to the analysis Student of the year earned the lowest mean score i.e. -2.70. Whereas Angrezi Medium and Uri: the surgical strike has the highest mean score i.e. 12.66.

4.2 Test of Normality

Table 4.2

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
nepo cinema	.144	10	.200*	.935	10	.495
non nepo cinema	.126	10	.200*	.982	10	.975

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

4.2.1 Interpretation:

Kolmogorov- Smimov's Test of Normality Model result states whether or not the table of derived data is normally distributed. The significant value on the test of normality is more than .005 and the value is .200 for Nepotistic and non-Nepotistic Cinema, which means that they both are insignificant and also that it is normally distributed, referring to a genuine collection of data.

4.3 Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	nepo cinema	259.90	10	242.501	76.686
	non nepo cinema	433.20	10	111.649	35.307

Table 4.3

4.3.1 Interpretation:

The presented table will help us scale both the cinema by further comparing change in audience behaviour towards both the cinemas and find out whether there is a significant difference between the cinema or not. In the table drawn above, the score of Nepotistic cinema is 259.90, whereas the score of Non-nepotistic cinema is 433.20.

4.4 Paired Correlations Test

		N	Correlation	Sig.
Pair 1	nepo cinema & non nepo cinema	10	-.167	.645

Table 4.4

4.4.1 Interpretation:

The correlation value is -167 (weak correlation), which means that there is a negative correlation but its not highly significant ($p (.645 > 0.05)$) between the two types of cinema

4.5 Paired Samples Test

		Paired Differences				t	df	Sig. (2-tailed)	
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower				Upper
Pair 1	nepo cinema & non nepo cinema								

4.5 Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Pair 1 nepo cinema – non nepo cinema	-173.300	283.373	89.610	-376.013	29.413	-1.934	9	.085

Table 4.5

4.5.1 Interpretation:

On average, audience reception towards nepotistic cinema ($M = 259.90$, $SE = 242.501$) than to non-nepotistic ($M = 433.20$, $SE = 111.649$), $t(9) = 0.85$. ($p < 0.05$)

This data where p value is more than (0.05) shows no impact of nepotism on audience reception.

5. CONCLUSION

The primary and secondary study was successful in locating and collecting information that proves nepotism exists and has always existed in the hindi film industry. The opposing theory that nepotism has a substantial impact on the movies was denied by the statistical data of quantitative analysis, i.e. based on the survey. Instead, it accepted the null hypothesis that, while there is a difference between nepotistic and non-nepotistic Hindi cinema, the difference is insignificant.

The same data also shows that nepotism has no effect on a film's viewing; on the contrary, audiences were more interested in non-nepotistic films or content that was relatively new, as one must say. This means that the audience prefers to see films with more enticing plots, scripts, and characters played by actors. The actors themselves have very little to do with it.

According to secondary data, a mechanism is needed in which production firms can communicate about new projects and performers can be told about prospective chances so that they can apply for genuine opportunities rather than falling into a trap. It may or may not be effective at first, but it may prove to be worthwhile over time. More open discussions regarding the problem are needed in order to comprehend diverse points of view and come up with solutions that will help newbies in their struggles.

6. FUTURE SCOPE OF STUDIES

There are several jobs in the film industry, including directors, producers, screenwriters, sound directors, cameramen, event planners, distributors, and advertisements. The visible piece of film is actors and actresses, but a lot of background work goes into making a film, and it has been proven via this research that nepotism exists in each and every aspect.

During the investigation, it was discovered that in the current context, the OTT platform had supplied newbies and outsiders with a superior platform to the production house itself.

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Quality of Work Life: An Empirical Study on Female Professors in Pune

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ABSTRACT

Workplace quality is a crucial notion that plays a significant role in the lives of employees. The term "quality of work life" refers to a healthy balance of work and personal life that ensures organizational productivity and employee satisfaction. This research study attempted to find out the factors that have an impact and significance influence on quality of work life of college female professor. Quality of work life is a process in which employees at all levels of an organization may actively and effectively shape the organization's environment, procedures, and outcomes. Data have been gathered from 51 from Female college professors in Mumbai using a convenience sampling method. The Study focused on the Work Condition, Stress Management, Role Conflict, Liberty to work, Work-Life Balance and Quality of Work Life. The result of the Pearson correlation analysis shows that Quality is Work life and Stress Management, Working Condition and Liberty to Work have a positive relationship. A significant positive relationship exists between Quality of work life and Work Life Balance.

Keywords: Quality of work life, Work Life Balance, Work Condition, Liberty to work.

INTRODUCTION

Companies must improve on all critical aspects that contribute to their performance in order to survive in this competitive environment. Service quality, human resource quality, raw material quality, delivery efficiency, and marketing efficiency are all important factors to consider. Human resources are one of the most essential factors among all of them. Human resources are viewed as the lifeblood of any organization, thus it is critical to ensure that employees are happy with their positions, are driven, and fulfilled. Globalization has caused the economy to shift towards services and information technologies in the twenty-first century, making personnel the most valuable asset of a firm. Walton (2007) emphasized the importance of quality of work life (QWL) in preserving human and environmental values that have been neglected as a result of technology advancements in economic growth and productivity. Human resources, as a crucial component for efficient resource utilization and strategic decision-making, allows firms to gain a competitive advantage (Thakur and Sharma, 2019). As a result, it is critical to ensure that the workers' quality of life at work is commendable. A good work environment, such as remuneration, welfare programs, flexible work hours, excellent interactions, and possibilities for advancement, has been defined as quality of work life (Ahmad, 2013). In general, the physical, mental, social, and economic aspects of employment are included in the quality of work life. It is assumed that a high quality of work life will result in beneficial consequences for both the individual and the company. As a result, employee happiness and job performance are believed to be linked to the quality of work life (Gayathiri et al., 2013). The concept of work-life balance has become increasingly important in research since it is one of the work-related concerns affecting employee productivity in a corporation as well as in performing family-related roles. Work-life balance is a psychological concept that encompasses both positive and negative aspects of harmonizing work and personal lives (Murthy and Shastri, 2014). WLB, according to Byrne (2005), is the juggling of five components of one's life at any given time: work, family, friends, health, and self. WLB is characterized by Clutterback (2003) as awareness of multiple demands in terms of energy and time, the ability to allocate time and energy across different domains of work and life, and the ability to apply and make choices.

REVIEW OF LITERATURE

QWL is a broad notion that encompasses a variety of goals, institutional structures, and methods. Workers' opinions of safety and healthy working circumstances, enough and fair remuneration, and the ability to develop as human beings are represented by QWL (Chib, 2012; Narehan et al., 2014; Swamy, 2013). Unlike previous studies, Rose et al. (2006) investigated the connection between QWL and career-related characteristics. Their research adds to the establishment of a positive association between aspiration and professional achievement, QWL is linked to career growth, and career development evolves from individual interactions inside the company. QWL is a multidimensional notion that encompasses an employee's physical, social, psychological, and environmental elements. The subject has been explored comprehensively as a general idea in a variety of industries, workplaces, and countries. Only a few research (Schwartz, 1989; Doherty, 2004; Doble and Supriya, 2010; Tabassum et al., 2011; Karkoulou et al., 2016) have focused on QWL for female employees. Working conditions encompass a wide range of factors at work, including basic resources, physical conditions, and the

safety and security that are required to function efficiently. Working conditions have a significant impact on the quality of life of employees. Organizations must ensure that their employees work in a safe, appropriate, and clean environment (Mirvis and Lawler, 1984). Architecture, equipment, noise, lighting, decorating, and the usage of plants are all likely to have an impact on a person's achievement, affective satisfaction, and psychological strain. Furthermore, supervisory support appears to be a key component of job satisfaction. Working conditions have been identified as a common feature of QWL in previous research (Walton 1974; Mirvis and Lawler 1984; Sirgy et al., 2001; Mosadeghrad et al., 2011). Employees expect to grow and develop in their employment during the course of their careers. The professional development policies utilized inside the organization that provide and communicate a clear career path for employees are referred to as QWL. Training programs are seen as a means of achieving success. In any firm, training and development programs aim to improve employees' "learning experiences" in order to aid both employee and organizational development. QWL has been linked to opportunities for advancement and advancement in the workplace. (Rose and colleagues, 2006) Today, one of the most important workplace health concerns is stress. Employees who are subjected to severe job pressures may get stressed, which can lead to a variety of psychosomatic ailments. It is measured using questions on work demand, stress perception, and actual work overload. Workers must accept specific objectives, which are frequently imposed as task demands originating from their work description. When this is a job necessity and it exceeds a certain limit, it might be stressful (Warr, 1994). Ducharme and Martin (2000) found that high job pressure is inversely and significantly connected to job satisfaction in their study. Employees' psychological well-being is just as vital as their bodily well-being. According to recent studies, the pressures of the office combined with the constant demands of personal life create an imbalance, which leads to stress. It is critical to manage and cope with stress in order to ensure the well-being of both employees and the organization, as well as to protect commercial performance (Sahni, 2016) Job stress is a highly regular occurrence among employees of all levels, and it is the result of job requirements and the resources available to meet those expectations. Job stress is defined as the negative physical and expressive responses that occur when the job demands do not meet the worker's capabilities, resources, or needs (Michie, 2002). It has a tremendous effect on the employees' psychological and physical well-being, as well as their productivity. Excessive job stress has been linked to a variety of health issues, including high blood pressure, depression, and anxiety, according to previous research. (Balkan, 2014)

Work-life balance, on the other hand, is a situation in which a person tries to maintain a balance between two environments at the same time: work and personal (Chandra, 2012). Workplace environments are often stressful, causing employees to work long hours and care for their families, especially if they are married and have children. Work-life balance is now about balancing time between these two settings. Work-life balance, on the other hand, is rarely viewed as a positive element and is frequently viewed as a bad aspect. The employee's favorable feelings about their job and career are used to determine job satisfaction. Job satisfaction is measured by whether or not an employee finds their work enjoyable. Job satisfaction has been examined extensively across industries, and past research has indicated that it contributes to the quality of work life (Rethinam and Ismail, 2007).

SIGNIFICANCE

How do professors feel about their work-life balance in their educational institutions' organizational contexts is a major source of concern for practically everyone. To get an answer to this question, the researcher used a self-made inventory (due to the lack of a standard inventory for this purpose) to investigate the nature of teachers' perceptions of their work-life balance. Since little effort has been made in the Indian setting to examine work-life balance among teachers, with this backdrop in mind, the current paper attempts to assess the level of work-life balance among university and college professors. The primary goal of this study was to discover characteristics that influence work-life balance among university professors in both government and private institutions. The current study will examine the effects and variances in work-life balance that may occur among university and college instructors in Mumbai, among the identified contributing components of work-life balance

OBJECTIVES:

The current research aims to answer the following research questions in particular.

1. To highlight the demographic profile of the college teachers from Pune City
2. To explore work environment and institutional culture of professors

3. To explore relationship between Quality of Work Life and Working Condition , Stress Management, Liberty to Work, Role Conflict
4. To find out work life balance of college female teachers and conclude with the findings

HYPOTHESIS

1. H_0 : There is no relationship between Quality of Work Life and Working Condition, Stress Management, Liberty to Work, Role Conflict.
2. H_0 : There is no correlation between work life balance and quality of work life.
3. H_0 : There is no association between marital status and work life balance of college teachers
4. H_0 : There is no association between Qualification and Quality of work life of college teachers
5. H_0 : There is no association between Discipline and Quality of work life of college teachers

METHODOLOGY

A descriptive survey design was used in this investigation. This research was conducted in Mumbai. The data was gathered from primary sources by the researcher. The study's sample size was determined using the convenience Sampling Technique population (51). The questionnaire is the most important tool employed in this study. In this research, face and content validity were used. The instrument was originally validated by two of my colleagues. Their revisions and ideas were integrated into the questionnaire's final draft. The questionnaires utilized for data gathering were also put to the test. Thereafter, the responses were collated and recorded. The Cronbach Alpha was used to determine the instrument's reliability. Work Condition (0.877), Stress Management (0.862), Role Conflict (0.701), Liberty to work (0.888), Work-Life Balance (0.715), and Quality of Work Life (0.694) each had a Cronbach Alpha score of 0.877. To investigate the influence of Quality of Work Life on female teachers, descriptive statistics, correlation analysis, Kruskal-Wallis rank sum test, and Mann-Whitney two-sample rank-sum test were used.

Table 1: Descriptive Statistics

	Levels	Counts	% of Total
Position (Designation)	Assistant Professor	26	51.0 %
	Lecturer	21	41.2 %
	Professor	4	7.8 %
Teach	School	13	25.5 %
	Junior college	13	25.5 %
	Degree College	25	49.0 %
Nature of Job	On C.HB	5	9.8 %
	Part time	5	9.8 %
	Full time	41	80.4 %
Post	Approved	24	47.1 %
	Non-approved	27	52.9 %
Qualification	B.ED	9	17.6 %
	Post Graduate	22	43.1 %
	PG with SLET, NET	14	27.5 %
	Ph.D	6	11.8 %
Discipline	Commerce and Management	29	56.9 %
	Humanities and Social Sciences	10	19.6 %
	Science and Computers	12	23.5 %
Marital Status	Married	43	84.3 %
	Unmarried	8	15.7 %

Workload	10-15	13	25.5 %
	15-20	13	25.5 %
	20-25	18	35.3 %
	More than 25	7	13.7 %

Source: Author's Compilation from SPSS Version 26.0

Table 2: Descriptive Statistics

	Mean	Std. Deviation
Stress Management	25.43	6.29
Role Conflict	11.22	3.11
Working Condition	17.92	4.89
LibertytoWork	17.98	4.76
Quality of Work life	30.08	7.24
Work Life Balance	72.55	14.38

Source: Author's Compilation from SPSS Version 26.0

▪ **HYPOTHESIS TESTING:**

- H₀: There is no relationship between Quality of Work Life and Working Condition, Stress Management, Liberty to Work, Role Conflict**

A Pearson correlation analysis was conducted between Quality of Work Life and Working Condition, Stress Management, Liberty to Work, Role Conflict. Cohen's standard was used to evaluate the strength of the relationship, where coefficients between .10 and .29 represent a small effect size, coefficients between .30 and .49 represent a moderate effect size, and coefficients above .50 indicate a large effect size (Cohen, 1988).

Table 3: Result

Combination	N	r _p	p-Value	Significance	Relationship
Quality of Work Life -Stress Management	51	0.638	< .001	Significant at < 0.01 level	Positive
Quality of Work Life - Working Condition	51	0.758	< .001	Significant at < 0.01 level	Positive
Quality of Work Life - Liberty to Work	51	0.822	< .001	Significant at < 0.01 level	Positive
Quality of Work Life - Role Conflict	51	0.067	0.642	Not Significant at < 0.05 level	No

- H₀: There is no correlation between work life balance and quality of work life.**

Result: The result of the correlation was examined based on an alpha value of 0.05. There were significant correlations between Quality of Work Life and Work life balance

Table 4: Result

Combination	N	r _p	p-Value	Significance	Relationship
Quality of Work Life - Work life balance	51	0.823	< .001	Significant at < 0.01 level	Positive

- H₀: There is no association between marital status and work life balance of college teachers**

A two-tailed Mann-Whitney two-sample rank-sum test was conducted to examine whether there were significant differences in work life balance between the levels of marital status. The two-tailed Mann-Whitney two-sample rank-sum test is an alternative to the independent samples *t*-test, but does not share the same assumptions (Conover & Iman, 1981). There were 43 observations in group Married and 8 observations in group Unmarried

Table 5: Result The result of the two-tailed Mann-Whitney U test was not significant based on an alpha value of 0.05.

	Group	N	Mean	Median	U	z	p
Work life balance	Married	43	71.7	77	160	-.311	0.766
	Unmarried	8	77	76			

4. H₀: There is no association between Qualification and Quality of work life of college teachers

A Kruskal-Wallis rank sum test was conducted to assess if there were significant differences in Quality of work life between the levels of Qualification. The Kruskal-Wallis test is a non-parametric alternative to the one-way ANOVA and does not share the ANOVA's distributional assumptions (Conover & Iman, 1981).

Table 6: Result The results of the Kruskal-Wallis test were significant based on an alpha value of 0.05

Qualification	N	Mean Rank	χ^2	df	P
B.ED	9	26.06	8.957	3	0.030
Post Graduate	22	32.39			
PG with SLET, NET	14	17.64			
Ph.D	6	22.00			
Total	51				

Table 7:

Dwass-Steel-Critchlow-Fligner Pairwise comparisons – Quality of Work Life			
		W	p
B.ED	Post Graduate	2.01	0.486
B.ED	PG with SLET, NET	-2.507	0.287
B.ED	Ph.D	-0.839	0.934
Post Graduate	PG with SLET, NET	-3.954	0.027
Post Graduate	Ph.D	-1.748	0.604
PG with SLET, NET	Ph.D	0.351	0.995

Pairwise comparisons were examined between each level of Qualification. The results of the multiple comparisons indicated significant differences based on an alpha value of 0.05 between Post Graduate & PG with SLET, NET.

5. H₀: There is no association between Discipline and Quality of work life of college teachers

Table 8:

Result: **The results of the Kruskal-Wallis test were significant based on an alpha value of 0.05**

	Discipline or Stream	N	Mean Rank	χ^2	df	P
Quality of Work life	Commerce and Management	29	22.03	6.44	2	0.04
	Humanities and Social Sciences	10	26.8			
	Science and Computers	12	34.92			
	Total	51				

Table 9:

Dwass-Steel-Critchlow-Fligner Pairwise comparisons – Quality of Work Life			
		W	p
Commerce and Management	Humanities and Social Sciences	1.44	0.567
Commerce and Management	Science and Computers	3.39	0.044
Humanities and Social Sciences	Science and Computers	2.2	0.266

Pairwise comparisons were examined between each level of Discipline or Stream. The results of the multiple comparisons indicated significant differences based on an alpha value of 0.05 between Commerce and Management with Science and Computers.

DISCUSSION OF FINDINGS

- This work examined the effect of Quality of work life on female teachers in Mumbai. A total of 51 samples were studied. The hypotheses formulated were tested using correlation analysis, Kruskal-Wallis rank sum test, and Mann-Whitney two-sample rank-sum test. At the end of the analysis, the following were discovered.
- The result of the Pearson correlation analysis shows that Quality is Work life and Stress Management, Working Condition and Liberty to Work have a positive relationship. A significant positive relationship exist between Quality of work life and Work Life Balance.
- A two-tailed Mann-Whitney two-sample rank-sum test was conducted to examine whether there were significant differences in work life balance between the levels of marital status and the result of the two-tailed Mann-Whitney *U* test was not significant based on an alpha value of 0.05
- A Kruskal-Wallis rank sum test was conducted to assess if there were significant differences in Quality of work life between the levels of Qualification.: The results of the Kruskal-Wallis test were significant based on an alpha value of 0.05
- A Kruskal-Wallis rank sum test was conducted to assess if there were significant differences between Discipline and Quality of work life of college teachers. : The results of the Kruskal-Wallis test were significant based on an alpha value of 0.05.

CONCLUSION

Getting ensnared in the work/life balance trap will continue to be a difficulty for working women. Those who have established a balance in their work and personal lives advise careful planning and personal effort. Work-life balance and work quality Life is a person's ability to exert control over their working environment. It is achieved when a person is happy in both their personal and professional lives. When a person's personal life is balanced with his or her own job, it benefits the individual, business, and society. The work-life strategy tries to strike a balance between work and recreation in our increasingly frantic society. "Work to live," is a phrase that encapsulates the concept of Quality of Work Life and Work-life balance. "Don't work to live."

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Reverse Logistics Return Policies: Key for Sustainability for E-Tailers W.R.T. Apparel Industry

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ABSTRACT

An online retailer could have the most delightfully outlined website, dynamic web-based systems administration endeavours and consistent checkout encounter, yet without customer agreeable returns, all those endeavours are undermined. Returns are a bit of the shopping background, and any failure related with this procedure will leave a persisting, negative impact on the consumer. In this growing market, there is a challenge in front of every e-retailer regarding understanding consumer behaviour and act accordingly. The deprivation of touch makes it all more difficult to ascertain the quality of a product especially in apparel. This leads to cases where the customer wants to return the product within the stipulated timeframe and manufacturers needs to accommodate the returned products in the reverse logistics flow. If reverse logistics process handled well may lead to gain long term corporate sustainability in this digital market creating long term stakeholder value.

Keywords: E-tailer, Reverse Logistics, return policies, corporate sustainability

1. INTRODUCTION

Firms give more priority to their forward supply chains as compare to their reverse logistics. Companies should also focus on the required output of the reverse logistics to ensure corporate sustainability in the organization by concentrating on three pillars of that is, people, planet and profits. Return management is a broader concept under Supply chain management's Reverse Logistic. Return management incorporates all exercises identified with Return stream, reverse logistics, compelling gate keeping and returns shirking. Retail Reverse Logistic has generally been set low inside the Supply Chain Process, yet over the rise of E-commerce industry it is as of now increasing a great deal more consideration as it has coordinated effect on consumer loyalty, consumer maintenance, net revenues, organizations' ecological picture and corporate social obligation.

Return policies are the rules a retailer creates to manage how customers return and exchange unwanted merchandise they purchased. A return policy tells customers what items can be returned and for what reasons, and the timeframe over which returns are accepted.

2. STATEMENT OF THE PROBLEM:

The research study aims to probe into the consumer purchasing behavioural pattern on apparels and management of return cycle process at e-commerce industry end. The research helps the participants to understand the following:

- Does lenient and easy to understand return policies attract consumers' attention?
- Does it effect on consumers' Apparel purchasing pattern?
- What is result of the interaction of Return policies and purchasing behaviour for the E-tailing Business?
- What is the objective behind return acceptance and return management at e-tailers end?

3. OBJECTIVE OF THE STUDY:

The aim research is to study the concept of Return polices and management strategies of reverse logistics process to achieve certain ensured objectives. In this broader framework, an attempt is made to achieve the following specific objectives:

1. To analyse the impact of Return Policy on Apparel purchasing behaviour of consumers
2. To identify the Factors Considered While Online Purchase of Apparel
3. To understand the actions and difficulties in returning the apparel purchased online.
4. To study the Motives for returns acceptance and management of returns

5. LIMITATIONS OF THE STUDY:

- ❖ The study has been focused on only one segment of the E-commerce market viz. Apparel Purchase. The other segments like Jewellery, foot wares, electronics, health & beauty etc. have not been considered.

- ❖ The study has been done in select cities like Mumbai, Pune, other tier 1, 2 and 3 cities have not been considered. The analysis is based on the perception and opinions of a limited number of respondents.

6. REVIEW OF LITERATURE:

Hjort et al. (2016) concluded that retailers must segment their customers on the basis of their returning behaviour this necessitates a better understanding of why and when consumers decide to return. By offering differentiated return services, retailers could both attract new customers and better support the existing customer groups that have diverging purchasing and returning patterns.

Foscht et al. (2013) analysed the returning behaviour of mail order buyers and classified the returners based on their returning frequency into four groups: heavy returners, medium returners, light returners and occasional returners. These groups did not differ only in the extent to which return policies were used, but also in terms of their initial motivation for shopping and their spending patterns.

Sandy and Minjeong (2010) in their study to understand external cues on website of apparels that encourage impulse buying found that free shipping or a shipping discount, promotional offers and purchase ideas were desired the most as reasons for impulse buying online. This study suggested online marketers to provide more of offers, new style/fashions, and gift ideas and provide more return options and expand locations.

7. RESEARCH METHODOLOGY

7.1 Methods of collection of data:

Primary Data: The study population covers all the consumers doing online shopping through different e-commerce business, which covers large population and hence sampling method is used to collect the information.

Secondary data: obtained from records, books, research reports, dissertations, research papers, websites, online journals and articles.

7.2 Sampling technique /Size

Sample size: The sample size collected by the researcher is 100 respondents' consumers and 16 logistic personnel's working for Amazon, Flipkart and Firstry.

8. ANALYSIS & INTERPRETATION

8.1 Analysis of Customer's Data

8.1.1 Factors Considered While Online Purchase of Apparel

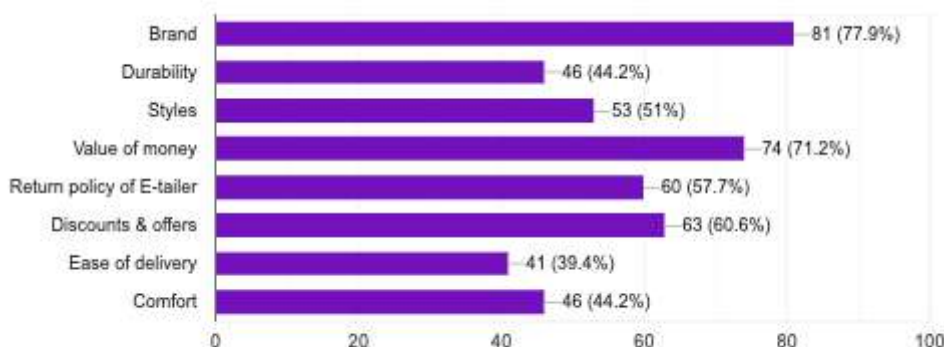


FIGURE: 8.1.1 Factors Considered While Online Purchase of Apparel

Table 8.1.1: Factors Considered While Online Purchase of Apparel

Factors	No of Respondents	Percentage
Brand	81	77.9
Durability	46	44.2
Styles	53	51
Value of money	74	71.2
Return policy of E-tailer	60	57.7
Discount & offers	63	60.6
Ease of delivery	41	39.4
Comfort	46	44.2

Above table indicate that maximum 81 respondents considered brand the biggest factor behind the purchase, 74 respondents think about value of money, 63 respondents look for discount & offers, 60 respondents look for the return policy offered by the E-tailer, 53 respondents considered styles while online purchase, 46 respondents looks for comfort and 41 respondents looks for ease of delivery.

8.1.2 REASON FOR RETURNING OF APPREL

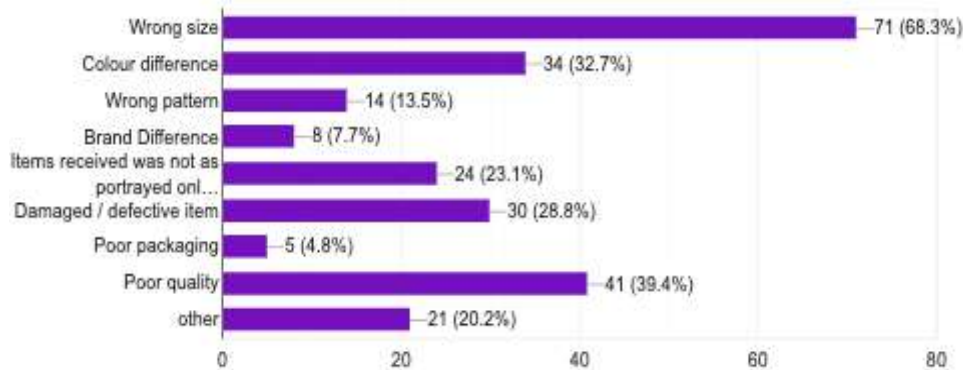


FIGURE: 8.1.2 Reason for Returning of Apparel

Table: 8.1.2 Reason for Returning of Apparel

Option	Number of Respondents	Percentage of Respondents
Wrong size	71	68.3
Colour difference	34	32.7
Wrong pattern	14	13.5
Brand difference	8	7.7
Items received was not as portrayed online	24	23.1
Damaged /defective item	30	28.8
Poor packaging	5	4.8
Poor quality	41	30.4
Other	21	20.2

Above table indicate that 71 respondents returned item for the reason of wrong size. It happened in most of the cases the products purchased were wrong size. Next main reason with 41 respondents was poor quality of the product, Colour difference 34 respondents believe product on the screen does not look exactly same that of color of actual item. There are 30 respondents who returned the goods because they were damaged / defective. And 24 respondents for this reason, as the product received was not the same as it was portrayed online. Further, 14 respondents returned due to wrong pattern, 8 respondents returned purchased apparels due brand differences, 8 respondents have returned apparels due to poor packaging.

8.1.3 ACTIONS AND DIFFICULTIES IN RETURNING THE APPAREL PURCHASED ONLINE

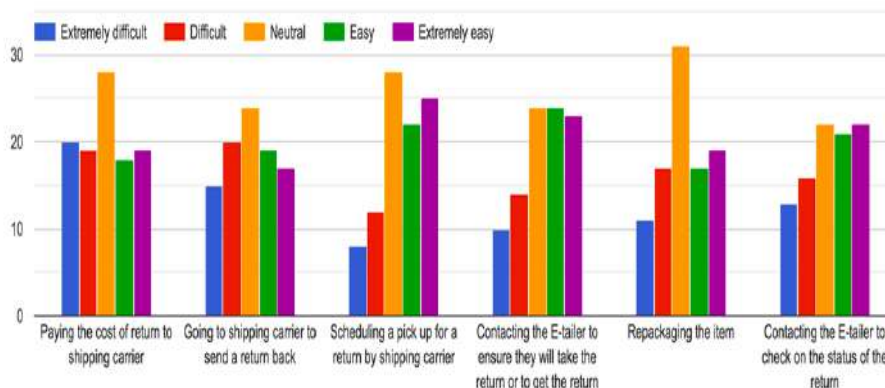


Figure 8.1.3: Actions and Difficulties in Returning The Apparels Purchased Online

Actions& difficulty	Extremely difficult	difficult	Neutral	Easy	Extremely easy
Paying the cost of return to shipping carrier	20	19	28	18	19
Going to shipping carrier to send a return item	15	20	24	19	17
Scheduling a pick up for return	8	12	28	22	25
Contacting the E- tailer to ensure they will take their return	10	14	24	24	23
Repackaging the item	11	17	31	17	19
Contacting E- tailer to check the status of the return item	13	16	22	21	22

Above table indicate that opinion for each action of return. For first action ‘Paying the cost of return to shipping carrier’ opinion of respondents is recorded. 20 respondents feel that it is extremely difficult, 19 feel difficult, maximum 28 feel neutral, 18 respondents feel it is easy and only 19 respondents feel it is extremely easy. For the second action ‘going to shipping carrier to send a return back’, 15 respondents find it extremely difficult, 20 find it difficult, 24 are neutral, 19 find it easy and 17 find it extremely easy. Another 8 respondents find it extremely difficult to manage scheduling pick up for returning their product 12 feel difficult, 28 are neutral, 22 find it easy while 25 feels it is extremely easy, 24 respondents find it difficult to contact e-tailer for further follow ups. 31 respondents find Re-packaging neutral neither difficult nor easy while 22 respondents find contacting E-tailer to check the status of the return item extremely easy and 21 say easy and 22 says its neutral.

8.2 ANALYSIS OF EMPLOEES DATA

8.2.1 MOTIVES FOR RETURNS ACCEPTANCE

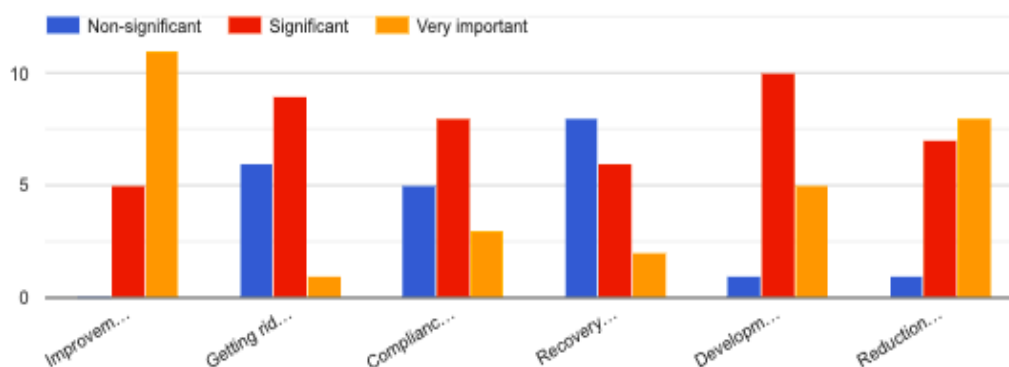


FIGURE 8.2.1: Motives for returns acceptance

TABLE 8.2.1: Motives for returns acceptance

Motives	Non-significant	significant	Very important
Improvement in customer service quality	0	5	11
Getting rid of unnecessary products from the market	6	9	1
Compliance with legal and environmental provision	5	8	3
Recovery of materials and components	8	6	2
Development of an environment-friendly company reputation	1	10	5
Reduction in the loss of value on returned or defective products	1	7	8

The most important motives for acceptance of product returns by the companies are the improvement in customers service quality 11% respondents says it’s very important while 5% says its significant and 0% says its non-significant ,while 2nd most important motive was 8% respondent feel that its reduction in the loss of value on returned or defective products . while development of an environment-friendly company reputation was very important motive for 5% and 10% feel it’s significant and 1% says its non-significant. While 3% respondents feel Compliance with legal and environmental provision was very important while it was significant for 8% and non-significant for 5%

8.2.2 BARRIERS IN EFFECTIVE MANAGEMENT OF RETURNS

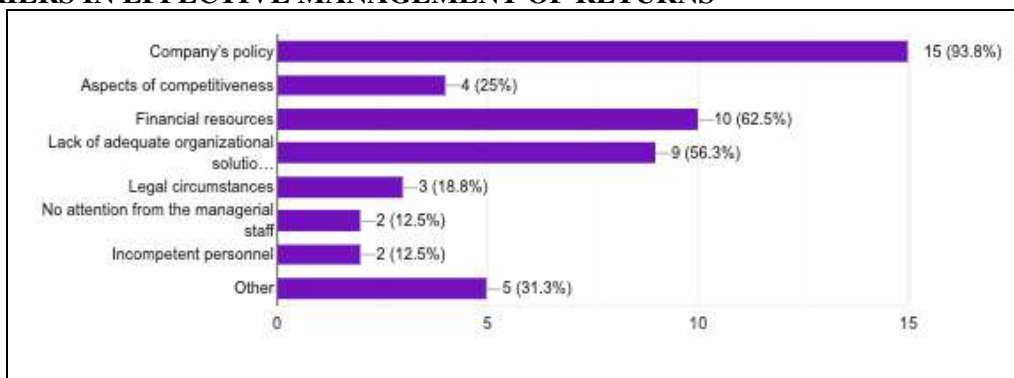


FIGURE 8.2.2: Barriers in effective management of returns

TABLE 8.2.2: Barriers in effective management of returns

Company's policy	15	93.8
Aspects of competitiveness	4	25
Financial resources	10	62.5
Lack of adequate organizational solutions	9	56.3
Legal circumstances	3	18.8
No attention from the managerial staff	2	12.5
Incompetent personnel	2	12.5
Others	5	31.3

Out of total respondents 93.8% respondents most frequently pointed the company's policy as the major barrier. the next listed was financial resource with 62.5, 56.3% respondents said lack of adequate organizational solutions was the barrier, others, 25% respondents finds aspects of competitiveness as a major barrier which is equally followed by no attention from the managerial staff 12.5% and incompetent personnel 12.5%.

9. FINDINGS, RECOMMENDATIONS & SUGGESTIONS

9.1 FINDINGS:

9.1.1 Association between return policies and consumer purchasing behavior

There is a significant association between Return policies and consumer purchasing behavior on the basis of online purchasing pattern. Major problems associated with online apparel purchasing were scheduling pick up for a return by shipping carrier, contacting the online retailers to ensure to take the product back, contacting the retailers to check on the status of the return, paying the Return shipment cost etc. There is significant impact of easy and lenient return policies on consumer behavior.

9.1.2 Return Management and barriers in effective management of returns at retailer's end:

Improvement in customer service quality, Development of an environment-friendly company reputation and Reduction in the loss of value on returned or defective products is the motives behind return management. Thus, collected products are mostly either remanufactured or repacked and sold. But company's policies and lack of financial resources are the major hindrances in the effective management of returns as per employees' feedback.

9.2 SUGGESTIONS:

9.2.1 Specific and detailed description of Apparel:

As maximum returns take place due wrong size, quality of apparel, improper description of apparel etc., it is recommended that e-tailer should focus more on giving detailed description of an apparel with standard and universal size as per location, quality of material used, type of fitting, availability of colors and patterns etc.

9.2.2 Specific time period:

In the select e-commerce businesses, this is been observed that the maximum time given for returning the product is 30 days. By making it little flexible and having customized return policies will grab attention of consumers' and will allow consumer to buy more with that e-tailer.

9.2.3 Returns for wrong delivery:

If the product which is been delivered to consumer is wrong size product, color differences or physical appearance is as per specification, e-tailer should help consumer in getting it replaced immediately without making any hassles. This would win-win situations for both of them.

9.2.4 Return for consumer satisfaction:

At times, in order to earn consumer's attention and appreciation, returns can be accepted even after specific period. This would motivate the consumer to make instant decision making about the product purchase.

9.2.5 Clarity in Return policy options:

This is being observed that, in select E-commerce websites clear return policies are not stated. Terms like exchange for few items, Replacement for few items, refund for certain items does not give clear idea about return policies and consumer do not get clarity about return processes. E-tailer can put their return policies for purchased product in confirmation emails of purchases.

9.2.6 Efficient Record Keeping and Tracking system:

Efficient record keeping and tracking as a regulatory requirement regarding recycling and product disposition should be implemented by the online retailers.

10. CONCLUSION:

The customers are confident when the purchase is guarded with a feature of returning the goods in case it does not satisfy the needs of the customer. Reverse Logistics management in apparel industry may lead to reduction in inventories, improvement in cash flows and improved customer satisfaction. Online retailers have to give top most priority to return policies to enhance logistics activities in the supply chain, including sorting, reused and recovery materials back to the original suppliers.

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Role of E-Commerce in Reducing Operational Cost

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ABSTRACT

E-Commerce is that the method of conducting business electronically among varied entities so as to satisfy individual objective. A key ingredient of E-Commerce, generally spoken as electronic mercantilism, is that the advertising and procurance of products and services over the web (Rhodes & Carter, 1998). The success and volume of E-Commerce on the net has been wide reported successful within which E-Commerce will grow and flourish, each laptop will become a window receptive each business, massive and tiny, round the globe. The electronic medium we have a tendency to decision the web has the potential to cut back actual group action time, time interval and operational price dramatically, whereas at constant time creating information on the market globally. Internet-based E-Commerce has been embraced as suggests that a way a method of reducing operational price and as a high potential means of generating revenue (Levis, 1996). The omnipresence of the net and also the availableness of browsers across totally different platforms offer a standard base upon that E-Commerce applications are often designed, particularly within the enterprise. This common platform has reduced the importance of problems concerning code distribution and code installation, so encouraging the growth of E-Commerce via Intranets, Extranets and also the web. E-Commerce provides new channels for the worldwide promoting of tangible product and presents opportunities to form new businesses providing information and alternative knowledge – based intangible product (Rhodes & Carter, 1998) though most E-Commerce is presently at the inter-corporate and inter-organizational level, services targeted at individual customers are evolving quickly. The web is that the most blatant example of this and may be a major catalyst within the diffusion of E-Commerce, serving to foster a standard atmosphere for electronic transactions of all types.

Keywords: E-Commerce, Extranet, Omnipresence, Catalyst

INTRODUCTION

E-Commerce encompasses all varieties of interactive business transactions that are expedited by networks of computers. E-Commerce is increasing owing to the bigger range of companies and people UN agency are ready to use these networks and also the growing range of how within which businesses will conduct transactions electronically with alternative organizations and directly with customers at a reduced price (Bartell et al, 1999). At present, business-to-business E-Commerce appears still to be of bigger volume than business-to-consumer. E-Commerce with the first motive of operational price reduction, however this could amend within the future. These trends are vital to the worldwide economy and to the economy of individual countries as a result of E-Commerce contribute to economic potency.

E-Commerce contributes to economic potency in 5 vital ways that. They includes shrinking distances and timescale, lowering distribution and operational prices, dashing development, providing additional information to patrons and sellers and enlarging client alternative and provider reach (Turban et al, 2000). However, this paper is targeted on the role of E-Commerce in reducing operational price in a company.

Furthermore, once offline stores calculate operational prices, they need to think about un numberable business expenditures together with the particular range of transactions. Once there are fewer transactions, the value of per group action is higher. On the flipside, transactions inward in high amount will overwhelm the personnel and distributors.

In AN E-Commerce business, the operational price is that the same across the board, whether or not one order or thousands are available in.

For example Dealdey.com was launched in March 2011 and they options a daily deal on the simplest things to try and do, see, eat, and furnish Federal Republic of Nigeria. Deal Dey is attempting to form a simple and fun thanks to get fantastic deals on nice experiences. DealDey.com supports native businesses and reciprocally they support customers with sensible savings. They're trying to form a "Win-Win" state of affairs every and each day for native merchants UN agency wish to draw in new customers, and customers UN agency wish to save lots of cash and benefit nice services and activities in their own town.

REVIEW OF LITERATURE

1. China's Alibaba Group and affiliate Ant Financial became the largest shareholders of One97 Communications, the parent of Indian e-tailer Paytm, by investing \$680 million, in 2015 (Aulakh, 2015). To tap the potential of what it regards as "underdeveloped internet economy" of India, Japanese investment company and technology powerhouse Softbank invested \$627 million into online retailing marketplace Snapdeal and \$210 million in Ola cabs. (Mac, 2014). Similarly, New York firm Tiger Global Management has funded companies such MakeMyTrip, Flipkart, Myntra and Quikr. The 130lectronic130n of funds has presented a favourable ecosystem and growth opportunities for big as well as small companies. It has enabled local startups to survive in cut throat competition against foreign giants and has facilitated the penetration of e-commerce to every facet Growth of E-commerce in India: An Analytical Review of Literature DOI: 10.9790/487X-1906019195 www.iosrjournals.org 93 | Page of human life; such that the 130lectronic130nal130 between e-commerce and traditional 130lectron is getting blurred. (Aggarwal, 2014).
2. Mishra and Kotkar (2015) trace the timeline and development of B2C e-commerce in "A Study on Current Status of E-Commerce in India: A Comparative Analysis of Flipkart and Amazon" with its inception in the mid 1990s through the advent of matrimonial and job portals. However, due to limited internet accessibility, weak online payment systems and lack of awareness, the progress was very slow. The Indian B2C e-commerce industry got a major boost in mid 2000s with the expansion of online services to travel and hotel bookings which continue to be major contributors even today. Das and Ara (2015) observe in "Growth of E-Commerce in India" that though online travel and hotel bookings still control the lion's share of e-commerce market, their share has 130lectronic130na fallen over the years due to the recent augmentation and consequent rise of e-tailing services. There has been a tremendous surge in the volume of investment in this sector. With the e-commerce markets in the west reaching their saturation, investors see tremendous potential in the Indian market, in the light of which, many start ups have received funding from venture capitalists and private equity firms.
3. Gupta, (2014) in her paper "E-Commerce: Role of e-commerce in today's business", presents a comprehensive definition of e-commerce while isolating it from e-business. The paper enlists the different ecommerce models i.e. B2B, B2C, B2G and C2C, narratively 130lectroni the nitty gritty of each. Rina (2016) also elaborates the different applications of e-commerce in "Challenges and Future Scope of Ecommerce in India", at the same time, defining the degree to which they are operational in the country. Gunasekaran et al., (2002) give a broad outlook of electronic commerce within 130lectronic130nal systems in "E-commerce and its impact on operations management", defining it with reference to e-trading and elaborating- how it has permeated every field of business. The paper identifies the revolutionary role played by earlier internet applications like e-mail and 130lectronic data interchange and details the revolutionary changes brought by the internet technologies in manufacturing, marketing, purchasing, design, production, selling and distribution, warehousing and human resource management. Internet based technologies have enabled businesses to shorten development, purchase and procurement cycles, maintain upto date product and market information, significantly increase the speed of communications and increase the quality of customer relationships by facilitating close contact and constant communication. The paper studies in depth, the significance of web based technologies in different business operations, thus, improving their efficiency through effective B2B e-commerce.

STATEMENT OF THE PROBLEM

Electronic commerce could be a widespread topic in business management, mass media and in IP circles also may be its impact is most visible within the areas of monetary services and marketing. Several E-Commerce initiatives have up in a very short amount of your time. Those initiatives embrace innovative sensible cards to facilitate E-Commerce, remote payments and electronic checking, on-line commerce of stocks, bonds and connected money instruments, on-line banking, and on-line marketing (e-tailing). However, its impact on the reduction of operational price of organization has been examined in a very wide variety of the way relatively to brick and mortar organizations as an example the money received for each dealings pays for the item; it'll conjointly contribute to the employee earnings, master card fees, lease on front, electricity, telephone, heating/cooling, taxes, displays, repairs and maintenance to the building. However, the money received for associate E-Commerce dealings pays for the item, net hosting, handcart computer code, distribution and small else. The value overall of maintaining a virtual store is much but that of a brick and mortar store.

OBJECTIVES

The following are the objectives of this Paper:

1. To examine the role of E-commerce in reducing operational cost in an organization.
2. To identify other benefits accruable from E-commerce.
3. To identify the limitations and disadvantages of E-commerce.

OPERATING COSTS

Operating costs are those needed for the daily maintenance of your ecommerce business within the business trade normally talk to business operative prices as OPEX or operative expenses. The first part of ecommerce budget items is that the expenses of products oversubscribed or(COGS). The COGS are the prices that are directly associated with your business's merchandise or services and additionally embrace things like:

- Workers labour prices, like payroll
- Worker insurance and alternative advantages
- Incentives
- Sales Commissions
- Maintenance prices
- Depreciation
- Loan/Debt Payments

Knowing the way to live and scale back operative prices is vital as a result of it permits you to enhance your business that can have an immediate impact on your profit.

Three ways to cut back Operations Costs:

- Assess Monetary Expenditures
- Source Business Functions
- Improve Selling Efforts

A business owner is often searching for ways in which to chop operative prices and optimize operative profit margins.

Here are some suggestions:

1. To reduce operative prices, businesses can change the area necessary for production.
2. By chase and mensuration business's operational potency, scale back and alter the utilization of accessible resources. Set performance metrics that outline goals and supply incentives once those goals are met.

LOWER MONETARY EXPENDITURES

To reduce your business operative prices, it's very important that investigate your monetary expenditures that embrace insurance policies and monetary accounts. Save expenses on insurance by obtaining it at the foremost competitive rate. Raise your insurance supplier to match the price along with your demand. Consolidate the insurance policies if attainable to confirm not over-insured or duplicating coverage. Never attack spare debt. Do a radical analysis of cost-benefits and future business growth take into account the likelihood of debt payments on income because it would possibly have an effect on company rating, interest rates, and therefore the ability to borrow within the future.

OUTSOURCING BUSINESS FUNCTIONS

Identify business processes that may be outsourced. Businesses trying to cut back operational prices ought to additionally take into account whether or not outsourcing functions will economize for them or not. one amongst the normally outsourced business functions is selling, advertising, and communications. there's tons [most] competition within the marketplace and finding a result-driven outsourcing supplier will prevent defrayal a lot of cash. Outsourcing of business functions is especially useful for small-to-medium businesses, which can not have the necessity for a full-time selling team or advertising resource. you'll notice outsourcing services at less expensive or hourly rates.

Reducing prices can assist to increase business's revenue, place more cash into lead generation, scale back your business's pricing strategy, and more.

All-in-all, operational price reduction can offer you additional fuel to stay the engine of your business running at full capability. It's a self-reinforcing cycle wherever price reductions prevent cash that you simply will then use to grow your business larger and stronger thus you'll create even more cash, and on and on. place these price reduction methods to figure nowadays and begin building additional roaring e-commerce business.

MODERNISE SELLING EFFORTS

Don't wish to pay additional for marketing; but, it will be worthy to appear at cheaper alternatives. economize on selling efforts by contacting vendors to allow them to apprehend searching for marketing services at lower prices. Look outside of ancient vendors. Also, re valueate your suppliers for selling efforts. Confidence many completely different selling companies, you will realize that you simply will get services of quality from a trafficker that charges less. Regular outsourcing and inquiries may additionally lead your current trafficker to chop costs for selling services.

Business - to -Business (B2B) a kind of commerce group action that exists between businesses, like those involving a manufacturer and middleman, or a middleman and a merchant is thought as Business-to-Business (B2B). It refers to business that's conducted between firms, instead of between a corporation and individual customers. This is often in distinction to Business to shopper (B2C) and business to government (B2G). web site following B2B business model sells its product to associate intermediate vendee United Nations agency then sells the merchandise to the ultimate client. For instance, a middleman places associate order from a company's web site and when receiving the consignment, sells the top product to final client United Nations agency involves obtain the merchandise at wholesaler's retail outlet. B2B implies that marketer moreover as vendee is business entity. B2B covers sizable amount of applications that allows business to create relationships with their distributors, resellers, suppliers etc. IBM, Hewlett Packard (HP), CISCO, hollow area unit the samples of B2B. Chemconnect.com and chemdex.com area unit the samples of B2B that brings 2 companies along on the virtual market. Following area unit the leading things in B2B e-commerce, natural philosophy, shipping and deposition thirty seven • motorcars , petro chemicals, paper, workplace product, food, agriculture B2B applications is witnessed within the following areas: provider management, inventory management, distribution management, channel management, payment management.

TheB2Bmodel is provider central, vendee central or go- between central models provider central model during this model, a provider sets up the electronic commerce market place. varied customers move with the provider at its electronic market place. The provider is usually a dominant provider. He could thirty eight offer tailored solutions and rating to suit the requirements of patrons. Intel and Cisco are adopting the provider central Model. vendee central Model during this model, business sector organisations with high volume purchase capability produce associate electronic commerce market place. the web electronic commerce marketplace is employed by the customer for putting requests for quotations and closing the complete purchase method. The federal government and also the General electrical commercialism method Network area unit samples of buyer-centric model. go-between – central model during this model, a 3rd party sets up the electronic commerce market place. The third party attracts each vendee and marketer to move with one another at its market place. the customer places their request interacts with one another and reaches a final judgment in purchase or sale of products.

IMPACT OF COVID-19

The pandemic has accentuated the trend towards bigger adoption of social media and growth in sales through e-commerce websites. Shifts in consumption habits have conjointly been discovered, driven by the requirement for sourcing essential things. Social media and own e-commerce outlets area unit necessary sales channels for the e-commerce firms. Each channel has witnessed higher growth since the start of the COVID-19 crisis. The COVID-19 crisis has been related to a amendment in sales composition for over sixty five per cent of them. to boot, the survey confirms that a lot of customers have gone on-line to appear for essential product. Groceries, prescription drugs, health and hygiene product, eating place delivery, moreover as money services, area unit the sales classes that saw the biggest will increase within the COVID-19 crisis through third-party on-line marketplaces. E-payments have intimate with quick growth, however money on delivery remains distinguished. Shifts in consumption habits are in the midst of a quicker uptake of cashless payment ways. Nearly sixty per cent of e-commerce firms and seventy per cent of on-line third-party marketplaces area unit seeing comparatively higher growth rates in mobile cash payments, followed by dealings through e-banking and credit cards. However, as money on delivery remains distinguished in absolute terms, significantly in LDCs, it's

continued to grow since the occurrence of the pandemic as shoppers have progressively turned to e-commerce. whereas the pandemic has been a chance for several digital-driven business models, business outlook appearance difficult for a big share of e-commerce businesses. The COVID-19 crisis has adversely affected the prices of sixty six per cent of the participants within the sample. Some fifty six per cent of respondents reportable that their hands has remained stable to date or would possibly even increase within the short term. Still, a high share (44 per cent) of respondents have had to downsize their business hands. The pandemic has bolstered pre-existing bottlenecks within the e-commerce system that countries have to be compelled to address to learn from e-commerce development by enhancing their e-trade readiness. Disruptions in offer chains and trade supply, moreover as unaffordable net thirty four seven fifty eight sixty four seven twenty nine enhanced Stable bated E-commerce firms Third-party on-line marketplaces

COVID-19 AND E-COMMERCE IMPACT ON BUSINESSES AND POLICY

Access area unit the most challenges encountered by the respondents. supply and trade facilitation had proven difficult for over sixty per cent of respondents, joined to non continuous offer chains because of lockdowns, business closures and closed borders. to boot, over fifty per cent thought-about their operations to own been restricted by supply issues arising from restrictions to movement. 1/2 the respondents spoken high value of broadband services. Moreover, respondents needed enhancements in e-commerce policies and techniques within the COVID-19 response. The present pandemic has bolstered sure pre-existing bottlenecks in e-commerce ecosystems of the surveyed countries in vital and interconnected policy area unit as that are key for the event of inclusive e-commerce. Challenges in these areas have affected the capability of respondents to speculate in e-commerce business growth, any exacerbated gaps in info and communication technology (ICT) adoption, and at identical time highlighted challenges associated with shopper protection and truthful competition, and a persistent money on delivery culture. Public and personal sectors have enforced a good vary of measures to mitigate the results of the pandemic. Governments and also the personal sector have taken a spread of measures to reply to the challenges brought by the pandemic and to mitigate its economic impact . In keeping with survey responses, the foremost relevant measures taken embrace developing or change of a national e-commerce strategy, which may preferably be understood because the revived impetus shown by governments to show e-commerce into a strategic economic sector amidst the pandemic. Followed by enhanced e-commerce visibility through advertising campaigns, skills coaching programmes and reduced e-payment dealings prices. even so, nearly one in four respondents indicated that no measures had been taken in support for the e-commerce sector. Findings from a public sector fast scan in twelve out of the twenty three countries coated by the survey, show that nine out of twelve countries have enforced kinds of liquidity support for the world. different measures have targeted on reducing prices of net and e-payments moreover as supporting supply efforts.

ADVANTAGES OF E COMMERCE

- 1. Faster Buying Process:** E-commerce has speed up the whole buying process for customers. They do not need to visit physical outlets for shopping and can purchase products by just sitting at their home. It saves huge times and performs faster transactions.
- 2. Eliminates Operating Cost:** It has reduced the overall operating cost of businesses. E-commerce has eliminated the need of opening physical outlets by the business. For operating an outlet, there are huge expenses in terms of rent, utilities, various bills, and staff salaries. It saves all these expenses and operates all business activities through an online website.
- 3. Personalize Shopping Experience:** E-commerce enables customers in enjoying personalized shopping experience. Customers can search for a large variety of products as per their choice and needs without any restrictions. Online business shows products to customers according to their interest and their location.
- 4. Available 24×7:** Online shopping facility is available at all the time that is 24 hours a day and 7 days a week. This is one of the major advantages of e-commerce that customers can access online products at any time. Unlike physical outlets, there is no official opening and closing time here.
- 5. Connects far and wide:** Online businesses are able to reach and connect to customers at far distant places with no geographical limits. People can place their orders from any place and get their orders delivered at their location.
- 6. Detailed Product Information:** Peoples can acquire a full description in detail regarding the products online. It gives full information so that customers can make a comparison with other products easily and choose the best one.

- 7. Retargets the Customers:** Online shopping has made it easy for a business to retargets their customers. The electronic business acquires vast information about their customers while they are doing their shopping online. Customers can be contacted from time to time by sending them personalized emails, messages, coupons and discounts offers.

DISADVANTAGES OF E COMMERCE

- 1. Lack of Personal Touch:** Customers lack the facility of touching and feeling products in case of online shopping. They are sometimes more satisfied by purchasing at physical outlets by properly checking the product before buying.
- 2. No Guarantee about Product Quality:** Customers cannot get ensured regarding the quality of products available online. They may be cheated by companies and receive faulty products.
- 3. Security Issues:** Customers may lose their essential credentials while shopping online. There are various hackers over the internet which may steal customer's data and may cause great loss to them.
- 4. Long Delivery Period:** Another major disadvantage of online shopping is that customers need to wait for longer time periods for getting their products delivered. In the case of offline shopping, customers get on-spot delivery of their products.
- 5. Cannot try before Buying:** Customers cannot take a trial of products before purchasing when they are doing online shopping. They don't have a facility of negotiating the prices and cannot acquire better information regarding usage and features of the product as in case of the physical outlet where salesperson interacts directly.

CONCLUSION

The COVID-19 crisis served as associate accelerator for bigger public-private cooperation. However, access to finance for e-commerce businesses remains a predominant obstacle for economic recovery and growth. Moreover, the COVID-19 crisis has spurred action within the e-commerce sector. the maximum amount as forty per cent and a lot of the respondents' businesses are or area unit concerned in either public-private sector collaboration initiatives or pure personal sector ones. Reduced prices for net and broadband access, moreover as for mobile and different electronic payments were the opposite high measures suggested to be taken to support the economic recovery. International cooperation and a robust multi-stakeholders' partnership is required to spice up countries' efforts for inclusive e-commerce development. UNCTAD is well poised to mobilize the e trade for all partnership to support developing countries and LDCs' COVID-19 recovery plans. Building on a sure-fire track-record of implementation of recommendations printed in e trade readiness assessments (Et Readies), UNCTAD is functioning with several partners, as well as United Nations Resident Coordinators, to make sure that e-commerce is integrated into national development plans and development partners' development cooperation frameworks.

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Understanding Convenience and Satisfaction Level of OTT Platform Audience in Mumbai City

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ABSTRACT

Over the Top services (OTT) refers to movies and shows that are delivered directly to the digital user without using any cable or satellite television. OTT is online deliverer of video content via internet. Indian market has more than 60 OTT platforms who offer various drama and series to audience. OTT content has emerged among millennial audience as the new standalone digital multi-media platform where multi-cable or direct broadcast satellite television do not distribute or control content. In India approximately 51 million audience use OTT platform per month.

This study specific focused on to understand the competition between OTT media services and traditional TV channels in the Indian media market. Based on the previous uses, the researchers have chosen two factors through which try to find relationship between age group with convenience to use OTT platform and age group with customer satisfaction level of OTT platform audience. This study shows a significant relationship between the age group of the OTT platform audience and convenience use of OTT platform. It can be understood that viewers belonging to lesser age group (16 - 25 years) tend to feel it is easy to use any kind of Online Streaming video services, while viewers of a bigger age group (50 and above years) feel it is not very simple. This study also shows no significant relationship between the age group and the satisfaction level among the users of OTT platform. It can be observed from this research, that the age group of the viewers does not have any impact on their satisfaction level.

Keywords: OTT, TV, Video streaming, Digital media, Convenience

I) INTRODUCTION

Over the Top services (OTT) refers to movies and shows that are delivered directly to the digital user without using any cable or satellite television. OTT is online deliverer of video content via internet. OTT is large market comprised media and entertainment industry and it has emerged as the most dominate industry due to increase number of online video consumers. (Puthiyakath and Goswami, 2021); (Kumari, 2020). In India approximately 51 million audience use OTT platform per month (Ormax, 2021).

Indian market has more than 60 OTT platforms who offer various drama and series to audience. OTT content has emerged among millennial audience as the new standalone digital multi-media platform where multi-cable or direct broadcast satellite television does not distribute or control content. Viewers will now have complete autonomy in terms of choosing their own content and pricing, keeping in mind the exact type and amount of content they want to view. Another major trend emerging in television content viewing is the emergence of OTT platforms by individual media houses. This trend is primarily fuelled by increase in the number of devices that support these platforms along with tremendous rise in the number of internet and mobile data subscribers. The rise of OTT platforms has also seen growth with the steady but positive increase in the number of people who are wanting and demanding both 'Produced-for-TV' as well as exclusive freshly brewed content on demand anytime of the day, thus making it one of the biggest opportunities in the video and content sector in the entertainment industry.(DASGUPTA and GROVER, 2019)

II) REVIEW OF LITERATURE:

1. As we look back from a few years in India, OTT's platform subscriber growth rate is raising toward high till the date through this (Covid-19) Pandemic Lockdown as this growth is based upon the great Technological advancements that contributing to the OTT providers to bringing high-quality content to our near screens through the Internet. OTT's providers not only depend on their repository but invest a lot of money in producing their content. Many factors, such as new technologies, a drop in data charges, improved Internet speeds both at home and on the Internet. Mobiles, tablets, laptops, and Smart TVs are now to be made for entertainment and made it easy for the consumption of content provided by the OTT providers. This paper is in a novel approach to understand the user profiles and preferences from an Indian perspective.(Gangwar et al., 2020)

2. The entrance of Over the Top services like Netflix, Amazon Prime, and Hotstar in India has caused turmoil in the entertainment industry. Today OTT players have become part of mainstream media and thus influenced the viewing behavior of consumers all over the world. The recent affair between internet and entertainment has not only changed the mode of content distribution but has also impacted the nature of content creation. The present study aims to understand the changes in pattern of content consumption behavior of consumer after the introduction of OTT services in India and the factors contributing to the success of OTT services. Convenience sampling technique was used for the study and response from 106 respondents (N = 106) were collected through online survey questionnaire. The findings of the study shows that majority of users (88%) agrees that emergence of OTT platforms have affected their television and movie watching habits. Smart phones are the most preferred device for watching OTT channels and majority of viewers are night time users. The analysis presents that affordable internet connection is the most important technological reason for the growth of OTT services in India. Majority of users are satisfied with the content and quality of service of OTT services. Other important factors which significantly contribute to the growth of OTT services are cost, ease of use, convenience and user customization. The findings of the study not only provides an insight on the most important factors contributing to the success of OTT services but also the reasons for people not adopting to OTT services. Content openness, cost and lack of technological readiness are emerging as major barriers in adoption of OTT services in India. (Kumari, 2020).
3. With the rapid advancement in technology, penetration of smart phones and increase in levels of affordable internet facilities resulted in the rise of OTT media services. An OTT platform gives freedom to their users to watch T.V. series, movies, etc. at their own convenience. The study was conducted to find out the factors influencing consumer's choice of streaming OTT platforms. Convenience sampling technique was used for the study and response from 200 respondents (students, working people/ staff, homemakers and entrepreneurs), was collected in Hisar city, through semi-structured questionnaire. The variations in the factors (Growth, Benefits of OTT, Integrated marketing and communication) were 41.321, 6.621, 5.977, and 5.378 per cent, respectively. As per factor analysis, all four factors were most important that influenced consumers' choice of streaming OTT services, and the Cronbach alpha values were 0.844, 0.812, 0.798 and 0.629, respectively. (Ghalawat et al., 2021).
4. Since the outbreak of COVID-19 and the consequent national lockdown, the usage of over the top (OTT) platforms has significantly increased in India. The growing popularity of video streaming has made a substantial impact on the traditional TV channels during pandemic times. The purpose of this study is to examine the competition, coexistence and competitive superiority of OTT and TV in providing consumer satisfaction. The study adopted the niche theory to empirically measure the degree of gratification fulfilled by OTT and TV, the similarity between OTT and TV and the competitive superiority of OTT and TV across seven microdimensions of gratification. The data for the study has been gathered from 223 online users across India. The results of the study reflect that OTT provides a higher degree of satisfaction across all seven dimensions of gratification with the greatest difference manifested in the convenience dimension. The niche overlap measures indicated that the highest level of similarity between TV and OTT is in providing gratification in the relaxation dimension, whereas the least similarity was observed in the convenience dimensions. The competitive superiority of OTT surpassed TV in all dimensions with the greatest difference manifested in relaxation. (Paulose, 2020); (Puthiyakath and Goswami, 2021)

III) OBJECTIVES OF STUDY:

1. To analyse various factors of growing audience of OTT platform.
2. To investigate relationship between OTT audience age group and convenience to use OTT platform.
3. To understand the relationship between age group and satisfaction level of OTT audience.

IV) RESEARCH METHODOLOGY

This study specific focused on to understand the competition between OTT media services and traditional TV channels in the Indian media market. Based on the previous uses, the researchers have chosen two factors through which try to find relationship between age group with convenience to use OTT platform and age group with customer satisfaction level of OTT platform audience (Paulose, 2020) .

The data for the present study has been collected via the online convenience sampling method for 10 questions from Mumbai city and suburban area of Mumbai region. The questionnaire was shared among various Indian virtual communities of WhatsApp and Facebook. In the end, 225 total feedbacks were received, of which 10

responses were found to be invalid. The questionnaire consisted of three parts – OTT users’ demographics, OTT convenience use of platform and OTT customer level satisfaction.

V) RESEARCH HYPOTHESIS:

H1: There is a relationship between the age group and the convenience use of OTT platform.

H2: There is a relationship between the age group and the satisfaction level of OTT platform audience.

VI) FACTORS OF GROWING OTT PLATFORM AUDIENCE:

1. While starting with a slow migration from feature phones to smartphones, the arrival of affordable smartphones and low-cost mobile data services made a giant leap in terms of the number of smartphone users in India. Almost 600 million Indians owned smartphones as of December 2020, which indicates over 77 % of Indians access the Internet through smartphones.
2. The cheaper mobile data has been observed as one of the reasons for the growing numbers of Internet users in the country. India has the cheapest mobile data in the world with 1GB costing just INR 18.5 (approximately USD 0.25 in 31 December 2019) as compared to the global average of about INR 600 (approximately USD 8.4 in 31 December 2019; (News18, 2020). The spike in smartphone penetration and cheaper rate of Internet triggered the growth of the 4G network across the country in a quick time.
3. The cheaper mobile data has been observed as one of the reasons for the growing numbers of Internet users in the country. India has the cheapest mobile data in the world with 1GB costing just INR 18.5 (approximately USD 0.25 in 31 December 2019) as compared to the global average of about INR 600 (approximately USD 8.4 in 31 December 2019; News18, 2020). The spike in smartphone penetration and cheaper rate of Internet triggered the growth of the 4G network across the country in a quick time.
4. The growth in OTT may be looked at as also the result of the absence of outdoor entertainment during the lockdown and subsequently restrictions in the movements, online release of big banner films with popular stardom and contents without censorship among others. During the pandemic, there has been a substantial increase in the number of Indians subscribing to various global OTT services such as Netflix and Amazon Prime Video as well as Indian video on-demand services such as Zee5 and ALTBalaji.
5. A large population of Indians with smartphones use OTT platforms for entertainment. The OTT entertainment apps have emerged as the most penetrated app category among smartphone users in recent times after social networking, chatting and e-commerce apps.(Puthiyakath and Goswami, 2021)

VII) RESULTS & FINDINGS

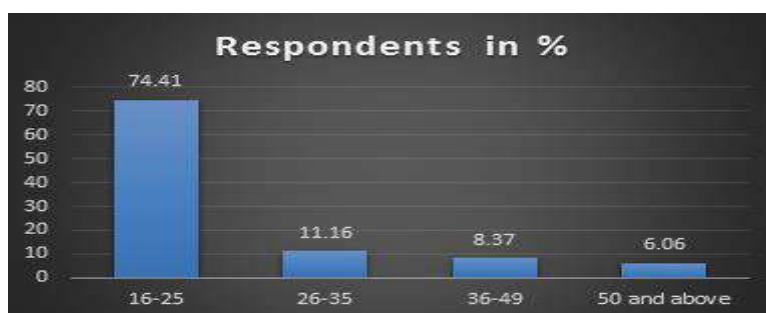
Testing of Hypothesis:

Ho: There is no relationship between the age group and the convenience use of OTT platform.

H1: There is a relationship between the age group and the convenience use of OTT platform.

Table 1: ANOVA Test showing relationship between the age group and the convenience use of OTT platform

Age	Number of respondents	Respondents in %	Mean	Standard Deviation	F	Significance
16-25	160	74.41	4.33	0.801	5.234	0.002
26-35	24	11.16	4.12	0.966		
36-49	18	8.37	4	0.912		
50 and above	13	6.06	3.21	0.970		
Total	215	100.00	4.22	0.863		



Interpretation:

From the above table, it is shown that the level of significance is 0.002 which is less than 0.05. Hence Null Hypothesis is rejected. Hence, Alternate Hypothesis is accepted at 95% significance confidence level.

There is a significant relationship between the age group of the OTT platform audience and convenience use of OTT platform. It can be understood that viewers belonging to lesser age group (16 - 25 years) tend to feel it is easy to use any kind of Online Streaming video services, while viewers of a bigger age group (50 and above years) feel it is not very simple and requires a lot of knowledge about technology in order to operate the Streaming video services apps. While the age group up to 49, there is not much of a difference in their mean level but for the viewers above the age of 50, there is a vast difference in the mean level with just 3.22. This infers those viewers belonging to the age group of 50 and above find it difficult in operating Online Streaming Video Service.

H0: There is no relationship between the age group and the satisfaction level of OTT platform audience.

H2: There is a relationship between the age group and the satisfaction level of OTT platform audience.

Table 2: Chi-Square Analysis showing relationship between the age group and the satisfaction level of OTT platform audience

Hypothesis relationship	χ^2 Value	Ho	P	Decision
relationship between the age group and the satisfaction level of OTT platform audience	12.832 ^a	3	0.343	Rejected

Interpretation:

From the table it is shown that the level of significance is 0.343 which is more than 0.05. Hence, alternate Hypothesis is rejected. Null Hypothesis is accepted at 95% significance confidence level. There is no significant relationship between the age group and the satisfaction level among the users. It can be observed from this test, that the age group of the viewers does not have any impact on their satisfaction level.

VIII) DISCUSSION & CONCLUSION

This study shows OTT platform became a popular medium of entertainment among the youth, specially in age group of 16 to 25 year of age group. It is big concern for parents and teachers because youth can be addicted to OTT platform very easily through smart phone and smart TV. Some people says it has more harmful effect than good effect, other take opposite point of view. It is end with very interesting note millennial generation is less interested in TV cable entertainment than OTT platform. OTT platform provides new content very fast and it is related to reality. OTT platform very easy to provide content on smart TV and smart phone. Government has very less control on OTT platform as compare to TV cable and cinema movies. OTT platform at a time compete to TV cable and big screen cinema movies, in future new generation increase their daily time to OTT platform than other entertainment.

IX) LIMITATIONS OF RESEARCH:

1. This research is conducted in Mumbai city and suburban of Mumbai city.
2. There are less respondents
3. This study focused only on age group, convenience use of OTT platform and satisfaction level of audience.

X) FUTURE SCOPE:

1. Research can be conducted on Online gaming on OTT platform
2. Research can be conducted on Business content on OTT platform
3. Research can be conducted on Regional language content on OTT platform

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Yoga and Meditation in Schools for Stress Management among Students

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ABSTRACT

This paper discusses that yoga has powerful effect to alleviate the stress level among students. Yoga is not for only physical exercise but yoga bring balance between mind and body. Now a days students are facing stress, due to covid-19 pandemic schools are closed from last year most of the time students are spending their time on computer and mobile to attend online classes and for other activities they are also learning through virtual mode and all these results stress, frustration, irritation and mood disorder. Yoga is a potential tool to calm down and help students to cope up from stress and fatigue. Students at secondary and senior secondary level feel much pressure of their board examination as well as competitive examination. They face numerous challenges and expectations from parents, society, peers, internet and social media. We present research literature suggesting that yoga and meditation is a powerful technique to improve student's mental and emotional health. Similarly yoga practice in schools on regular basis helps students improve their concentration, self discipline, self realization skill, eliminate stress and increase creativity and productivity.

Key words: yoga, stress, students, cortisol, mental and emotional health

INTRODUCTION

"In 20th century, the world go to knowledge based society with numerous better opportunities (Kalam, 2011) and requires the best citizens in future" (Rajput, 2004). Students and youth are future of a nation, they are like pillars of the foundation of a country, so it is important that pillars must be strong for a strong building. For a strong and developing nation its youth, students and children must have essence of good physical health as well as mental health. It is well said that healthy mind lies in healthy body and the state of mind is significantly correlated with the state of physical health. We live in a world today which is highly unpredictable shift in working & living style on one hand, the dramatic social and technological transformation on the other – are primary factors that cause stress and anxiety. It is more so with teenaged school going children and students at secondary and senior secondary stage. If stress is perceived negatively or becomes excessive then students experience physical and psychological problems/disorders that leads to low motivation and losing interest to achieve well academically. Most commonly noticed problems that are caused by stress includes migraines, depression, lack of sleep (insomnia), hypertension, high and low blood pressure, weight gain and spondylitis. Yoga is stress reliever, it is proved in many recent researches that if yoga practices and meditation done on regular basis it will reduce stress and enhance mental and physical health

Concept of Stress:

Stress is most common problem of everyone's life. Students at secondary and senior secondary level go through stress at different levels. Stress is the physical and mental disturbance caused to students due to various stressors. Stressors are mainly academic performance, undefined desired for achieving something, level of aspiration, finance, burden of tuitions, social relationship and time management. The concept of stress has been evolved in the field of physics by Hans Selye in 1920's. In physics stress describes the force that produces strain on a physical body i.e., bending a piece of metal until it snaps occurs because of the force or stress exerted on it. Stress resulted release stress hormones, which termed as general adaptation syndrome by Hans Selye. Stress causes different physical and mental symptoms that are significantly related to one's own surrounding factors. Stress is conceived as a conscious or un conscious feeling of an individual that affects individual physically or mentally in positive or negative ways. Therefore "Eustress" is considered to be positive while "distress" is considered to be negative. Besides these two categories other categories of stress exist which include acute stress and chronic stress. Stress depend upon a wide range of variables which includes novelty, rate, intensity, duration, personal interpretation of the input, genetic and experiential factors. It is always debated as and remain inconclusive that at what age do students have the greatest stress? Experts argue that it is adolescent stage which is defined as a period of stress and strain and therefore students at secondary and senior secondary stage are more vulnerable so far as the stress is considered. During these years, stress becomes hit-or-miss matter; and eventually students fails to understand the level of stress and its adverse effects on student's life.

Concept of Yoga

Yoga is an ancient tradition in India to attain physical, mental and emotional health as well as to attain spiritual enlightenment. Patanjali the author of the yoga sutra written 1000's of years ago demonstrate a scientific approach to study of yoga. In patanjali yoga sutra only two sutra describe about Asanas and there is not a single asana is described in patanjali yoga sutra. Yoga is in fact not only practice of Asanas, yoga is a wider subject to study. Asanas are only one part of yoga. Yoga is derived from Sanskrit word 'Yuj' which means united. Yoga means unity of physical and mental perspective of human body. Yoga include physical Asanas as well as pranayama for mental health, meditation and relaxation for spiritual progress. The eight limbs of Ashtang yoga consist: yama, Niyama, Asana, pranayama, pratyahara, Dharna, Dhayana, and Smadhi. One must follow first two limbs perfectly to do Third limb that is Asana, Asanas give strength to muscles and joints are maintained in a healthy and supple state and regulate many physiological abnormalities. pranayam or breathing techniques play vital role in supply oxygen and strengthen the lungs. practicing pratyahara mean by Relaxation technique the awareness from external environment withdrawn that reduce of stress of daily routine. yoga Nidra is also a technique of Relaxation that reduce stress by focusing on particular physical objects or surroundings that is focusing and concentration or Dharna are main elements of that technique. Dhyana is concentration or stilling the mind and channeling focused energy creatively. Smadhi is the ultimate stage of yoga that can be attain by constant yogic practice. yoga is a science and art that bring Body and mind at its holistic perspective. There are different types of yoga: integral yoga, Janana yoga, Bhakti yoga, karma yoga, Raja yoga, Hath yoga, Kundlini yoga, Mantra yoga, Tantra yoga, Modern yoga. All types of yoga brings an individual to get physically and mentally strong along with emotional and spiritually powerful. Some particular yogasanas and pranayamas are explained below to get rid of stress and frustration:

Asanas for Stress Relief:

1. Uttanasana: it is unique asana as the head is below the heart in this asana so reversing blood circulation relieves fatigue, stress and depression.
2. Balasana: It is forward bending and calm down head and reduce stress.
3. Prasarita padottanasana: very powerful asana strengthen spine and legs as well as relax body and calm the mind.
4. Shirshasana: It awakens sahasrara chakra, stimulate pituitary and pineal glands, calm the mind and relieve stress.
5. Matsyasana: This pose gives calmness to the mind, decrease the level of anxiety, stress and depression.
6. Halasana: This asana calm the brain and reduce stress and anxiety.
7. Purvottanasana: This is reverse plank pose which is good therapeutic practice for depression, fatigue and it relax the mind.
8. Paschimottanasana: This is seated forward bending pose that soothes headache and helps relieve stress and mild depression.
9. Sarvangasana: This asana Tranquilizes the mind, relieve mental and emotional stress.
10. Shavasana: This is Restorative type of asana done at last of yoga intervention. It removes worries and tensions, leads to relax state of mind.

Pranayama for stress relief:

Bharamari pranayama.

Nadi shodhana (Anulom – Vilom).

Ujjayi Breathing.

Sheetli and sheetkari pranayama.

KapalaBhati

Yogic breathing

Meditation:

Breathing meditation

Chakra meditation

Panch kosha meditation

Relaxation Techniques :

Yoga nidra

Progressive muscle relaxation

Kaya kriya

Mantras and chants:

The powerful mantra- OM .since ages , Indians have believed in the power of chanting the sacred word OM. Even science has agreed with the therapeutic, psychological benefits of this mantra. Medical studies have found that chanting OM with concentration enables a person to reduce the adrenaline level that in turn helps in reducing the stress level.

Thus OM chanting ,Gayatri mantra and meditation ,Relaxation,pranayama and asanas are very helpful to calm the mind ,alleviate stress and mild depression.

Benefits of yoga:

Yoga is beneficial for all aspects of an individual .yoga enhance physical , mental ,emotional , and creative aspects of a person . In physical aspects , while doing Asanas, most of the asanas have stretch, bend and twist of the spine. Spine is the most important structure of skeletal system .Regular movement of the joints and spine ensure proper posture and good health. Students who practice yoga asanas have very flexible joints and strong bones. Yogasanas also benefits for cardio vascular health ,Researches suggests that yoga increase “good cholesterol “(HDL) and decrease Bad cholesterol(LDL).This reduce the risk of heart disease by preventing arterial narrowing. pranayama or breathing exercises helps in enhancing lungs capacity and Nadi shodhna or alternate nostril breathing to balance the two hemispheres of brain , or yogic breathing are two important pranayama for achieving efficiency in respiration. Regular yoga practice activate nervous system most effectively . High level of the stress hormone cortisol are related to amygdale activity and decrease hippocampal activity.yoga practices are shown to reduce cortisol level and reverse these effects which may improve memory of students .Most of yoga practices also regulate the release of hormones that occurs in endocrine glands and bring emotional stability among students. Yoga is also called immunity booster at this covid-19 pandemic, as Evidence show that yoga can reduce chronic inflammation and it boost immunity of a person . yoga is beneficial in all aspects for students to get good physical , psychological emotional health .

Role of yoga for stress management:

From ancient time , In India sages and saints do meditation and Dhayana to calm down their mind free from anger, stress and anxiety . In gurukuls, pupils get mastery on yoga to strengthen their body and mind. Yoga is a popular technique in India for physical as well as mental and spiritual empowerment. Now a days when stress is very common in everyday and everyone’s life and mostly this stress effecting student’s mental and physical health , their creativity and productivity, its time to bring back this yoga tradition in schools again. Most of researches suggests that yoga reduce cortisol hormones and decrease stress level and improve mood and creativity. In yoga while doing breathing exercise ,deep breath activate the vagus nerve and help to reduce stress. vagus nerve is the main nerve of parasympathetic nervous system, extends from medulla through the diaphragm to abdomen and responsible for slowing respiration, reducing heart rate , lowering blood pressure, stimulating digestive activity. Many researches proves that yoga reduce stress, recently joshi a researcher suggest that kapalbhati kriya and Anulom Vilom pranayama have significant effect on lungs capacity and decrease anxiety and depression level among college students. Kauts concluded in his study that regular yoga practitioner students perform better in academics because yoga practice reduce stress and low stress students perform better than high stressed students . So student’s performance affected by stress also. So yoga classes should be mandatory for all students to bring their best . Tiwari proved in his study at high school students that through practice of yoga , memory and concentration improved and reduce stress level of students in examination. Raja yoga and meditation enhance mental health,so it is suggested that yoga should be introduced in schools. Deuskar concluded a study that Yog nidra relaxation technique show significant reduction in autonomic arousal, anxiety, strain muscle tension and depression . Mousumi examined that yoga has positive effect on stress management of working women, they were capable to control anxieties ,emotions and were capable of coping with stress . Yoga helped to develop positive attitude and lead to stress free mental state. In her review article, ”Effect of yoga on mental health in children” , one of the world’s most prominent yoga researcher, Shirley Telles, concludes that yoga improves children’s physical and mental health.

All these recent researches on yoga provide evidence that yoga practice reduce stress and anxiety and improve mental health as well. yoga practices alleviate stress, improve physical health that results good academic performance of students as well as their humble behavior and self discipline in classroom create healthy atmosphere for better learning.

CONCLUSIONS

The result of the present paper indicate that regular practice of asanas, pranayama, mantra chants, meditation, relaxation techniques reduce stress that is more common among students now a days. Stress can results low esteem, low confidence, early drug and alcohol addiction, suicidal ideas among students. chronic stress can also results different physical diseases that can affect their academic performance as well as create frustration, irritative behavior and such kind of students become dangerous for society. Therefore yoga classes on regular basis should be conducted in schools, it may be on virtual mode. Yoga classes for students will be very beneficial and also will be beneficial for parents and society because yoga bring totally transformation in student's behavior and their performance. Different asanas tone up muscles and release happy hormone Dopamine, different pranayama enhance respiratory system and increase lungs capacity to absorb more oxygen that will reduce stress, and increase concentration and memory power of students. Mantras chanting and relaxation techniques clam down the mind and improve behavior of students, samskara and sankalpa in yoga classes makes them humble and generous. yoga will help students to self realization self regulation, more confident, more creative and self disciplined in classroom. Regular yoga practice alleviate stress and transformed a normal student to a happy, healthy, humble, creative, confident, strong, productive and responsible citizen of country.

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Comparative Study of Rainfall Prediction Using Deep Learning with Genetic Algorithm

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ABSTRACT

Rainfall prediction is beneficial for water management, agriculture, drought assessment and other purposes. Accurate prediction of rain is essential for the countries whose economy primarily relies on agriculture. In this study, the DLGA (Deep Learning with Genetic Algorithm) model is developed using a deep neural network and genetic algorithm. The model's performance is compared with the SDL (simple deep learning) model. The models were tested on ten years of historical rainfall data to predict daily rainfall. A Binary Cross-entropy loss function is used to evaluate the model's performance. Experiment results demonstrate that both the DLGA and SDL models are appropriate for daily rainfall prediction. Furthermore, the study revealed that the DLGA model outperforms the SDL model in terms of predictive accuracy.

Keywords: Deep Learning, Genetic Algorithm, Prediction, Loss function, Rainfall

1. INTRODUCTION

1.1 Rainfall Prediction: Rainfall prediction is essential for effective proper water management, agriculture, drought assessment and other purposes **Lamine et al., (2020)**. Rainfall is random occurrence, and its prognosis is always challenging task for meteorologists in terms of complexity and technology **Shardoor and Mandapati, (2018)**. Rainfall plays a crucial role in agriculture, so accurate prediction of rain is good for better economic growth of the country **Satish et al., (2019)**. Meteorologist uses the traditional methods to predict the amount of rain by analyzing historical data. Still, it has not achieved accuracy because rainfall is non-linear and dependent variables are not constant **Shardoor and Mandapati, (2018)**. Clustering, Decision Tree, Artificial Neural Networks, Genetic Algorithm, machine learning, etc., are the different dynamic approaches for rainfall prediction.

1.2 Deep Learning: Deep Learning (DL) is a subset of machine learning that employs Neural Networks (NN) to learn both supervised and unsupervised data **Patel and Morena, (2020)**. It takes X as an input value to predict Y as an output value. DL utilized NN to discover the relationship between a set of inputs and outputs. NN is made up of three layers: input, hidden, and output. The input layer accepts numerical data representations, while the output layer holds the predicted data. Based on the input and output layers, the hidden layers correlate the computations performed [18]. The DL model benefits from implementing a single model since the features in the data are collected and classified as a single classifier **Aswin et al., (2018)**. Nowadays, DL is an effective neural network-based method for solving complicated problems in weather forecasting, automated voice recognition, computer vision, natural language processing, and in many other areas **Giang et al., (2019); Hamideh et al., (2020)**.

1.3 Genetic Algorithm: The Genetic Algorithm (GA) is a search optimization approach based on Charles Darwin's Genetics and Natural Selection theory, which describes a biological process in which the fittest individuals are likely to prevail in a competitive environment **Man et al., (1996)**. GA works on five main principles, i.e. initial population, fitness function, selection, crossover and mutation **Haldurai et al., (2016)**. The GA flow graph is depicted in Fig. 1.

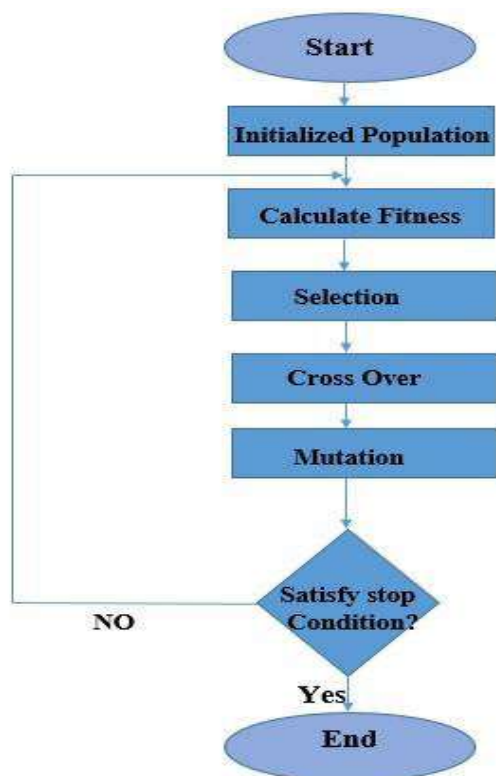


Fig. 1 Genetic Algorithm flow graph

1.4 The Keras framework: Keras is an excellent high-level open-source neural network API framework written in Python **Patel and Morena, (2020)**. It is built on the top of the Theano, CNTK and Tensor flow, allowing users to sharply implement train and test networks. Francois Chollet has developed and maintained Keras using four principles: User-friendliness and minimalism, Modularity, Easy extensibility and work with python **Giang et al., (2019)**. Keras provides customizability and an easy-to-use framework by encapsulating the low-level complexity of the complicated aspects of Tensor flow **Jordan et al., (2020)**.

1.5 Loss Function: The function that computes the distance between actual and predicted values is known as the loss function. The learning algorithm's goal is to reduce the error caused by the loss function during training **Divish et al., (2020)**. A smaller loss value implies better prediction and vice versa. The loss functions required to calculate the model error are mean absolute error (MAE), hinge, mean squared error (MSE), binary cross-entropy, mean squared logarithmic error (MSLE) and others **Patel and Morena, (2020)**. Cross-Entropy is a robust loss function applied to many deep learning algorithms **Hamideh et al., (2020)**.

2. RELATED WORK

Satish, S. Srinivasulu, and R. Swathi created a Hybrid Genetic Algorithm-based approach to solve the rainfall prediction challenge in a given time period. In this approach, a genetic algorithm utilizes a dimensionality reduction technique and a Multi-layer Perceptron for efficient and dynamic analysis of real-time data. It is then coupled with a deep neural network-based framework to accurately predict rainfall in a specific location. This study used the data collected from the "Kerala meteorological" dataset. Their proposed genetic algorithm-based strategy, coupled with a deep neural network framework, has demonstrated great performance with normalizing datasets and surpasses several existing techniques in predicting accuracy **Satish et al., (2019)**.

To predict the SET50 stock index movement, Montri Inthachot, Veera Boonjing and Sarun Intakosum have developed a hybrid intelligence of ANN and GA models. ANN is the most accepted method for predicting future trends based on previous data, whereas GA is an efficient feature selection method using ANN's input variables. The study made use of a Thailand Stock Exchange dataset of daily SET50 index closing times from January 5, 2009 to December 30, 2014. (1,464 days). The hybrid model sought to outperform the ANN model in terms of prediction accuracy. The hybrid model's test results indicate 63.60 percent average prediction accuracy and a 12.4011 percent improvement in prediction accuracy over the prior ANN model **Montri et al., (2016)**.

To process a large amount of data for rainfall prediction, Meng-Hua Yen and his team used effective and speedy algorithms, namely, the Echo state network (ESN) and Deep Echo state network (DeepESN) model. From 2002 to 2014, this study made use of hourly meteorological data gathered from the Tainan Observatory in southern Taiwan. The seven parameters used to predict rainfall are air pressure, temperature, humidity, wind speed, wind direction, precipitation, and sea level. The results of the tests demonstrated that the ESN and Deep ESN models are adequate for rainfall forecasting. According to the research, the Deep ESN model outperforms the back propagation network, Supporting Vector Regression, and MATLAB models in terms of rainfall prediction **Meng et al., (2019)**.

To assist farmers in agriculture, R.Kingsy Grace and B.Suganya have developed Machine Learning based rainfall prediction model using Multiple Linear Regression (MLR) for the Indian dataset. This study analyzed the data collected gathered from publicly available sources. The given model is validated using parameters such as accuracy, correlation, and Mean Square Error (MSE). As a consequence, it is determined that the model outperforms techniques such as Linear Regression, Feed Forward with Back –Propagation, LSTM and ConvNet, Deep Convolutional Neural Network, and others found in the literature **Grace and Suganya, (2020)**.

Hatem Abdul-Kader and his team have developed the hybrid Machine Learning technique to forecast rainfall. Particle Swarm Optimization (PSO) and Multi-Layer Perceptron (MLP) were combined in the suggested hybrid method, which was then employed in a Feed Forward Neural Network (FFNN). The combination of PSO and MLP not only forecasts rain but also enhances network performance. In the first phase of the proposed hybrid technique, the neural network determines the number of neurons in all three layers, i.e. input, hidden and output and then optimal weights are automatically produced by PSO, which is utilized to train the network, in the second phase. Data used in the study are collected from the Automatic Weather Station (AWS) of New Capital Management through an astronomical site (Kottamia dome) for the year 2009. The proposed hybrid technique PSO based MLP is compared with Back Propagation (BP) Levenberg-Marquardt (LM) algorithm based MLP using Root Mean Square Error (RMSE) values. Experimental results have shown that the RMSE value of MLP based PSO is 0.14 while MLP based LM is 0.18 **Hatem et al., (2021)**.

3. PROPOSED METHODOLOGY

A deep learning approach paired with a genetic algorithm is used to build the proposed DLGA model. The model's goal is to predict rainfall based on 10 years of historical rainfall data. The DLGA model is implemented using the Keras API framework. The Binary Cross-entropy loss function is used to assess the model's performance. The proposed DLGA model approach entails gathering raw data and preprocessing it. A Deep Neural Network is used for prediction by utilizing a genetic algorithm to update the weights. The loss function evaluates the model's performance, which is then compared to SDL.

3.1 Raw Data Collection: The study employed raw data (3651 records) of 10 years of Navsari District. The data was divided into two sets: a training dataset and a testing dataset, comprising 70% (2555 records) from 2009 to 2015 and 30% (1096 records) from 2016 to 2018. Table 1 describes six input attributes that are used by both SDL and DLGA models. The output attribute is a rainfall type that is categorized into different classes [19] mentioned in Table 2.

Table 1. Input Attributes

Sr.no	Attributes	Type	Description	Measurement Unit
1.	Tmax	Numerical	Maximum Temperature	°C
2.	TMin	Numerical	Minimum Temperature	°C
3.	RH	Numerical	Relative Humidity	%
4.	WS	Numerical	Wind speed	Km/h
5.	Rf	Numerical	Rainfall	Mm

Days	DATE	Tmax	Tmin	RH%	Ws(km/hrs)	Rf (mm)
971	August 30, 2011	27.0	25.0	89.99	0.38	16.0
972	August 31, 2011	29.3	24.8	82.11	2.75	1.0
973	September 1, 2011	31.5	26.0	88.57	1.88	0.0
974	September 2, 2011	31.2	25.5	88.57	1.25	0.0
975	September 3, 2011	29.5	25.5	88.93	1.38	23.0
976	September 4, 2011	32.0	25.5	89.32	1.83	2.0
977	September 5, 2011	29.5	25.5	89.20	9.46	20.0
978	September 6, 2011	30.3	25.0	95.48	13.96	30.0
979	September 7, 2011	29.0	24.0	86.02	11.42	35.0
980	September 8, 2011	30.3	25.7	85.28	9.58	5.0
981	September 9, 2011	30.2	26.7	87.60	7.42	1.0
982	September 10, 2011	30.5	26.4	93.23	5.32	0.0
983	September 11, 2011	28.0	25.5	89.81	1.07	12.0
984	September 12, 2011	29.0	24.2	93.42	0.91	34.0
985	September 13, 2011	27.0	24.0	82.74	2.25	92.0
986	September 14, 2011	30.5	24.8	85.26	3.63	0.0
987	September 15, 2011	31.2	25.5	94.82	1.00	1.7
988	September 16, 2011	28.0	24.8	83.32	0.13	4.0
989	September 17, 2011	30.5	24.5	86.35	4.17	2.0
990	September 18, 2011	30.3	24.0	87.22	2.42	8.0
991	September 19, 2011	30.0	24.0	84.56	2.46	0.0
992	September 20, 2011	30.5	23.8	87.66	3.92	0.0
993	September 21, 2011	28.0	23.3	82.09	2.67	25.0
994	September 22, 2011	30.2	22.9	79.37	2.54	25.0
995	September 23, 2011	30.5	23.4	75.62	2.04	1.0
996	September 24, 2011	31.5	23.3	82.76	1.29	1.0
997	September 25, 2011	31.0	24.0	82.20	1.50	1.0

Fig. 2 Raw Dataset

Table 2. Classes of Output Attributes

Sr. no.	Class Type	Rainfall Range (in mm)
1.	No Rain	0
2.	Light Rain	0.1 to 7.5
3.	Moderate Rain	7.6 to 64.4
4.	Heavy Rain	64.5 to 244.4
5.	Extremely Heavy Rain	Above 244.4

3.2 Data Preprocessing and Cleaning: In data preprocessing, the missing values are replaced with the input parameters' mean value to clean the data [17]. Further, the binning process is used to partition the data into bins to set the values of the attributes. After cleaning the data, they are scaled and normalized between the values [0-1], which minimize the errors [16]. The normalization method employed to normalized data is given below [3]:

$$X_{norm} = \frac{X_t - X_{min}}{X_{max} - X_{min}}$$

Here, X_t represents the value of normalizing, X_{min} and X_{max} are the minima and maxima values registered for the variable. X_{norm} is a normalized output data.

3.3 Building the prediction model: The Keras API framework is used to develop both SDL (simple deep learning) and DLGA (Deep Learning with Genetic Algorithm) prediction model. A deep neural network employed by prediction models consists of input layers, fully connected hidden layers, output layers, and activation functions. All the input variables listed in Table 1 are fed into the prediction model to form the input layer. The hidden layer consists of fifty nodes as per the complexity of the problem. Table 2 shows the value of the output class attributes retrieved from the output layer. ReLu activation function is applied in the input and hidden layer, whereas the Softmax activation function is used in the output layer. The binary Cross-entropy loss function assesses the model's accuracy. Tables 3 and 4 show the parameters used to build the SDL and DLGA prediction model.

Table 3. Simple Deep Learning (SDL) Model Parameters

Name	Description	Value
Input Parameter	An Input Parameters used in the model.	4
Iteration	The number of rotations utilized by the model to update the weight during training.	100
Learning Rate	An estimated error that influences how the model changes when the weight is updated.	0.01
Activation Function	Assist the model in introducing and learning the data's non-linearity at each layer.	ReLU (input & hidden layer) Softmax (Output Layer)
Output Parameter	An Output Parameter used in the model.	1

Table 4. Deep Learning with Genetic Algorithm (DLGA) Model Parameters

Name	Description	Value
Input Parameter	An Input Parameters used in the model.	4
Generation	The number of rotations utilized by the model to update the weight during training.	100
Fitness Value	The best fitness value for controlling model change when weight is updated.	Change as per the best prediction.
Activation Function	Assist the model in introducing and learning the data's non-linearity at each layer.	ReLU (input & hidden layer) Softmax (Output Layer)
Output Parameter	An Output Parameter used in the model.	1

4. RESULT & DISCUSSION

In this section, the researchers will compare the performance of the SDL and DLGA models. The model's utilized dataset is 3651 records separated into a training dataset (2555 records) and a testing dataset (1096 records). The parameters used to calibrate the models are shown in Tables 3 and 4.

Table 5. Comparative statement demonstrating 'True' and 'False' prediction of SDL and DLGA model.

Model	Total Testing (1096 records)		Model Accuracy
	True prediction	False Prediction	
SDL	851	245	77.64%
DLGA	940	156	85.77%

As shown in Table 5, the SDL model predicts 851 true and 245 false values, whereas the DLGA model predicts 940 true and 156 false values. The graph below depicts the outcome in terms of model accuracy for both the SDL and DLGA models.

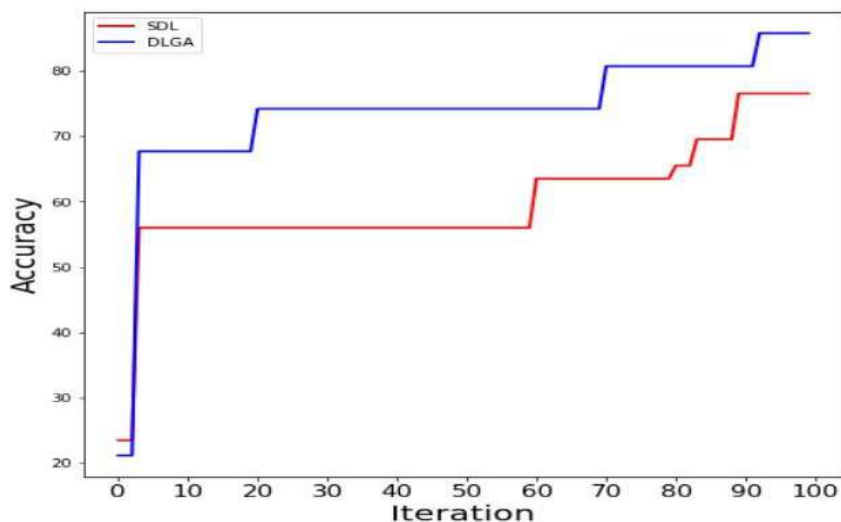


Fig. 3. Accuracy Result of SDL and DLGA Model

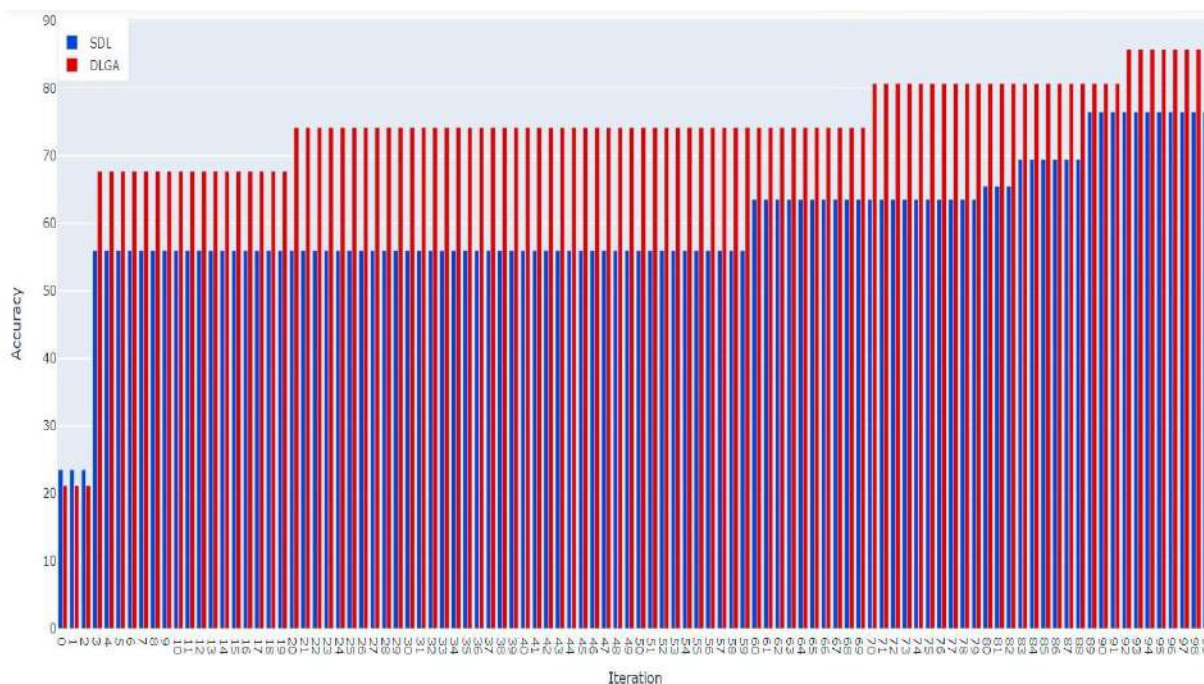


Fig. 4. Iteration wise Accuracy chart of SDL Model

Figures 3 and 4 demonstrate the accuracy gained by evaluating the SDL and DLGA models at each generation. The best accuracy obtained by SDL and DLGA models is 77.64% and 85.75% respectively.

5. CONCLUSION

In this research, SDL and DLGA prediction model is developed to predict the daily rainfall based on ten years of historical data of rainfall. The model was built in Keras API framework using a deep learning approach. This prediction is beneficial for the water management, agricultural sector, drought assessment and other related areas to make crucial decisions. The experimental results demonstrate that the performance obtained by evaluating SDL and DLGA models is appropriate for daily rainfall prediction. However, in terms of accuracy, the SDL and DLGA models predict 77.64% and 85.77% accuracy, respectively. Thus, the study concludes that the DLGA model outperformed the SDL model in terms of predictive accuracy.

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Role of Feature Selection on Performance Analysis in EDM

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ABSTRACT

In the presented work, a method is devised to recommend-cum-rank the academic efforts of the students based on the prediction results of their academic performance in their on-going courses using training data patterns of passed-out batches purely by analyzing the attributes that contribute to their academic effort, once they are admitted to their current course of graduation study. The attributes are identified that contribute the most significant to the student's academic performance using various combinations of inherent and external attributes. Novel Feature Selection Approach is formulated. Its feasibility as well as performance evaluation is also studied in arriving at descending order of attribute relevance for designing students' recommender systems. The whole simulation setup is outlined in two successive stages: Four- Attribute Feature-Extraction (FE) model and Six-Attribute Feature-Extraction (FE) model. In the previous work author performed this experiment with four attributes. Current work done with two more non changeable attributes. After completing the process of input parameter selection, total Six attributes were considered as input parameters for building Feature-Extraction-cum- Ranking model to provide student-wise counseling.

Keywords: Feature Extraction, Naïve Bayesian classification, Relief Algorithm, Nearest-Hit (Z^+), Nearest-Miss (Z^-)

1. INTRODUCTION

Research in education data mining, till date, shows that the decision making dimensions revolve merely around over all students appraisal in their course of participation. In this context, many feature selection models have been developed since two & half decades. The most striking features of data mining techniques are classification, clustering, and prediction. The prediction function estimates different types of outcomes like transferability, persistent, retention and success in study. Almost all student's performance evaluation tools declare the kind of effort they need to put in order to float through their ongoing courses. None of the prediction models is able to optimize the depth, up to what extent these extra efforts must be implemented at student levels or at teacher level so that they enter into the category of pass students.

The proposed work follows the recent research trends that focus on the objective of utilizing the prediction results in gearing up the student's academic potential during their on-going period of studies. The salient feature of the proposed learning model, (Naïve Bayes), is that it works well both for prediction as well as graded feature-relevance tasks. The results obtained from the proposed model are compared to the popular RELIEF Feature Extraction model.

2. METHODOLOGY SURVEY

Since two and half decades, the educational data mining objectives shifted from study of interactive learning environments to the study of learners' behavior, student retention issues, enrollment issues in admission processes, personalized recommender systems for students in different types of learning environments viz. face-to-face interaction logs, web-logs and collaborative classroom interactions.

One of the case study closest to current problems, Pandey and Pal (2011) used Bayesian classification method to predict the students' result divisions on the basis of previous year data base upon input attributes: "Caste Category", "Language Medium" & qualification of Eligibility ("Class").

The researchers now focused to unfold medium class teaching, defined by domain value set: {HINDI, ENGLISH, MIX}. After taking the verbal statistics upon attribute: "students' interestingness in hearing the language medium of classroom teaching"

Yadav and Pal, (2012) aimed to resolve students' enrollment management system for admissions in MCA course. They simulated a mining model using ID3 decision tree technique with test option comprising of 10-fold cross validation was selected as their evaluation criteria. A vast training data set of 432 instances from the Department of MCA, from the above university at Jaunpur were considered with the set of attributes.

3. WORKING MODEL PARAMETERS

The decide to take two category of attributes these were the : inherent (static / non- changeable / past) and external (changeable with academic effort).The data set used in this study was gathered from different sources:

Student personal data (Name, gender, cast, medium, living location, food habit...), demographic data (student's family background detail like father's occupation, mother's occupation, father mother qualification, family status and family income), past academic performance (10th and 12th examination scores, previous exposure to programming, background stream). All the mentioned attributes were inherent attributes and hence, were found not to reflect the change in prediction-model accuracy.

Hence, there was a need to take up some additional attributes (changeable) that were used to upgrade student's academic performance to an optimal level. These attributes selected were students' attendance, internal assessment scores, assignment credit, and subject count (number of subjects in which the student appeared in internal examination). Previous experiment performed with only 4 attributes and obtained accuracy was more than 80 %. In this 6 Attribute FE Model 4 attributes were changeable or dynamic and two attributes static or non-changeable were namely Lab Credit and percentage of last passed exam.

Table I. External Attributes used for Feature Extraction

Sl. No.	Name of the Parameter	Parameter Description	Domain Values	Domain Value
X1	Attendance	Student's attendance from July to January. Minimum 70% attendance is compulsory.	0..100%	+7,+5,+3, ,+1, 0, - 7,-5, -3, - 1}
X2	Assignment Credit	Assignment Credit were given by teachers in theory subject	0..10 (Marks)	0..10
X3	Internal Score	Performance in three internal unit tests	0...100%	0..3
X4	Subject count	Student appear in how many internal paper out of 10	0.....100%	0..10
X5	Lab Credit	Laboratory Score in three practical subjects	40%.....100%	1....10
X6	Past Percentage	Previous Exam Grade or score	40%.....100%	1....10

4. FEATURE EXTRACTION-CUM-RANKING MODEL /MODELLING APPROACH

The computations begin with the classification of the test-tuples into fit and unfit predictions using Naïve Bayesian Classifier. This was followed by attribute-wise fitness evaluations upon those tuples. The training data sets of 87 tuples from three passed-out batches of Second year BCA (Bachelor of Computer Application) course were processed to compute prior probabilities of „at risk“ students.

The data of Eighty seven students of college is collected who appeared for the second year of BCA course in the sessions 2009-10 to 2011-12 and stored as training data comprising of three passed out batches of

BCA. Similarly 20 instances of test data were collected from session 2012-13. Nevertheless, the authenticity of the feature-extraction model was then validated by repeating the experiments for the following scalable domains:

1. The nature of students' data sets is such that it grows inherently year after year, the experiments could easily be vertically scaled by considering more than three no. of batches as training sets and last passed out batch of
2. students pursuing second year BCA course as set of test tuples. Under similar educational environment settings, assuming that same set of instructors or subject experts teach the students of the specified course, the data sets can now be horizontally scaled by considering varied (extended) combination of attributes in order to evaluate their overall ranking on contributing to the students' performance. The proposed model was carefully developed with two-phase functionality. The first phase helped in arriving at predicted values of class variable i.e. „at-risk“ and „above-risk“ values of the test data set (students of the on-going course). This was achieved with Naïve Bayesian posterior probability computations. The expressions for the same were formulated as mentioned in 4.1 and 4.2 respectively.

$$4 .p^{x_i}$$

$$P_{fit} \{x, x, x, x\}$$

$$P_{unfit} = \prod_{i=1}^4 p_{unfit}^{x_i} \quad (4.1)$$

1 2 3 4

$$P_{unfit} = \prod_{i=1}^4 p_{unfit}^{x_i}$$

i=1

unfit

$$P_{unfit} = \prod_{i=1}^4 p_{unfit}^{x_i} \quad (4.2)$$

i=1

The higher of these posterior probabilities computed for each test tuple, pertaining to the current 2nd year batch: () and () helped in deciding the predicted risk value of each test- instance as illustrated in figure 1. It may be noted that these predicted values further contribute in defining Z+ and Z- components of the weight update expression using RELIEF algorithm.

4.1 Six-Attribute Feature Extraction-cum-Ranking Model

The subsequent computations are extracted from the individual portions of the numerator components contributing to total conditional probabilities of fitness and unfit. In order to generate the precedence order of these experimental six attributes, once again the components of the expression (4.1) and (4.2) are revisited used for computing average fitness (average_fit(xi)) and average unfit (average_unfit(xi)) of the students owing to each attribute as shown in equation (4.3) and (4.4). It was interesting to know that the fitness precedence for initially used four attributes retained the same sequence among themselves, what so ever may be the positions of the two additional attributes of Six-Attribute FE model.

Fig.4.1.1 Attribute Precedence of fitness / unfit (proposed FE model)

Name of Stud	Tuple_id	p f	precedence fitness
Adarsh Shivast	1	1	0.17-x2 0.24-x4 0.27-x1 0.31-x3 0.32-x5 0.42-x6
Anshul Lanjawre	2	1	0.23-x5 0.25-x2 0.32-x1 0.32-x4 0.36-x6 0.36-x3
Chandan Kumar S	3	0	0.00-x4 0.16-x5 0.21-x6 0.25-x2 0.31-x3 0.42-x1
Deepesh Ganjir	4	1	0.16-x5 0.40-x4 0.40-x2 0.42-x1 0.42-x3 0.42-x6
Ku. Jigyasha	5	1	0.24-x4 0.28-x6 0.31-x3 0.32-x5 0.40-x2 0.41-x1
Manoj Kumar	6	0	0.00-x4 0.16-x5 0.17-x2 0.21-x6 0.27-x1 0.36-x3
Md. Majhar	7	1	0.31-x3 0.32-x5 0.33-x2 0.36-x6 0.42-x1 0.42-x4
Mona Mandavi	8	1	0.25-x2 0.32-x1 0.32-x4 0.32-x5 0.36-x3 0.42-x6
Nandita Sardar	9	1	0.00-x4 0.23-x5 0.25-x2 0.32-x1 0.42-x3 0.42-x6
Neha Khandelwal	10	1	0.32-x5 0.40-x2 0.41-x1 0.42-x3 0.42-x4 0.42-x6
Nidhi Khandelwa	11	1	0.28-x6 0.36-x3 0.40-x5 0.40-x2 0.41-x1 0.42-x4
Pratima Soni	12	1	0.28-x6 0.33-x2 0.36-x3 0.40-x4 0.40-x5 0.42-x1
Promod Kumar Sa	13	1	0.32-x5 0.33-x2 0.36-x3 0.42-x1 0.42-x4 0.42-x6
Ruchika Pandey	14	1	0.23-x5 0.25-x2 0.36-x3 0.42-x1 0.42-x4 0.42-x6
Saleya Khatoon	15	0	0.00-x4 0.17-x2 0.23-x5 0.31-x3 0.32-x1 0.42-x6
Sanju Patel	16	1	0.00-x4 0.25-x2 0.31-x3 0.40-x5 0.42-x1 0.42-x6
Santosh Kumar	17	1	0.16-x5 0.31-x3 0.33-x2 0.36-x6 0.40-x4 0.42-x1
Suraj Tripathi	18	1	0.16-x5 0.25-x2 0.31-x3 0.36-x6 0.40-x4 0.42-x1
T. anita Soni	19	0	0.00-x4 0.23-x5 0.25-x2 0.27-x1 0.31-x3 0.36-x6
Yogendra shyam	20	0	0.14-x1 0.21-x6 0.23-x5 0.24-x4 0.25-x2 0.36-x3

The second phase was followed by relative fitness evaluation step among the participating attributes. The characteristic feature that the individual conditional probabilities upon each attribute $x_1, x_2, x_3, x_4, x_5, x_6$ together contribute for the classification task, their relative comparisons could be used to compare the degree of involvement in affecting the risk- category of the students. In order to generate the precedence order of these external attributes, once again the components of the above formulae were revisited used for computing average fitness () and average unfit () of the students owing to each attribute. Expression pairs for one such attribute x_1 are shown in the equations 4.1 and 4.2 below.

$$P_{unfit} = \prod_{i=1}^4 p_{unfit}^{x_i}$$

$$average_fit = \prod_{i=1}^4 p_{unfit}^{x_i} \quad (4.3)$$

$$i_j$$

$$4 \cdot p \cdot \text{fit} \cdot p^{x_i + 4}$$

$$p \cdot \text{unfit} \cdot p(x_i)$$

$$i=1$$

$$\text{fit}$$

$$i=1$$

$$\text{unfi}$$

$$\frac{1}{4} \cdot p^{x_i} \cdot \text{average_unfi} \cdot t = \sum_{i=1} \text{unfit} \quad (4.4)$$

$$i_j$$

$$4 \cdot p \cdot x_i + 4$$

$$p \cdot \text{unfit} \cdot p(x_i)$$

$$i=1 \text{ fit}=1$$

Then, equivalent Attribute Precedence Relations are found by computing the weight updates for Six-Attribute FE model by the two conceptualized weight initialization approaches i.e. weights in Normalized Scale and weights with prior probabilities, designated as methods I and II respectively. The Figures 4.1.1 and 4.1.2 show the comparisons of the attribute precedence relations between the Bayesian driven FE model and RELIEF FE model by computing similarity between the sets of attribute precedence relations obtained through the above mentioned models. Comparing by RELIEF method.

I, the green highlighted attribute-relations are five in number that exhibit the total match in precedence; yellow highlighted attributes exhibit partial precedence match instances: ([one relation, 25%] [nine relations, 50%] [five relations, 75%]). Comparing with relations obtained by RELIEF method II, the match % ratios are obtained as: ([NIL relation, 25%] [twelve relations, 50%] [four relations, 75%] [four relations, 100%]).

AN22	A	C	D	E	F	G	H	J	K	L	M	N	O	P	U	AB	AC	AD	AE	AF	AG	AH	AI		
1	S	1	2	3	4	5	6		1	2	3	4	5	6		1	2	3	4	5	6	Per %	%		
2	1	x6	x5	x2	x1	x4	x3		x2	x4	x1	x3	x5	x6		0	0	0	1	0	0	16.67	%		
3	2	x4	x2	x5	x3	x6	x1		x5	x2	x1	x4	x6	x3		0	1	0	0	1	0	33.33	%		
4	3	x4	x5	x2	x3	x6	x1		x4	x5	x6	x2	x3	x1		1	1	1	1	0	1	83.33	%		
5	4	x3	x5	x2	x6	x4	x1		x5	x4	x2	x1	x3	x6		0	1	1	0	0	0	33.33	%		
6	5	x4	x5	x6	x2	x3	x1		x4	x6	x3	x5	x2	x1		1	0	1	1	0	1	66.67	%		
7	6	x5	x4	x2	x6	x1	x3		x4	x5	x2	x6	x1	x3		1	1	1	1	1	1	100	%		
8	7	x2	x4	x3	x5	x6	x1		x3	x5	x2	x6	x1	x4		0	0	0	0	1	1	33.33	%		
9	8	x4	x2	x6	x5	x3	x1		x2	x1	x4	x5	x3	x6		0	1	0	1	1	0	50	%		
10	9	x4	x2	x6	x3	x5	x1		x4	x5	x2	x1	x3	x6		1	1	0	1	0	0	50	%		
11	10	x5	x2	x1	x6	x4	x3		x5	x2	x1	x3	x4	x6		1	1	1	0	1	0	66.67	%		
12	11	x4	x6	x2	x3	x5	x1		x6	x3	x5	x2	x1	x4		0	1	1	0	0	1	50	%		
13	12	x3	x6	x2	x5	x1	x4		x6	x2	x3	x4	x5	x1		0	1	1	1	1	0	66.67	%		
14	13	x5	x3	x4	x2	x6	x1		x5	x2	x3	x1	x4	x6		1	1	0	0	1	0	50	%		
15	14	x5	x2	x6	x3	x4	x1		x5	x2	x3	x1	x4	x6		1	1	0	1	1	0	66.67	%		
16	15	x4	x2	x6	x5	x3	x1		x4	x2	x5	x3	x1	x6		1	1	0	1	1	1	83.33	%		
17	16	x4	x3	x2	x5	x6	x1		x4	x2	x3	x5	x1	x6		1	1	1	1	1	1	100	%		
18	17	x4	x2	x5	x6	x3	x1		x5	x3	x2	x6	x4	x1		0	1	0	1	0	1	50	%		
19	18	x6	x5	x3	x2	x4	x1		x5	x2	x3	x6	x4	x1		0	1	1	0	1	1	66.67	%		
20	19	x5	x4	x1	x3	x2	x6		x4	x5	x2	x1	x3	x6		1	1	1	1	0	1	83.33	%		
21	20	x2	x5	x1	x4	x3	x6		x1	x6	x5	x4	x2	x3		0	1	0	1	1	0	50	%		
22																						Total			
23																						Total no of tuple of 25 %			1
24																						Total no of tuple of 50 %			9
25																						Total no of tuple of 75 %			5
26																						Total no of tuple of 100 %			5
27																						Total no of tuple of 0 %			0
28																						Average Accuracy			60 %

Figure 4.1.1 Attribute Precedence comparisons for Six-Attribute Bayesian Driven FE Model Vs RELIEF (Normalized) FE Model, (Method I)

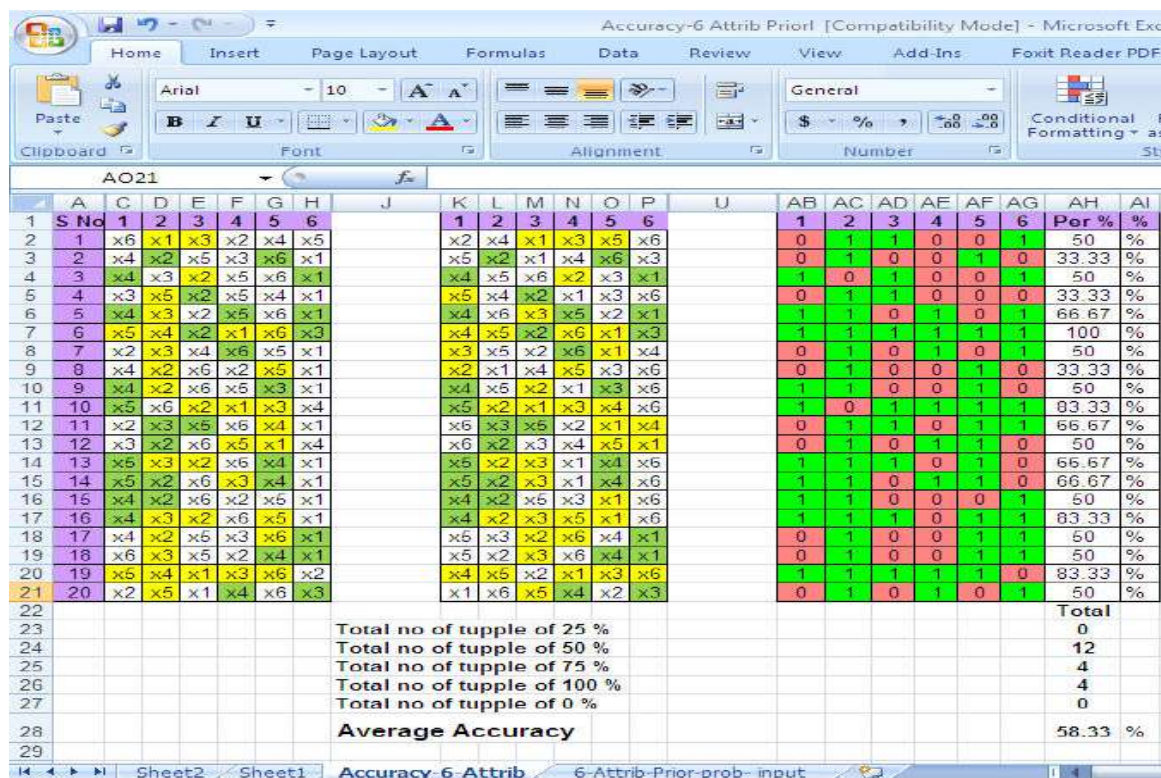


Figure 4.1.2 Attribute Precedence comparisons for Six-Attribute Bayesian Driven FE Model Vs RELIEF (Prior-probabilities) FE Model, (Method II)

5. FEATURE-EXTRACTION CUM RANKING: PERFORMANCE ANALYSIS

The performance comparisons of innovative (Naïve Bayesian driven FE) model with benchmark methodology (RELIEF based FE model) can be visualized from accuracy figures of ranking attributes in increasing order of their relevance as summarized in Table II. The tabular summary shows the p-attribute model accuracies when evaluated upon both the RELIEF benchmark settings (Methods I and II). In order to validate the overall significance of initial set of four attributes, entirely referring to students' academic efforts (put to Four-Attribute FE modeling experiment), experiments were conducted in increasing order of „p“ values; p denotes number of experimental attribute dimensions. The tabular observations show that for p=4, the model accuracy value ranges from 83% to 84%; for p=6, the accuracy reduces to span of 58 - 60% .

The comparisons with equivalent precedence relations, obtained by RELIEF benchmark FE models are shown in the accuracy tabulations as illustrated in Table 2

Table II: Performance comparisons of Four, Six Attribute Precedence Relations of Fitness

Experiment_ID	Data Sets		Modeling Attributes	Accuracy (%)	Accuracy (%)
Model Type	Training tuple count	Test tuple Count	(Proposed FE Model)	Comparison with RELIEF weights (normalized)	Comparison with RELIEF weights (prior-probabilities)
4-ATTRIBUTE MODEL	87	20	Attendance, Assignment Credit, Internal Score, Subject Count	83%	84%
6-ATTRIBUTE MODEL	87	20	Attendance, Assignment Credit, Internal Score, Subject Count, Laboratory Credit, previous Year Percentage	60%	58.33%

CONCLUSION AND FUTURE WORK

When the model accuracies are computed in for Four-Attribute FE model, the performance of the model decreased to the span of 60% and 58.33% when compared with RELIEF methods I and II.

As a matter of fact, the precedence relations for students are bound to vary with the underlying fact that a class consists of students do possess diversified academic potentials at individual level. Yet, the performance

evaluation experiments showed similar patterns of results as that exhibited with BCA data sets, i.e. decreasing order of Feature Extraction model accuracies for increasing order of attribute schemas ($p=4$, and 6) This ensured the generic functionality of the newly implemented Naïve Bayesian driven Feature Extraction model in ranking any number and any type of attributes with any kind of real- time academic domains. The Experimental set can be implemented by introducing new attributes.

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Profitability and Its Determinants: A Case Study of Regional Rural Banks Operating in Southern Region of India

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ABSTRACT

The aim of this study is to examine the profitability behavior to variation in bank specific factors of Regional Rural Banks (RRBs) operating in the southern region of India over a period 2016 to 2019. The estimated results indicate that, with the exception of risk cost all bank specific indicators significantly affect the RRBs profitability in an anticipated way. The variables influencing profits selected for the present study are CD ratio, ratio of capital to total assets, ratio of loans to total assets, ratio of operating expenses to average working fund and risk cost. The variable indicating profit is the net margin. The data is analyzed by using multiple correlation and regression techniques. Negative effect on profitability is found for the variables risk cost and the ratio of operating expenses to AWF in the study.

Keywords: Profitability, Regional rural banks, Southern region, Multiple Regression.

I. INTRODUCTION

Profit is one of the cursor representing the competence of a business unit. Profits initiated by a business unit reveal the managerial competence and appropriate deployment of its funds. The profit guarantees the efficient performance of the business unit. It promotes the stakeholders to be associated with the company. Apart from profits of a company there are many in-house factors which persuade the credibility of a company. In case of banks which carry business activities with stakeholders' money, these in-house variables play a vital role. Regional Rural Banks (RRBs) need to be profitable to sustain and serve the very purpose of their establishment way back during the year 1975.

As on March 2019, there are 53 RRBs working in India. The RRBs are operating in all the regions of India and in this study the RRBs working in the southern region are covered. 22.64 per cent of total RRBs of India are operating in the southern region in six states (Table-1). Branch network of 3921 in this region account for 17.92 per cent of all India networks of RRBs. These branches cover 15.67 per cent of the total districts of India. About 18.91 per cent of the total RRBs employees are working in this region.

Table 1- Details of RRBs working in Southern Region as on March, 2019

State	No. of RRBs	Name Of RRB	Districts Covered	No. of Branches	No. of Employees
Andhra Pradesh	3	Andhra Pragati GB	5	552	2606
		Chaitanya Godavari GB	3	218	975
		Saptagiri GB	2	220	914
Telangana	2	Andhra Pradesh GVB	22	775	3181
		Telangana Gramin Bank	18	416	1790
Tamil Nadu	2	Pallavan Grama Bank	15	219	894
		Pandyan Grama Bank	16	339	1394
Kerala	1	Kerala GB	14	633	3640
Pudicherry	1	Puducherry	2	43	108
Karnataka	3	Kaveri GB	10	506	1976
		Karnataka Vikas Grameen Bank	9	636	3525
		Pragathi Krisha GB	11	661	3389
Total Southern India	12		107	3921	17478
All India	53		683	21871	92443
Percentage to all India	22.64		15.67	17.93	18.91

Source: Compiled from Financial Statements of RRBs, NABARD, March 2019.

II. OBJECTIVE OF THE STUDY

To identify and analyze the determinants of profitability of Regional Rural Banks operating in the southern region of India is the main objective of this study.

III. REVIEW OF LITERATURE

Osuagwu (2014) has used return on equity, return on assets and net interest margin as a measure of profitability in his study on 'Determinants of bank profitability in Nigeria'. Findings reveal that the bank profitability is determined largely by the credit risk in addition to other bank specific factors.

Musaed, (2019) in his article entitled 'Exploring the Internal Determinants of Kuwaiti Banking Sector Profitability' applied OLS regression to find the effect of independent variables i.e size, leverage, managerial efficiency and asset quality of banks operating in Kuwait on the dependent variables which measures the profitability of banks i.e return on assets and return on equity. His study has revealed a statistically significant effect of size, asset quality and leverage on the dependent variables.

Bennaceur and Goaid (2008) analyzed the effect of banks internal factors and macroeconomic factors on the net interest margin and profitability of ten Tunisian banks over a period of twenty one years from 1980 to 2000 in their study titled 'The Determinants of Commercial Bank Interest Margin and Profitability: Evidence from Tunisia'. According to their observation, Size has negatively influenced the profitability of banks. Banks with large amount of capital and overheads had high profits and net interest margins.

Athanasoglou et al., (2006) examined the behaviour of bank-specific, industry related and macroeconomic factors on the profitability of seven South Eastern European banks for five years from the year 1998 to 2002. The operating expenses and credit risk variables presents a negative and significant effect on Profitability. Bank size and capital variable had a positive and statistically significant impact on profitability.

Madhuwanthi and Morawakage (2019) investigated the impact of liquidity risk on the performance of commercial banks operating in Sri Lanka over the period from 2006 to 2016. ROA, ROE and NIM are the influential variables and NPA ratio, liquidity gap and deposits to total assets are the influencing variables selected as proxy for liquidity risk in the study. Non-Performing Loan Ratio is the most significant liquidity risk factor which affects the performance indicators of the banks.

IV. DATA AND METHODOLOGY

The data related to regional rural banks operating in six states of southern region of India is collected for a period of four years and analyzed using multiple regression analysis. The data is compiled from the publications of NABARD.

The effect of banks capital on profitability (ROA) is positive and highly significant in contrast to the negative effect of banks capital on the ROE (Ponce and Antonio, 2013). A higher capital ratio tends to reduce the risk on equity and therefore lowers the expected return on equity that investors seek. In other words, a high capital ratio signifies that a bank is operating over-cautiously and ignoring potentially profitable trading opportunities (Ponce and Antonio, 2013).

The ratio of total loans to total deposits (CD ratio) is one of the influencing factors for profits of a bank as the banks business revolves around take money from those who have surplus funds and those who need money. Flamini et al., (2009), Osuagwu (2014) have used this ratio as an independent variable in their studies.

Costs of funds directly foster the fall in profits of any organization and the banks are not exceptional. High operating cost eats away the financial margin as well as net margin. The ratio of operating expense to average working fund is considered as an independent variable affecting dependent variable profit.

Loans are one of the internal factors to a bank which is expected to influence its profitability (Ahmad Al-Harbi, 2019). The amount of loans and advances sanctioned would result in flow of interest income and leads to escalate its financial margin and there after its profitability. A positive relation between loans and ROE is expected (Hoffmann, 2011). The larger the bank's loan portfolio on its balance sheet, the higher is its profitability measured both by ROA and by ROE (Ponce and Antonio, 2013). However, few studies also shown that the loans have a negative effect on profitability (Ahmad, 2019).

Risk cost plays a considerable role during the weak economic conditions of country. More number of loan defaulters will foster bad and doubtful loan assets and adequate provisions are required. The higher the risk cost, the lower will be the net margin. Direct and significant negative relationship between bank profitability and loan

quality measured through the loan loss provisions ratio is found (Ponce and Antonio, 2013). Risk cost is provisions made towards bad and doubtful debts over average working fund (AWF) with respect to RRBs.

Most common measures of bank profitability which were widely used by the researchers are the Return on Equity and Return on Assets. Return on Assets was used as an index of profitability in studies conducted by Osuagwu (2014); Musaed, (2019).

The relationship between profitability of the banks and the internal variables chosen for the study are expressed in linear regression equation and is developed based on the literature which stress that OLS model is a suitable model for studies which are directed to study the influence of explanatory variables on response variables (Naceur and Goaid, 2008), (Ponce and Antonio, 2013), (Esat et al., 2014), (Hoffmann,2016), (Iacobelli and Anthony, 2017); (Lamia and Sihem, 2018).

Net Margin (NM) referred to as return on assets (ROA) is chosen as proxy for profitability of regional rural banks which is ratio of net profit to average working fund. ROA is used as proxy for profitability in studies done by many researchers and includes Lamia and Sihem (2018), Naceur and Goaid (2008), Esat et al., (2014). Internal variables on which the profitability of regional rural banks depend and chosen for the present study are ratio of capital to total assets (TA), ratio of loans disbursed to total assets, ratio of total loans to total deposit (CD ratio), risk cost and ratio of operating expenses to average working fund (AWF). Correlation and Multiple Regression are used to analyze the data. Care was taken to avoid multicollinearity problems. The model developed is:

$$NM_{it} = \alpha_1 + \beta_1 \text{ capital to TA}_{it} + \beta_2 \text{ loans disbursed to TA}_{it} + \beta_3 \text{ risk cost}_{it} + \beta_4 \text{ CD ratio}_{it} + \beta_5 \text{ operating expenses to AWF}_{it} + e_{it}$$

Where:

NM_{it} is the response variable which indicates profitability of banks measured by Net margin appearing here as the ratio of net profit over AWF for the bank i during the period t .

$\beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are the coefficient of regression. ' α_1 ' is constant, and ' e_{it} ' is the error term.

V. ANALYSIS AND INFERENCES

The independent variables selected for the study may be highly correlated with one another. The regression coefficients become less reliable with increase in the degree of correlation between the independent variables. An attempt is made to know the correlation between independent variables by applying multiple correlation and is shown in table 2.

Table 2- Results of Multiple Correlation

	Ratio of Capital to TA	Risk Cost	CD Ratio	Operating expenses to AWF	Loans to TA
Ratio of Capital to TA	1				
Risk Cost	0.127534	1			
CD Ratio	-0.04185	0.091721	1		
Operating expenses to AWF	-0.03585	0.134423	0.684499	1	
Loans to TA	-0.54498	-0.24589	0.493621	0.486274	1

Source: Calculated by the Author

Positive and negative relationship exists among the explanatory variables as observed from table 2. The highest positive correlation is found to be 0.68 between CD ratio and the ratio of operating expenses to AWF. The correlation between ratio of capital to TA and the ratio of loans disbursed to TA is observed to be negative with 0.54. The correlation between all the explanatory variables is less than 0.70 and hence the problem of multicollinearity is not found.

Table: 3- Analysis of Regression Equation

Dependent Variable	Net Margin
Multiple R	0.653
R Square	0.427
Adjusted R Square	0.359
Standard Error	0.350
Observations	48
F-Test	6.260
Significance F	0.000*

Source: Calculated by the author * Significant at one percent level

The results of regression are depicted in table 3. From the analysis it is observed that the R square is 0.43 which indicate that 43 per cent of variation in net margin can be explained by the five explanatory variables used in the model. For the F-test the null hypothesis assigned is that none of the independent variable selected for the study is related to the profitability (NM) of the RRBs. The F-value is 6.26 and it is significant at one per cent. From this it can be concluded that, at least one of the explanatory variable in the model is related to the profitability performance of the RRBs.

Table4- Results of Regression Equation (Dependent Variable is NM)

	Coefficients	Standard Error	t -Stat	p-value
Intercept	0.795	0.587	1.354	0.183
Ratio of capital to TA	0.098	0.032	3.099	0.003*
Risk Cost	-0.061	0.098	-0.627	0.534
CD Ratio	0.106	0.028	3.765	0.001*
Operating expenses to AWF	-0.108	0.031	-3.477	0.001*
Loans to TA	0.010	0.016	-0.023	0.782

Source: Calculated by the author * Significant at one percent level

The result of the estimated model for NM is depicted in table 4. Based on the results, three out of four explanatory variables are the significant predictors of the dependent variable (NM). The explanatory variables which significantly influence are the ratio of capital to TA, CD ratio and ratio of operating expenses to AWF. Negative effect on profitability is found for the variables risk cost and the ratio of operating expenses to AWF in the study. The results are in consistence with the earlier studies such as Trujillo-Ponce and Antonio, 2013.

VI. CONCLUSION

The findings of the study prove that the variable, ratio of operating expenses to AWF of the RRBs has a negative significant impact on NM and is statistically significant at one percent level. The results are in consistence with the findings of Panayiotis Athanasoglou et al., (2006). The explanatory variables, ratio of capital to TA and CD ratio have shown a positive significant impact on profitability measured by NM and are statistically significant at one percent level. The findings of the study are similar to the study performed by Ponce and Antonio (2013); Bennaceur and Goaid (2008).

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A Study on Satisfaction towards Online Shopping With Special Reference to Government and Non Government Employess (Salaried Employees)

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ABSTRACT

The process of buying products and services over the internet is called online shopping. Now a days both rural and urban areas availing internet facilities. This is one of the reasons people choose online shopping. This study aimed to analyse the online shopping satisfaction of salaried employees(both Government and non Government). In this study the researcher used simple percentage analysis to analyse the data and to test the hypotheses ANOVA is used. It is found that more customers are aware of Amazon and Flipkart and also most of them prefer Amazon and Flipkart. This study also revealed that Educational qualification of online shoppers, online shopping experiences, Amount spent per online transaction have significant relationship with online shopping satisfaction.

Keywords: Online shopping, online shopping behaviour, ANOVA

INTRODUCTION

Online shopping is a new form electronic commerce which enables the consumer to buy directly goods and services from the seller or producer over the internet using browser. For the past few years internet became inseparable media which attached with consumers not only a networking media but also act as means of transaction for customers at global market. The modern Indian consumer is technologically awared, educated and they are comfortable with usage of internet. Today consumers are attempting to shop online due to advanced technology as well as consumer's characteristic in terms of demographic, psychographic and situational influences. Due to the accessibility of technology, the availability of the information online, convince of marketing order, delivery of products on their door steps, various offers and discounted price offers and the ability to interact, increasing number of people are including towards serious use of internet for shopping. Online shopping is a process of buying products with the help of computerized business transactions electronically using the internet. In online shopping customers are having multiple payment methods over traditional shopping. And consumers have variety of products and they can purchase products sitting at home. These characteristics of online shopping gain popularity among customers about online shopping. The Indian ecommerce market is expected to grow to US\$ 200 billion by 2026 from US\$ 38.5 billion as of 2017.

REVIEW OF LITERATURE

Scarlet(2021), has found that female customers whose annual income is high are satisfied towards online shopping and concluded that even though online sites giving branded and quality product but customers are very much attracted towards the best services of online shopping. **Tzeng et.al., (2020)** attempted to assess the effects of online retail service features on consumer satisfaction with singles' day which is the world's biggest online shopping event in online. They found that good after sales service can ease the product return process create customer satisfaction more in offline retail as compared with online retail. **Gokulanathan and Saraswathy, (2020)**, in their made an attempt to examine the customer satisfaction towards online shopping in Chennai city and found the problems faced by online shoppers. They found that gender, Variety of own family members, Annual Income, duration of Income and pre-buy choices has as advantageous impact on the customer delight. **Pratimamerugu and Vaddaddi, (2020)**, examined the major factors influencing online customer satisfaction. They identified that Ease of Use, Service reliability, responsiveness, assurance and security are the major determinants of customer satisfaction with reference to online shopping. They also found that majority of the respondents are spending one to two hours per day to access the internet. **Perera and sachitra, (2019)**, found that the factors namely Convenience, Website functionality, customer service have significant influence on customer satisfaction towards online shopping. **Lakshmanan and karthik, (2018)** found that 'Age', 'Employment status' and 'Monthly income' have significant association with online shopping decision. 'Delay in delivery' is the main problem faced by most of the respondents followed by 'Replacement of damaged goods. **Singhal and Patra, (2018)** found that 'Price', 'Convenience', and 'Brand availability' are the top three reasons for male to shop online and the female give much preference to Convenience. It was also found that men spent Rs.5000- 10,000 for a single purchase with preferred websites like Amazon.com and Flipkart.com. **Mathankumar and Velmurugan, (2017)** revealed that customers are highly satisfied with regard to price of

the product followed by discount offered and time taken for delivery of product in online purchase. It was concluded that customers who face low level of problem in their online purchase are more satisfied and so they do repetitive purchase on the same web portal. **Sudhakar and Kumari, (2016)** concluded that consumers are looking for 'Trust', 'Security and Privacy of data', 'Timeliness', 'Accessibility', 'Convenience', 'Customer service Cost' and 'Wider choice throughout online shopping'. Young customers enjoy in their online shopping process. In order to overcome the problem of lack of human interaction, interactive interface is available in online shopping. **Bama and Raga, (2016)** found that demographic factors like 'Age', 'Gender', 'Occupation' had association with Online buying behaviour and Amazon has got first rank followed by Flipkart and the tenth rank is occupied by India times. This study revealed that there is no follow up from the sellers regarding the performance of the goods and lack of awareness about sellers and lack of knowledge about technology. **Silpa et.al., (2016)** highlighted that, 'Cost of internet', 'Intangibility', 'Security and Privacy', 'No bargaining', 'Never ending wait for the product to arrive' and 'Shipping cost' were the disadvantages of online shopping. This study proposed that measures should be taken to improve quality elements of the product shopped online, assures the accuracy in the delivery. It is concluded that online shopping will take over as the prime marketing and selling channel in India in the near future. **Mahesh, (2016)** concluded that even though e-shopping has certain problems, it is widely accepted by the people as they consider it as more convenient and easier than offline shopping. **Chakraborty, (2016)** found that independent variables namely, 'Products availability', 'Time saving', 'Ease in cancellation on return', 'Reasonable price of the product' are significantly correlated with dependent variable purchase decision of consumer. **Wang et al., (2016)** suggested that e-tailers should remedy and return policy. Only through these ways retailers can minimize the risk of mistakes. **Sarvepalli and Prakash, (2016)** concluded that, companies should concentrate their strategies innovatively on mobile - app using customers but at the same time measures should be continued to retain desktop portal using customer. **Nuryakin and Naili, (2016)** indicated that the factor 'Convenience in accessing' in online store consisting the variables like 'Time flexibility in accessing information', 'Site searching facilitation', 'Place flexibility in acquiring information', have given positive influence for customers' satisfaction. This study also revealed that 'Web design', 'Information search facilities', and 'Product accessing speed' have become important part. **Kapoor and Sharma, (2016)** concluded that factors related to Content, Credibility, and Convenience significantly, positively and largely impacted the future intent to purchase online. **Rehman et al., (2016)** found that only users' perceptions are not enough for a better online shopping trading but service factors namely Technology fitness to task, Satisfaction, Confirmation of user's expectations, Usefulness and Trust play important role in growth of online shopping. Hence the business should focus more on fulfillment of online shoppers expectations. **Panda and Swar, (2016)** found from the in-depth literature review that 'Shopping orientation', 'Trust', 'Prior online purchase experience', 'Ease of use', 'Price', 'Convenience', 'Effortless shopping', 'Perceived risk', 'Privacy and Security features' etc., are the factors determining the intention in online shopping in Indian context. **Aqila et al., (2016)** confirmed that Website usability is the most important factor influencing the consumers' intention to shop online. **Keveh et al., (2016)** found that except shopping experience all the other variables are significantly related to each other. **Sharma et al., (2016)** found that the four factors namely Marketing Strategies of the 'Company', 'Delivery System', 'Product Diversity' and 'Browsing Speed' are found to be the most important factors influencing teenagers' behaviour while going for online shopping. **Anitha, (2015)** More Selection, Convenience, Better Price, and Ability to find a more personalised gift, Home page, Fun and trust are analysed. The researcher found that factors such as Time consuming for registration, Disclosure of personal information, Lack of full cost disclosure, Personal feel is missing, Website shall be thorough, Concise and uncluttered, Lengthy process for billing, Suspicion on Timely delivery of the products and Lack of trust on confidentiality of website are the problem faced by the consumers. **Jayasubramanian et al., (2015)** found that most of the consumers consider product review before shopping. They concluded that Variety, Quick service and Reduced price are the three significant factors influenced the people which shopping online. **Bhuvaneshwaran et al., (2015)** found that there is significant difference between male and female respondents with respect to the factors of customers' satisfaction towards online shopping in Flipkart site. The researchers analysed the factors related to website, Product, Payment, Delivery etc. It was concluded that, the online shoppers need to get aggressive at providing better services which can be fulfilled by reducing the Delivery time, Selling second hand products will increase consumers affordability much more and it will enhance penetration into market. **Amaravathi and Raja, (2015)** stated that, it is essential to understand the psyche of the online shoppers. Online shopping really saved a lot of time for many in this competitive world. Though the use of technology and various shopping applications in the latest gadgets available, many customers prefer online shopping based on various criteria of their personal space and based on their demographic constructs. **Aruna and William, (2015)**, found that Intangibility is the factor create dissatisfaction

to online purchasers. This study pointed out that even people prefer online shopping, though it is convenient, there are certain things like price, quality, delivery time which customer looked before online purchase. So the online website must be aware and carefully handle these factors to be successful and to retain the customers. **Mateen, (2015)** found that, Availability, Trust, Convenience and Discounts are the important determinants that insist the customers to shop online. **Dias and Ranwala, (2015)** revealed that consumer dissatisfaction was high in factors such as Response time, Security, Privacy Transaction Ability, Delivery speeds and Customer service after sales. **Kumar and Shoba, (2015)** found that element of risk in terms of Delivery of products, Safety in payments through credit card, Doubt in quality of product delivered, Fear of misusing information and Non returnable policy of goods etc., influenced the youngster decision to purchase products through online. It was also found that the largest driving factor for online shopping is convenient.

STATEMENT OF THE PROBLEM:

Occupation of the consumer plays an important role in their buying behavior. Especially in salaried employees, they are getting salary once in a month. They are very calculative in spending their money. In physical store they can see the product and they take purchase decision. But in online they take purchase decision only based on the information presented in the digital screen. So in this study the researcher concentrated the Salaried employees namely government and non government employees satisfaction towards online shopping.

OBJECTIVES OF THE STUDY:

- To analyse the online shopping behavior of the salaried employees
- To analyse the satisfaction towards online shopping of salaried employees
- To analyse the problem faced by them while shopping online

SCOPE OF THE STUDY:

In this article the researcher has studied the satisfaction of salaried employees (both Government and Non Government employees) towards online shopping.

RESEARCH METHODOLOGY:

This study is descriptive in nature. Both primary and secondary data have been used for the purpose of the study. The primary data were collected from 120 respondents through questionnaire. Secondary data collected from the journals, books, magazines and various websites. Convenient sampling technique was used for selecting samples from the study area. to analyse the socio economic factor and online shopping behaviour simple percentage analysis is used and to analyses the hypotheses , ANOVA is used.

HYPOTHESES OF THE STUDY:

H₀₁: There is no significant relationship between socio economic factors(Age, Gender, Education,Occupation,Family Monthly Income and dwelling place) and satisfaction towards online shopping.

H₀₂: There is no significant relationship between online shopping behavior (Online shopping experience, Number of times purchased, Mode of payment, Amount spent for online shopping and Willingness to recommend) and satisfaction towards online shopping.

ANALYSIS AND INTERPRETATION OF DATA

Percentage analysis has been used to analyse the demographic profile of the respondents and their behaviour regarding online shopping.

Table -1 Analysis of Socio Economic Factors

Demographic profile		Frequency	Percentage
Age	18-25	31	25.83
	26-35	50	41.67
	36-45	22	18.33
	Above 45	17	14.17
Gender	Male	68	56.67
	Female	52	43.33
Educational qualification	Below Higher Secondary	4	3.33
	Higher Secondary	2	1.67
	Graduate	39	32.50
	Post graduate	75	70.83
Occupation	Private employee	55	45.83

	Government employee	65	54.17
Family Monthly Income	Rs.10,000 and below	22	18.33
	Rs.10,001 - 30,000	39	32.50
	Rs.30,000 above	59	49.17
Marital status	Married	87	72.50
	Unmarried	33	27.50
Dwelling place	Urban	60	50.00
	Semi urban	27	22.50
	Rural	33	27.50

Source:Primary data

From Table 1 it can be inferred that out of 120 respondents 41.67% are belong to the age group 26-35 years, 56.67% are male, 70.83 % are PG degree holders, 54.17% are government employees and 49.17% of the respondents' monthly family income is above Rs.30,000, 72.50% are married and 50% are staying in urban area.

Table -2 Respondents' Online Shopping Behaviour

Variables		Frequency	Percentage
Number of years experienced in online shopping.	One year back	52	43.33
	2 -3 years back	26	21.67
	More than 3 years back	42	35.00
Number of times purchased during last year	Only one time	14	11.67
	2-4 times	67	55.83
	5-10 times	20	16.67
	More than 10 times	19	15.83
Sources of awareness	Online advertisement	45	37.50
	Friends	38	31.67
	Colleagues	02	1.67
	TV advertisement	08	6.67
	Relatives	9	7.50
	More than one of the above source	18	15.00
Payment method	Debit Card/ Credit card	18	15.00
	Mobile payment	11	9.17
	Cash on Delivery	81	67.50
	Online bank transfer	10	8.33
Amount spent per transaction	Below Rs.2000	72	60.00
	Rs.2000 to 5000	27	22.50
	Above Rs.5000	21	17.50
Willingness to recommend online shopping to others	Yes	93	77.50
	No	23	19.17

Source: Primary data

From Table 2 it is clear that out of 120 respondents, 43.33% are doing online shopping since One year back, 55.83% are shopped through online 2-4 times during last year, 37.50% of them aware about online shopping through online advertisement, 67.50% are prefer cash on delivery for payment, 60% are spent below Rs.2,000 per Online purchase. 77.50% are willing to recommend online shopping to others.

Table -3 Responses Regarding Awareness and preference towards Online shopping Sites

Awareness			Preference		
Websites	Frequency	Percentage	Websites	Frequency	Percentage
Flipkart	104	86.67	Flipkart	89	74.17
Amazon	112	93.33	Amazon	101	84.17
Snapdeal	50	41.67	Snapdeal	40	33.33
Shopclues	78	65.00	Shopclues	12	10.00
Ebay	43	35.83	Ebay	4	3.33
Jabong	27	22.50	Jabong	5	4.17

Pepperfry	15	12.50	Pepperfry	0	0.00
Bigbasket	18	15.00	Bigbasket	4	3.33
Homeshop18	3	2.50	Homeshop18	3	2.50
Firstcry	5	4.17	Firstcry	0	0.00
Myntra	26	21.67	Myntra	7	5.83
Yebhi	1	0.83	Yebhi	0	0.00
Health kart	3	2.50	Health kart	1	0.83

Source: Primary data

From the Table 3 it clear that out of 120 respondents 93.33% are aware of Amazon whereas 86.67% are aware of Flipkart. Only 0.83% are aware of Yebhi. And out of 120 respondents, 84.17 % are prefer Amazon, 74.17% are prefer Flipkart and 0.83% are prefer Health kart.

To analyses the Hypotheses, ANOVA is used and the results are presented in table 4 and table 5

Table -4 Relationship between Socio Economic Factors and satisfaction towards online shopping

S.No	Socio- Economic Factors	F	P Value	Significant @5% Level
1	Age	0.804	0.494	Not significant
2	Gender	2.313	0.131	Not significant
3	Education	3.822	0.012	Significant
4	Monthly Family Income	1.138	0.324	Not significant
5	Dwelling place	2.590	0.079	Not significant

Source: Primary data

The significance is tested at the level of 5%. The above table 4 exhibits that there is significant relationship between education and satisfaction towards online shopping. At the same time the other four factors such as Age, Gender, Family Monthly income and Dwelling place have no significant relationship between education and satisfaction towards online shopping. Hence the hypothesis that there is no significant relationship between Education and Satisfaction towards online shopping is rejected and the hypotheses there is no significant relationship between Age, Gender, Family Monthly income and dwelling place and Satisfaction towards online shopping is accepted.

Table -5 Relationship between online shopping behaviour and satisfaction towards online shopping

S.No	Socio- Economic Factors	F	P Value	Significant @5% Level
1	Number of years experienced in online shopping.	4.345	0.015	significant
2	Number of times purchased during last year	2.862	0.040	significant
3	Mode of payment	3.273	0.024	significant
4	Amount spent per transaction	5.493	0.005	significant
5	Willingness to recommend	20.453	0.000	significant

Source: Primary data

The significance is tested at the level of 5%. The above table 5 exhibits that there is significant relationship between online shopping behavior (Online shopping experience, Number of times purchased, Mode of payment, Amount spent for online shopping and Willingness to recommend) and satisfaction towards online shopping. Hence the null hypotheses that there is no significant relationship between online shopping behavior (Online shopping experience, Number of times purchased, Mode of payment, Amount spent for online shopping and Willingness to recommend) and satisfaction towards online shopping is rejected.

PROBLEMS FACED BY ONLINE SHOPPERS

Unlike traditional method of shopping, online shopping provides convenience and ease of use to the customers. Online shopping sites have larger scope in future by satisfying its customers. To sustain in the competitive world online shopping sites have to solve the problems faced by the online shopper. Table 6 shows the overall opinion regarding problems faced by online shoppers while doing online shopping.

Table-6 Overall opinion regarding Problems faced by online shoppers while doing online shopping

S.No	Statement	Score	Rank
1	Complexity of technology	404	3
2	Lack of computer knowledge	361	7
3	Terms and conditions are hidden and not clearly mentioned	382	5
4	Fake online website	382	5
5	Delay in delivery	346	8
6	Difference exists between the ordered and the delivered product	398	4
7	difference exist between price quoted and the cost paid	334	10
8	Damaged goods are not taken back	338	9
9	No scope for bargaining	419	1
10	Impossibility of product testing to assess Quality	405	2

Source: Primary data

From the above table it can be inferred that overall opinion regarding the problems, No scope for bargaining has secured highest score of 419 and has got First rank and followed by the problem of impossibility of product testing to assess quality which secured Second rank with the score of 405. The Complexity of technology has got third rank and the problem of difference exists between price quoted and the cost paid has got Tenth rank.

SUGGESTION AND CONCLUSION

Most of the online shoppers aware of amazon and Flipkart and the same sites are prefer by most of the respondents. The other shopping sites should create awareness about their sites and induce the consumers towards their sites. The findings of the study show that educational qualification of the shoppers has impact on online shopping satisfaction. It is advised to shopping sites to design the features of shopping sites to suit to all people whether they educated or not then only they can extend their customer crowd. This study specially focused on salaried employees' satisfaction towards online shopping whose spending mentality is different from other kinds of occupation namely businessman, professionals. This study also proves that mode of payment, Amount spent per transaction have significant impact on their satisfaction. No scope for bargaining is a major problem faced by online shoppers. The online shopping sites are advised to formulate solution for this problem. Even difference exist between price quoted and cost paid has got 10th rank but also it a problem for online shoppers. Online sellers should take care of this deviation in price and remove the difference exists in price. It is concluded that online shopping sites have to take steps to remove the barriers faced by online shoppers to keep them as loyal customers.

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A Study on Impact of Covid-19 on Indian Jewelry Industry in E-Commerce Era

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ABSTRACT

A few years ago, no one would have ever realized that one day the internet would be trusted for something as valuable as gold and other jewelry, and that too in India! The companies who indulged in trust-building measures like giving a Hallmark certificate with every piece of jewelry, cash on delivery service, 14 days no questions asked return policy and a fully trained customer care team which can resolve all queries explored new avenues to acquire greater hold of the market. They discovered the fact that If the component of trust and choice is intact, people will open up to online purchases.

Safety in online jewelry is also considered of highest priority by the Online companies as buying Online is quite safe in terms of supply chain as the products movement is secured with safe payment mechanisms. However, most of the times cash collection mode at the time of the delivery is exercised. Jewelry being high involvement product most successful online jewelry sites emphasizes a lot on service, before and after sales. Most importantly companies are concerned about customer care services as it is most important to gain customer's confidence.

Thus, the jewelers who wish to stay competitive in this vibrant market post-covid will need to step up their game to sell their collection online and also increase footfalls to brick & mortar stores with the technical aid of e-commerce.

Keywords: E-Commerce, Online, Jewelry, Covid-19

Indian E-commerce Industry

E-commerce offers a huge platform growing at an unprecedented rate all over the world. People from every age whether they are children, teenager, mid aged or old, prefer buying from different e-stores. This makes E-Commerce, India's fastest-growing and most adopted channel for doing commercial transactions.

The Indian e-commerce market is expected to grow to 200 billion by 2026. The remarkable growth of Indian e-commerce has aided several industries. It is aiding wider penetration of international brands and better-quality products being digitally connected with Indian shoppers with their increased awareness. This has contributed to growth in several lifestyle products, consumer electronics, clothing, footwear etc. jewelry is one of this segment highly impacted by growth in e-commerce business.

E-commerce impact on Indian Jewelry Industry

E-commerce has ensured flourishing returns for the jewelry industry. The Indian jewelry business which was once restricted to family-owned entities is now transforming with the advanced technology. At present a great proliferation in the jewelry retail outlets along with an increase in the presence of online players due to e-commerce websites and applications is witnessed. Before few years back customers were buying a small ticket size of jewelry online and were till hesitant to buy online. This scenario no more prevails as in the last 2 - 3 years internet usage has increased tremendously and this move is expected to grow as the customer's journey matures buying jewels online.

According to a study by McKinsey and Company, the share of the online jewelry market in Asia is set to double, from 10% to 20% by 2022. About 18% of the sales are expected to be made online by 2025 taking its worth to about \$79 billion annually. Estimates indicate that this would make Indian e-commerce the world's third-largest luxury market, after China and the United States. This tremendous growth opportunity has led jewelry retailers rushing to establish a presence online.

Online jewelry retailers have empowered people in Tier II and Tier III cities to shop for a variety of jewelry like; gold, silver, diamond and platinum etc. at the click of a button. Convenient delivery options supported by a variety of payment options like cash on delivery and other advantages such as easy installment and discounts have made jewelry shopping stress-free and enjoyable. As more retailers in the jewelry segment realize the huge opportunity in the e-commerce sector, the market is set to become increasingly competitive. Consumer expectations are rising and they are not just looking for the best options but also a great online jewelry shopping experience.

Covid-19 impact on Indian Jewelry business

The pandemic has transformed our lives and changed the way we look at things. It has impacted every nook and corner of our lifestyle. The weathering of the economic condition of the country has also led the jewelry industry to slow down. But, the natural calamities, recession, and many other factors haven't been able to affect this particular industry, as there has always been a demand for jewelry in the Indian market.

Indian society is more emotional and rational towards jewelry especially gold. It is not only considered just a mere investment but also a status symbol at weddings and festivals. The purchasing frequency is likely to increase soon after the effect of the pandemic wears off. All because of Covid-19, people hesitate to go for long outdoor vacations with their family members. This has resulted in saving of big traveling expenditure which is likely to be invested in gold as gold is seen as a safe haven and most trust worthy instrument during pandemic time.

Gold security investments such a Gold Exchange Traded Fund (ETF) and Government gold sovereign bonds are considered as most demanded financial instruments in this pandemic situation. Traders being actively involved in tapping upon upcoming profitable opportunities have immediately made their investments with the hope to gain brighter future returns.

A trend changes in the gems and jewelry industry every now & then. Because of Covid-19 many marriages were postponed & now post covid jewelers are hopeful about boost in sales. Post-pandemic many marriages are planned which will surge the demand for jewelry. Gold prices being too high, a shift in demand for light-weighted jewelry such as diamonds and solitaires is observed. Because of the financial constraints & more inclination towards saving money, consumers are found to be preferring simple yet elegant & gorgeous designs. All the jewelers are working hard to come up with wider assortment with reasonable price range to support this trend. Moreover, the buying pattern has shifted to online platforms as simple jewelry designs do not require the customer to go for physical visits and can be bought easily online with required ease in purchasing them.

Another aspect to be considered post-covid is the overseas sales of jewelry. With the opening of the export-import market, more earnings of the foreign currency is expected. This makes the jewelry industry more feasible in the post-pandemic period. However, doing import& exports will not be as usual due to introduction of new normal rules & regulation. Also the demand for light-weighted jewels will require manufacturers to define distributions by wholesalers and retailers. With the second wave currently settled down, also consumer demand is expected to increase in the next quarter.

The jewelry industry was struggling hard to ensure its better reach & appeal to new generation customers post-covid. The shift to digitization by offering online buying platform has lead to brighter future prospect of the industry. Jewelers are providing wonderful buying experience with their well designed websites. Customers are also comfortable making online purchases. Moreover, jewelers offers free demonstration at home & this works out as wonder in doing selection while purchasing jewelry. Thus, These factors have boosted the industry running low for several months during Covid-19.

The jewelry industry contributes about 6-7 percent of the GDP and employees over 2.5 million workers, according to FICCI. Even the Government of India has declared the Indian gems and jewelry industry as a focal point for exports. India with the advantage of low costs and inexpensive skilled labour as turned out to be global hub for cutting and polishing of gems.

During Covid-19 and after its second wave also, the industry is continuously supported by the Government. The gold prices increased tremendously during the lockdown period and achieved new heights. This growth in prices of Gold has continued till date. With this gradual growth in gold market, the industry is making steady recovery. Moreover, the experts believe that this industry will sparkle like diamond forever. Some of the following points needs to be considered cautiously.

Festival & Marriage Seasons

It has been witnessed in India that most of the sales of any industry are assured during festivals and weddings season. In jewelry industry a trend of classic and light weighted jewelry has emerged & for the coming years more such kind of collection would be in great demand. Also the demand for solitaire diamonds and classic gold pieces of jewelry during marriage & festive season is observed on

continuous basis. Thus, the festival & marriage seasons contributes to the growth of online jewelry business on account of the pandemic.

Simple designs preference

Fashion keeps changing. Earlier very heavy jewels were in fashion & now light weighted and elegant and simple jewelry is the preferred trend. The companies like tanishq has come up with Mia Collection which is specifically designed for working women considering their need of simple yet classy looking jewelry which is wearable in the offices on daily bases. This collection is offered with customization option of 18 carat and 14 carat jewelry. It helps customers to buy their selected designs in low range also. Thus, with the growing need of people to look sophisticated with jewelry, a high demand for simple jewelry pieces has emerged. This light weighted designs comes in reasonable budget making it convenient to buy them online.

Growing digitization

The rise in digital shopping and social media is contributing to the growth of online jewelry business. Easy payment options, free home delivery, free demonstrations, Easy returns etc facilitate buying online. However, buying heavy jewelry online is not much preferred as it involves huge investment & ultimate look of that jewelry after wearing it can be experimented at the store only.

Delightful Customer Experience

Its very important to provide a delightful and hassle free online shopping experience which customers would like to repeat for ensuring more sales online. This will also create positive word of mouth publicity which in turn would work out as free of cost advertisement for the jeweler. A courteous and well trained staff handling online queries is a must for assisting customers in making their purchase online. Jewelry being high involvement product with many technicalities demands appropriate assistant of the executive while purchasing online. This will help in overcoming the limitation of online purchasing wherein active face to face interaction with the company executive for doubt solving is not done.

Growing Online jewelry business in India

Online jewelry business in India is in its nascent stage. However, the Indian jewelry e-tailers are catering to the needs of the entry-level as well as high end customers requirements. Moreover, a change in consumer buying behavior is noted because of growing preference for buying online to avail the benefits of free home delivery, free demonstrations, more scheme & wider availability of varieties to choose from. Considering the same, online retailing of jewelry seems to be the preferred mode for reaching the customers spread across the different places without making the huge investments in setting up a physical store.

With the growing demand of online retailing of jewels within some time even the most traditional jewelry outlets will venture into online retailing of their jewels as buyers now a days are found to be searching for different designs & collections online prior to visiting the traditional store. Also they compare the jewelry range, designs, making charges online before deciding upon their final purchase. Thus, online presence of the jewelers will ensure better opportunity for growing along with the businesses in short time period.

Reasons contributing to growth of jewelry e-tailers

There are many challenges of doing online jewelry business like buyers requirement to see & try the design before purchasing, not much acquainted to purchasing online, no trust etc. These challenges are overcome by online jeweller by their lucrative offers of best deals, Cash On Delivery option, free home delivery with required security etc. This helps in assuring the purchase of jewelry online. Also the prospective buyers are able to search about the brand, could analyse & compare the designs before buying through online sales. This will further help in bridging the gap that exists between awareness and purchase of the jewelry.

Online Jewelers Business Moves

CaratLane- A Tanishq partner is the largest online jeweller. Its website receives more than 500,000 page views and records more than one thousand transactions every month. It offers 5000+ Stylish Designs starting from Rs. 2,700. It also provides designs of Diamond jewelry starting from very reasonable range of Rs. 5000. Moreover, it assures customers with lifetime exchange policy, 100% certified jewelry, 15 days money-back policy and one year warranty. To provide the add on facilities the company has also set up its jewelry stores at metropolitan cities like Delhi, Mumbai, Ahmedabad, Hyderabad etc.

Bluestone is the another gold and diamond online jewelry retailer in India. It offers wide collection of jewelry with the latest designs. Considering the pandemic situation, the company urges its customers to stay home and stay safe by buying all the designer collections from its website. It also offers lifetime exchange, certified jewelry, gold saving plans, free shipping, 30 days money back policy, try at home policy to make customer rest assured while making purchase of jewelry online. All because of these, the company does over 3500 transactions in a month.

Thus, the companies set up along with the understanding that online retail jewelry business in India is poised for a huge growth are growing tremendously in this pandemic situation wherein customers most preferred mode of purchasing all the things is online. With the increase in the trust factor while buying online most of the jewelry retailers are tapping the opportunity by setting up their online presence. This will lead precious jewelry market to newer heights in Covid-19 situation. Thus, the growing shift towards digitization is revolutionizing the jewelry and lifestyle ecommerce scene in India with focus on providing affordability, best quality and delightful user experience. Moreover, online retailers are addressing all the customer doubts during purchase of jewelry online through active phone conversation via Customer Care Centers. To resolve certain issues like ring & bangle size, online jewelry retailers are sending dummy ring & bangle for size verification

Also the online jewelry retailers like StyleMyDiamonds.com which is the retail wing of Diamonds Factory-London has entered in Indian jewelry industry. It offers specialized service to customize jewelry at no additional costs. The brand is London based and is serving customers across 70 countries. Considering the growing ecommerce space in India, it had entered Indian retail space in online mode initially many years back but that time online mode not being highly preferred by Indian customers for buying gold & diamond, it had to open physical stores also. At present due to Covid-19 situation, now customers are increasing their preference for buying online even the products like real diamonds. Moreover to facilitate online sales & to augment the online buying experience buying guides are provided to assist the customers in resolving all their queries while making online purchase. This buying guides engages in live chat or conversation with customer to resolve all the product related doubts.

However, most of the online jewelry retailers USP lies in offering highest quality diamonds, gold, platinum and real gems as well as introducing frequently new designer jewelry collections. This ensures their excellence in achieving customer satisfaction. Thus, the online jewelry retailers in the coming years will further increase their market share by penetrating in the existing market more easily in consideration to the present situation of Covid-19 wherein most preferred mode for purchase has been online even in case of high involvement products like real jewelry.

Future prospects of online jewelry business

With the growing ecommerce based businesses, the potential for online jewelry business has grown tremendously. Moreover at present organized online jewelry market is less than 2%. This provides the huge opportunity to be explored by jewelers by ensuring their online presences and overcoming the limitations of physical stores like big investments, limited reach, higher operating expenses etc. Considering the same, most of the established jewelry stores have ensured their online presence through atleast maintaining well designed websites allowing online buying & selling of jewelry.

Also the gold prices increasing day by day, the existing players have shown double fold growth year on year. In the near future, many more jeweler are expected to venture in online jewelry business in India as now Indian customers have developed required level of acquaintance in buying online & the situation of Covid-19 supports the functioning of online jewelers which assures stay home stay safe principle. Thus, the online jewelry retailers future seems to sparkle like diamond & shine like gold as they have been successful in delighting the customer. Few years back in India, gold jewelry and real diamonds as well as other precious gems were only bought from the trusted family jeweller. But now due to Covid-19 situation customers are relying upon online platform for making most of their purchases. In such a situation, online jewelers future prospects seems much more brighter with more and more people buying jewelry online.

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A Study of Environmental, Social and Governance (ESG) Theme Based Funds in India

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ABSTRACT

Traditional investing delivers value by translating investor capital into investment opportunities that carry risks commensurable with expected returns. Sustainable investing tries to balance traditional investing with environmental, social, and governance (ESG) related insight to improve long-term outcome. The motive behind ESG theme based investing is that the investments in environmentally and socially conscious companies having vigorous governance policies enhance the company's value and eventually result into financially profitable investment. An increasing number of investors have now become ESG conscious and are calling for their money to make a positive impact on society and the world at large. Under the ESG umbrella there are 10 funds available in India, the oldest being SBI Magnum Equity ESG Fund. These funds look for stocks that adhere ESG principles. The research paper tries to study and analyse the various ESG theme based Mutual Fund investments in India. The study is exploratory in nature to provide insights and understanding. The study is based on secondary data sourced from Published reports like Government reports, NSE, BSE and other official websites. The study findings will lend support to the case of ethical investing in India.

Keywords: Environmental, Social and Governance, ESG Principles, Mutual Fund.

INTRODUCTION

ESG is the abbreviation of environmental, social, and governance. Environmental, Social, and Governance (ESG) investing uses a framework taking into account three factors when selecting companies to support: environmental (the effects on the earth), social (the impact on society), and governance (how the company is run).

A healthy ESG practice helps an organisation to maintain good credibility or reputation. They carry lower risk probability because they incorporate sustainability as a core value. This results in steady and more long-lasting performance for the business over the years. So for any organisation that is performing well today and hoping to maintain this development in future will have to be ESG compliant. Companies that are operating on best ESG principles can attract funds from those investors who are also ESG conscious. ESG funds are mutual funds and ETFs with the asset allocation mostly including shares and bonds of companies that are evaluated based on the factors of environmental, social, and governance principles.

In a study for Sustainable Investing of ESG theme based mutual funds and ETFs by Morgan Stanley Institute, it was found that there is "no financial trade off in the returns of sustainable funds as compared to traditional funds, and that they demonstrate lower downside risk". The study found that sustainable funds experienced a twenty percent smaller downside deviation than traditional funds. Besides, the study found strong statistical evidence that during a period of extreme volatility, sustainable funds are more stable.

A Study by Organisation for Economic Co-operation and Development (OECD) - ESG Investing: Practices, Progress and Challenges, explained that ESG investing exists within a broader spectrum of investing based on financial and social returns. On one side of the spectrum, pure financial investment is pursued to maximise shareholder and debtholder value through financial returns based on absolute or risk-adjusted measures of financial value. At best, it assumes the efficiency of capital markets will effectively allocate resources to parts of the economy that maximise benefits, and contributes more broadly to economic development. On the other side of the spectrum, pure social investing, such as philanthropy, seeks only social returns, such that the investor gains from confirming evidence of benefits to segments or all of society, in particular related to environmental or social benefits, including with regard to human and worker rights, gender equality. Social impact investing seeks a blend of social return and financial return – but the prioritisation of social or financial returns depends on the extent to which the investors are willing to compromise one for the other in alignment with their overall objectives. Within this spectrum, ESG investing focuses on maximising financial returns, and utilises ESG factors to help assess risks and opportunities, particularly over the medium to long-term.

ESG in India

ESG is playing a material role in the decisions of governments, regulators, investors, lenders and corporates, which will not only transform the investment management industry, but also redefine corporate India's approach to risk management for sustainable value creation (Mr. Ashu Suyash, MD & CEO, CRISIL).

ESG theme is evolving in India in the last few years with a stream of policy reforms that have led to the greater inclusion of ESG in Indian organisations. Regulators are also taking a number of steps to lay the ground for ESG Investing. In the year 2007, Reserve Bank of India (RBI) issued a letter to all scheduled commercial banks, advising them on their role on Corporate Social Responsibility, sustainable development and non-financial reporting. In the year 2008, CRISIL, Standard & Poor, KLD Research & Analytics launched the S&P ESG India Index, first investable index of companies whose business strategies and performance demonstrate a high level of commitment towards meeting ESG standards. In 2009, the Ministry of Corporate Affairs (MCA) published Corporate Social Responsibility (CSR) guidelines. In 2010, the Department of Public Enterprises (DPE) issued CSR guidelines for Central Public Sector Enterprises (CPSEs), requiring Public Sector Enterprises to have a CSR policy approved by their respective board of directors. SEBI mandating corporates having a certain turnover and profitability to spend 2% of their earnings towards CSR Activities in 2014 to most recently, in 2020, making it mandatory for top 1000 listed companies (by market capitalisation) from FY 2022-2023 to Publish a Business Responsibility Report along with the Annual Report.

A number of sustainability Indices are also launched by both Bombay Stock Exchange (BSE) and National Stock Exchange (NSE). S&P BSE has three thematic indices launched by Asia Index Pvt. Ltd, a joint venture of S&P Dow Jones Indices and BSE: S&P BSE 100 ESG Index (considers and measures the ESG aspects of securities for sustainable investment and maintains a risk and performance profile), S&P BSE Carbonex (tracks the performance of the companies within the S&P BSE 100 index based on their commitment to mitigating risks arising from climate change and greenhouse gases emission reductions) and S&P BSE Greenex index (tracks the performance of the top 25 "green" companies in the underlying parent index S&P BSE 100). NSE also has an advanced index- Nifty 100 Enhanced ESG Index. Companies having more than 50% ESG score can become part of this index. In June 2020, a new Index- Nifty 100 ESG Sector Leaders was launched by NSE, which tracks the performance of select large-cap companies within each sector of NIFTY 100 (top 100 companies on NSE). Companies managing the ESG risk well and are not involved in any major controversies are given a high ESG score. Many third party research firms such as- Morningstar, MSCI, Sustainalytics etc. also have their own ESG indices.

Mutual funds are having investment strategies based on ESG principles and have also started using the new S&P BSE ESG Indices and NIFTY100 ESG indices for their mutual fund products. On an average, these thematic indices have given good Compounded annualized growth rates (CAGR) over last few years compared to their benchmark indices and flagship indices.

LITERATURE REVIEW

Dr. A. Anis Akthar Sulthana Banu, Dr. T. S. Bhuvanewari and Dr. Sajida Begum K. (2021), explained Socially Responsible Investment (SRI) includes assessing businesses on the Environmental, Social and Governance (ESG) screens and assessed the efficacy of the ESG Equity Fund in the investment portfolio of mutual fund investors. The study analysed SBI Magnum Equity Mutual Fund and analysed that average assets under management grew to 2690.30 crores from 1601.80 crores in the last 5 years, with an annual growth rate of 13.59 per cent in capital appreciation and suggested that in order to draw more buyers to the ESG Funds, SBI should create a more successful portfolio and carry out an in-depth analysis of the ESG conformal industries.

Gaurav Talan and Gagan Deep Sharma (2019), conducted a systematic review of the research work in the field of sustainable investment for identifying research gaps and laying down research agenda for the future. A total of 225 papers were found through the search criteria, out of which 213 papers were selected for review that suggested an addressal mechanism for the problems of reliability, inconsistency, institutional retrogression, and other barriers being faced by existing sustainable investment strategies and also suggested that a more holistic approach of sustainable investment may be developed as an alternative to the existing ESG framework. Furthermore, the impact of this alternative framework vis-à-vis the existing ESG framework can be studied by measuring financial and extra-financial returns obtained out of companies screened through these approaches.

Shipeng Yan, Fabrizio ferraro, Juan Almandoz (2018), contributes to a better understanding of the country-level institutional factors that foster SRI founding and examined how certain alternative logics—those of unions, religion, and green political parties— moderate these effects. The results shed light on how and to what extent

institutional change can occur in fields in which one institutional-logic is dominant. They also revealed country-level institutional factors that drive SRI.

Dr. Vanita Tripathi and Varun Bhandari (2015), seeks to evaluate and compare the performance of ethical mutual funds with general funds and benchmark index (S&P BSE 500 Shariah Index) in the Indian market. The study used return, risk-adjusted measures (Sharpe ratio, Treynor ratio, Jensen's alpha and information ratio), Fama's decomposition measure, paired samples t-test and growth regression equation to accomplish the objectives and from the findings suggested that some of the ethical funds generated significantly higher return than other funds and benchmark index. Despite having higher risk, ethical funds outperformed other funds and benchmark index on the basis of various risk-adjusted measures and net selectivity returns.

Arpana D. (2013), revealed more and more investors apply socially responsible screens when building their stock portfolios. This raises the question whether these investors can increase their performance by incorporating such screens into their investment process. And analysed that Investors who choose to place their money in socially responsible investing product accept that their savings are invested in activities that help people in difficulty, improving housing of society, protecting the environment or even in international solidarity

OBJECTIVE OF THE STUDY

To study and analyse the various ESG theme based Mutual Fund investments in India.

RESEARCH METHODOLOGY

The study is exploratory in nature to provide insights and understanding. The study is based on secondary data sourced from Published reports like Government reports, NSE, BSE and other official websites.

ANALYSIS AND FINDINGS

Companies that effectively manage the ESG factors through their corporate actions can provide attractive long term investment opportunities and will face significantly lower disruption risks to their business model. Therefore, companies with strong ESG practices score higher in terms of reputation and carry lower risk probability because they incorporate sustainability as a core value. This translates into steady and more sustainable performance for the business over the years.

Under the ESG umbrella there are 10 funds available in India, the oldest being SBI Magnum Equity ESG Fund. These funds look for stocks that adhere environmental, social and governance (ESG) principles. Some of the funds have an allowance for global stocks. Some are passive funds. Each has their own market-cap or sector preferences. Here is a listing (in order of inception date) of the ESG funds available in India:

Fund Name	Date of Inception	Fund Size in INR Crores – 20 th August, 2021	Performance of Direct Plan – Growth (as on 20 th August, 2021)				
			3 Months	6 Months	1 Year	2 Years	5 Years
SBI Magnum Equity ESG Fund	November 27, 2006*	4024.76	12.37	11.99	47.53	23.82	14.12
Quantum India ESG Equity Fund	July 12, 2019	47.11	12.02	14.49	52.62	30.20	-
Axis ESG Equity Fund	February 12, 2020	1963.0	12.76	12.37	48.06	-	-
ICICI Prudential ESG Fund	October 9, 2020	1861.36	11.35	13.97	-	-	-
Mirae Asset ESG Sector Leaders ETF	November 17, 2020	148.62	10.90	11.34	-	-	-
Quant ESG Equity Fund	November 6, 2020	23.07	13.22	29.24	-	-	-
Kotak ESG Opportunities Fund	December 11, 2020	1735.14	9.33	13.03	-	-	-
Aditya Birla Sun Life ESG Fund	December 24, 2020	1006.44	16.79	15.59	-	-	-
HSBC Global Equity Climate Change Fund of Fund	March 22, 2021	669.5	10.11	-	-	-	-
Invesco India ESG Equity Fund	March 18, 2021	691.14	16.20	-	-	-	-

Note: Returns less than one year is absolute and more than one year is annulaised. * The fundhas an inception date of 2006, but was repositioned as SBI ESG mandate in 2018.

ESG funds in India are still at a nascent stage but those that have been around for more than a year have shown impressive returns. According to Morningstar India, top-rated ESG funds are ICICI Prudential ESG, Kotak ESG Opportunities, Aditya BSL ESG, Invesco India ESG Equity and Axis ESG Equity.

Mutual Funds and Exchange traded funds (ETFs) based on socially responsible investment theme, that track ESG criteria, although still small in size, have the potential to grow into a mass market investment vehicle for sustainable development. There is need for more number of mutual funds to introduce ESG related investment plans. Many investors still do not know about the ESG Mutual funds. There should be dissemination of such information by the regulator, so that it reaches large number of investors.

Performance of ESG Mutual Funds in India

Performance track record is an important criterion to catch the eyeballs of investors in India. Graph 1: The point to point performance comparison of SBI Magnum Equity ESG (Direct)Growth and Quantum India ESG Equity Fund (Direct) Growth from 12th July, 2019 to 9th March, 2021 vis-a-vis the Benchmark, S&P BSE 100.



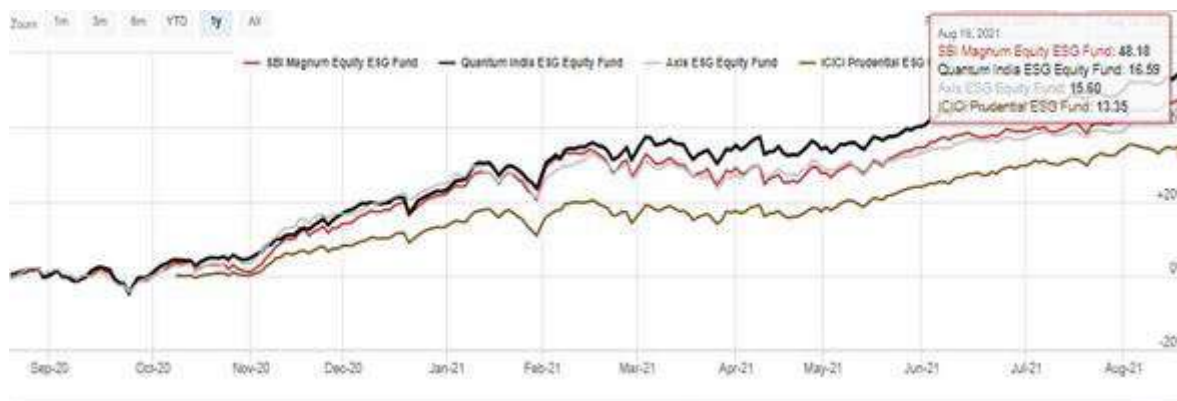
Source: moneycontrol.com/mutual-funds/compare-funds

Graph 2: The point to point performance comparison of Direct Plan - Growth of SBI Magnum Equity ESG Fund and Quantum India ESG Equity Fund from 24th July, 2019 to 19th August, 2021.



Source: moneycontrol.com/mutual-funds/compare-funds

Graph 3: The point to point performance comparison of Direct Plan - Growth of SBI Magnum Equity ESG Fund, Quantum India ESG Equity Fund, Axis ESG Equity Fund and ICICI Prudential ESG Fund (Direct Plans) from 24th July 2019 to 19th August, 2021.



Source: moneycontrol.com/mutual-funds/compare-funds

The study shows that ESG theme based funds are giving reasonable returns that are at par with those of their benchmark indices. Hence, if the investors invest in the ESG funds, they can achieve their financial objective of good returns as well.

At the same time, companies should be responsive to the fact that they will be able to attract funds for investment only if they are ESG compliant. Companies should frame robust governance policies, be transparent in disclosing their actions and disclose their performance on environmental factors and on the returns to society. By disclosing ESG information, companies enable investors to understand the impact of the business activities on sustainable development.

CONCLUSION

The sustainable finance market is rapidly growing, with investors increasingly focusing on corporate environmental, social and governance (ESG) factors in portfolio selection and management. Governance has always attracted market attention but over time environmental and social aspects will become more crucial as regulators and society demand prudence. Corporate India has enough success stories on ESG where managements have shown deeper commitment towards all stakeholders. Companies following sustainable ESG practices build a long-term enduring business model, which leads to superior risk-adjusted return.

ESG conscious, socially responsible and environmental friendly companies are believed to generate better financial returns. This will enhance the value of companies and maximize the wealth of the investors. The performance of all 3 bottom lines – Profit, Planet (environment), People (social) - are equally important, as against looking at only profit. ESG investment principles look at ‘how companies make money’ and not just at ‘how much money the company makes’.

WAY FORWARD FOR ESG IN INDIA

With regulators becoming more stringent every day, the steps that a company must take to be ESG compliant is going to get more robust in the days to come. The regulators are going to be tough on those organisations that are not following the regulations and is sure to impose penalties. A significant advantage that an ESG compliant company gets is that they will be on the safer side when the regulators come up with even more stringent rules.

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Financial Sustainability of Housing Finance Companies in India

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ABSTRACT

Financial Sustainability is helping indispensably to achieve more sustainable future for all and to accomplish Sustainable Development Goals (SDG's). The SDG's were developed in the post-2015 development agenda. SDG's are a collection of 17 interlinked global goals set up in 2015 by the United Nations General Assembly. Financial sustainability of corporation/companies is utmost important for any country in order to support accomplishing SDG's. Financial sustainability can be achieved by the companies if they take care of (1) Accessibility to capital (2) Profitability (3) Reporting and (4) Planning. Under this research paper Financial Sustainability of housing finance companies in India is studied and researcher has tried to show the financial sustainability of housing finance companies in India. To study financial sustainability researcher has considered various ratios of selected sample housing finance companies and tries to analyse that housing finance companies are financial sustainable or not. For studying financial sustainability following ratios are studies Per Share Ratios, Margin Ratios, Return Ratios, Liquidity Ratios, Leverage Ratios Turnover Ratios, Growth Ratios, Valuation Ratios. Researcher has considered 5 years for the study period that is from 2017-2021. Sample housing finance companies are taken on the basis of market capitalization. Top 10 housing finance companies are considered on the basis of market capitalization value. It is found that many housing finance companies are financial sustainable on the basis of selected ratios for the study period.

Keywords: Financial Sustainability, Housing Finance Companies, Financial Ratios

1. INTRODUCTION

Housing sector boost the economy because of its linkages to many other sectors directly. Government always tries to push housing sector to have accessibility of house to all in the economy and this sector also helps to achieve few SDG's. Housing finance companies are playing very important role in financial system. financial sustainability of housing finance companies leads to financial sustainability of whole financial system of a country. In India we have various regulatory bodies regulating and controlling housing finance sector. Regulatory and controlling bodies like RBI, NHB are framing policies and giving guidelines from time to time to smooth running to this sector. There are many Housing Finance companies which comes under the category of Non-Banking Financial Companies (NBFC's). Many housing finance companies are listed on stock exchanges. These housing finance companies provides finance to the individual and developers for housing sector. Growth of Housing finance companies means growth of housing sector and ultimately growth of economy therefor these companies must always be financial viable and sustainable. sustainability of housing finance companies can be understood with their business strategy, planning, accessibility to capital and profitability. Financial sustainability of companies can be explained through their financial performance of past years' financial data. Leverage ratio, turnover ratio, profitability ratio, growth ratio, valuation ration, Margin ratio etc. can help to understand the sustainability of any commercial organisations.

2. REVIEW OF LITERATURE

Maheshwari. S. (2010), have assessed "Financial Performance of Paper Industry in India" for 10 (ten) years from 1997-98 to 2006-07. Ratio analysis, Trend Analysis etc. financial analysis methods were used for the study. Altman's Z score model was used for analysing the financial strength of the firm, which revealed that financial health of certain paper corporations falls in unhealthy sector. Similarly, it was perceived from the study that there is a undesirable association amongst the inventory turnover ratio (ITR) and debtor turnover ratio (DTR). **Pratibha P. K., C. Krishnan (2018)**, has analysed the financial processes of Housing Finance Companies and schedule commercial banks in India and estimated their reasonable progress. The HFC's have augmented in number from 46 establishments in 2004-2005 to 71 establishments in 2015-2016. Also, the number of housing loans allowance given by Schedule commercial banks and Housing Finance Companies have increased. Numerically, Commercial banks have condensed in terms of market shares when linked with HFC's. **RBI Bulletin (2007)**, examined the performance of 1064 Government public limited establishments during 2005- 06 reliant on on their inspected yearly report closed during april 2005 to march 2006. The solidified significances of the analysis uncovered constant enhancement in the performance of the corporations saw with development in sales, assessments of production, gross profit after tax, profits reserved and net worth in 2005-06 when compared with 2004-05. **Batra, Vibha (2009)**, scrutinized the expansion implications in the

home loan marketplace and calculated the particular housing finance companies' financial operations over certain financial years. An enormous addition followed by interest rates failure, strike in monetary action, compensation in cost of property in abundant zones, and the initialization of "8% home loan schemes" have further absorbing extents to the Indian home loan markets in the on-going past. **Rao, Apparao, N. (2012)**, articulated that the resources reachable with entities are for each condition hugely gratified and housing improvement powerfully be contingent upon the budgetary institutions, through this paper, they measured main degrees of Indian financing system and encompassed the crucial issues, imminent point of view and established execution regarding Indian Housing Finance structure.

3. OBJECTIVES OF THE STUDY

- To Study financial sustainability of selected housing finance companies from the year 2017-2021 in India.
- To Analyse financial ratios of selected housing finance companies from the year 2017-2021 in India.
- To suggest measures for having financial sustainability in housing financial sector.

4. RESEARCH METHODOLOGY AND ANALYSIS

Data has been collected from the moneycontrol.com related to financial ratios of selected listed housing finance companies on the basis of market capitalisation. Top 10 housing finance company has been selected on the basis of market capitalisation as on 20th August, 2021. Selected financial ratios of sample company for the year 2017 to 2021 has been collected from the website of moneycontrol. Collected data has been analysed by mean, standard deviation, percentages, graphs. In order to see the changes and variation of financial ratios during study period, researcher has performed comparative analysis, trend analysis. To test significance of financial ratios during study period that is 2017 to 2021 of selected sample housing finance companies' ANOVA test has been performed.

Researcher has taken 11 financial ratios from 6 different categories which are elements of financial sustainability. These 6 categories are (1) Per Share Ratio (2) Margin Ratio (3) Return Ratio (4) Liquidity Ratio (5) Leverage Ratio (6) Growth Ratio. In each category of ratio few ratios are taken for the purpose of the study. List of category of ratio and selected ratios are given in this section.

List of selected sample housing finance companies on the basis of Market Cap.

Sr. No.	Housing Finance Companies	Market Cap (Rs. cr)
1	HDFC	4,90,649.03
2	LIC HOUSING FINANCE	19,570.83
3	AAVAS FINANCIERS LTD	19,235.64
4	PNB HOUSING FINANCE	11,036.47
5	INDIABULLS HOUSING FINANCE	10,171.10
6	HUDCO	8,438.01
7	CAN FIN	6,952.64
8	HOME FIRST FINANCE	4,889.90
9	REPCO HOME FINANCE LTD	1,820.54
10	GIC	763.07

List of Financial ratios considered for study

Sr. No.	Ratios	Category
1	Basic EPS (Rs.)	Per Share Ratios
2	Dividend/Share (Rs.)	
3	Gross Profit Margin (%)	Margin Ratios
4	Net Profit Margin (%)	
5	Return on Net worth / Equity (%)	Return Ratios
6	Return On Assets (%)	
7	Current Ratio	Liquidity Ratios
8	Quick Ratio	
9	Debt to Equity	Leverage Ratios
10	3 Yr CAGR Sales (%)	Growth Ratios
11	3 Yr CAGR Net Profit (%)	

In order to analyse the ratios, researcher has taken an average of selected ratios of all sampled housing finance companies for the period of study that is from the year 2017 to 2021. Further Comparative analysis has been done on year to year for all 11 selected ratios. Comparative analysis of selected ratios of selected companies are done in order to see trend of annual variations.

Table No.01: Descriptive Analysis of Selected Ratios Sampled Housing Finance Companies from the year 2017-2021

	Mean	S.E.	Median	S.D.	S.V.	K	S	Range	MIN.	MAX.
Basic EPS (Rs.)	40.68	1.11	39.73	2.22	4.94	3.62	1.89	4.70	39.28	43.98
Dividend/Share (Rs.)	7.41	0.87	7.83	1.75	3.06	-1.2	-0.8	3.73	5.12	8.84
Gross Profit Margin (%)	81.91	0.76	82.08	1.52	2.31	1.70	-0.6	3.69	79.90	83.58
Net Profit Margin (%)	17.42	0.40	17.37	0.80	0.65	-3.8	0.20	1.72	16.62	18.33
Return on Net worth / Equity (%)	13.22	0.82	13.41	1.64	2.68	-4.2	-0.2	3.35	11.36	14.70
Return On Assets (%)	1.93	0.02	1.93	0.05	0.00	0.43	-0.2	0.12	1.87	1.98
Current Ratio	31.11	8.93	34.54	17.85	318.68	0.31	-0.9	41.01	7.17	48.18
Quick Ratio	31.11	8.93	34.54	17.85	318.68	0.31	-0.9	41.01	7.17	48.18
Debt to Equity	6.05	0.28	6.17	0.56	0.31	2.26	-1.2	1.32	5.27	6.59
3 Yr CAGR Sales (%)	844.22	278.34	1062.20	556.68	309894	3.22	-1.7	1202.76	24.87	1227.62
3 Yr CAGR Net Profit (%)	335.78	105.81	413.77	211.62	44782	3.46	-1.8	468.87	23.36	492.23

Table No.02: Average Selected Ratios of Sampled Housing Finance Companies from the year 2017-2021

Types of Ratio	Ratios	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Financially sustainable
Per Share Ratios	Basic EPS (Rs.)	34.73	39.28	43.98	39.46	39.99	Yes
	Dividend/Share (Rs.)	8.53	8.71	8.84	6.96	5.12	No
Margin Ratios	Gross Profit Margin (%)	85.58	82.14	83.58	82.01	79.90	No
	Net Profit Margin (%)	17.42	18.33	17.85	16.62	16.89	No
Return Ratios	Return on Networth / Equity (%)	15.91	14.70	14.48	12.33	11.36	No
	Return On Assets (%)	1.85	1.94	1.98	1.92	1.87	No
Liquidity Ratios	Current Ratio	0.60	48.18	40.37	28.71	7.17	No
	Quick Ratio	0.60	48.18	40.37	28.71	7.17	No
Leverage Ratios	Debt to Equity	6.10	6.21	6.59	6.13	5.27	Yes
Growth Ratios	3 Yr CAGR Sales (%)	769.13	971.89	1152.51	1227.62	24.87	No
	3 Yr CAGR Net Profit (%)	386.09	406.72	492.23	420.81	23.36	No

Table No.03: Comparative Analysis of Selected Ratios of Selected Housing Finance Companies from the year 2017-2021

Types of Ratio	Ratios	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21
Per Share Ratios	Basic EPS (Rs.)	-	13%	12%	-10%	1%
	Dividend/Share (Rs.)	-	2%	2%	-21%	-26%
Margin Ratios	Gross Profit Margin (%)	-	-4%	2%	-2%	-3%
	Net Profit Margin (%)	-	5%	-3%	-7%	2%
Return Ratios	Return on Networth / Equity (%)	-	-8%	-1%	-15%	-8%
	Return On Assets (%)	-	5%	2%	-3%	-3%
Liquidity Ratios	Current Ratio	-	7880%	-16%	-29%	-75%
	Quick Ratio	-	7880%	-16%	-29%	-75%
Leverage Ratios	Debt to Equity	-	2%	6%	-7%	-14%
Growth Ratios	3 Yr CAGR Sales (%)	-	26%	19%	7%	-98%
	3 Yr CAGR Net Profit (%)	-	5%	21%	-15%	-94%

5. FINDINGS

From the above analysis it is found that maximum ratios which are considered here to find sustainability are showing decreasing trend during the study period, therefore we can conclude that housing finance companies are not financially sustainable during the study period.

Basic EPS is depicting decreasing trend over the study period. In the year 2017 average EPS was 34.73 which was increased by 13%, 12% in the year 2018 and 2019 respectively whereas it is reduced to Rs.33.46 i.e. by 10% over previous year. It can be said that considering Basic EPS ratio Housing Finance companies are financial sustainable. In the year 2020 and 2021 there is negative annual growth in Basic EPS that is because of decline in growth ratio in that year.

Dividend Per Share was Rs 8.53 in the year 2017 which has been increased to Rs 8.71 and Rs.8.84 in the year 2018 and 2019 respectively but in later years of study it is declining to Rs.6.36 and Rs.5.12 in the year 2020 and 2021 respectively.

Similarly, all other ratios show good result from 2017 to 2019 but in later years of study 2020 and 2021 it is showing decline trend. most of the selected ratios are having negative annual growth in the year 2020 and 2021. Year 2020 and 2021 result may be due to lockdown effect which limited the production and sales of the companies and most of the projects totally shut down and due to this there is decrease in sales of housing finance companies.

In the Table no.03 comparative analysis clearly discloses the annual variations in the selected average ratios of Housing finance companies. It is seen that from the year 2017 to 2019 housing companies are showing increasing trend but in later years depicts decreasing trend of the study period.

6. CONCLUSIONS

It is concluded that Housing Finance Companies are financially sustainable up to the year 2019 but in later years of the study period it is not. Most probable factor of this conclusion is lockdown effect.

If we consider study period from the year 2017 to 2019 selected housing finance companies show continuously growth in all selected ratios and therefore it can be concluded that they are financially sustainable but if we consider study period from the year 2017 to 2021 situations gets totally changed because of lockdown effect from march 2019.

7. SUGGESTIONS/RECOMMENDATIONS

In order to revive the economy and Housing Finance Companies government has to take care about housing projects minutely and refinance facility should be provided to the developer and infrastructure companies. Demand of house by people can boost housing sector and results in increasing in demand of housing finance. Government must have been taken appropriate measures and appropriate policy for housing finance sector to boost this sector.

6. APPENDIX

(1) Calculation of Average Basic EPS (Rs.) of selected Housing Finance Companies

Basic EPS (Rs.)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	19.6	8.47	31.9	38.19	27.43
REPCO HOME FINANCE LTD	45.97	44.81	37.51	32.13	29.13
HOME FIRST FINANCE	12.37	10.81	7.91	24.42	23.22
CAN FIN	34.25	28.25	22.29	21.49	17.68
HUDCO	7.89	8.53	5.89	5.04	4.21
INDIABULLS HOUSING FINANCE	27.72	51.7	95.83	90.51	68.8
PNB HOUSING FINANCE	55.29	38.45	71.19	50.52	NA
AAVAS FINANCIERS LTD	36.86	31.85	23.66	15.89	NA
LIC HOUSING FINANCE	54.32	47.63	48.23	39.85	38.49
HDFC	105.59	124.14	95.4	74.77	68.87
AVERAGE	39.986	39.464	43.981	39.281	34.72875

(2) Calculation of Average Basic DPS (Rs.) of selected Housing Finance Companies

Dividend/Share (Rs.)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	4	2	5.5	5.5	5
REPCO HOME FINANCE LTD	2.5	2.5	2.5	2.2	2
HOME FIRST FINANCE	0	0	0	0	0
CAN FIN	2	2	2	2	10
HUDCO	2.18	3.1	0.83	0.55	0.05
INDIABULLS HOUSING FINANCE	9	31	40	41	27
PNB HOUSING FINANCE	0	0	9	9	NA
AAVAS FINANCIERS LTD	0	0	0	0	NA
LIC HOUSING FINANCE	8.5	8	7.6	6.8	6.2
HDFC	23	21	21	20	18
AVERAGE	5.118	6.96	8.843	8.705	8.53125

(3) Calculation of Average Gross Profit Margin (%) of selected Housing Finance Companies

Gross Profit Margin (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	78.18	85.27	90.87	89	89.54
REPCO HOME FINANCE LTD	88.09	89.04	91.21	86.64	89.06

HOME FIRST FINANCE	75.83	77.35	75.54	74	73.59
CAN FIN	90.94	92.19	95.06	93.23	92.92
HUDCO	96.76	93.3	89.02	88.91	89.09
INDIABULLS HOUSING FINANCE	86.6	84.59	90.32	96.97	98.14
PNB HOUSING FINANCE	83.71	79.6	90.27	87.36	NA
AAVAS FINANCIERS LTD	75.35	75.07	73.63	67.46	NA
LIC HOUSING FINANCE	89.87	91.78	93.68	93.68	94.34
HDFC	33.62	51.91	46.21	44.17	57.98
AVERAGE	79.895	82.01	83.581	82.142	85.5825

(4) Calculation of Average Net Profit Margin (%) of selected Housing Finance Companies

Net Profit Margin (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	8.58	3.65	14.02	18.53	14.76
REPCO HOME FINANCE LTD	20.93	20.83	19.73	18.15	17.45
HOME FIRST FINANCE	20.98	19.95	17.58	17.63	9.45
CAN FIN	22.59	18.52	17.18	18.85	17.38
HUDCO	21.81	22.68	21.27	24.21	24.07
INDIABULLS HOUSING FINANCE	12.1	16.38	23.84	29.28	27.96
PNB HOUSING FINANCE	12.22	7.61	15.51	15.32	NA
AAVAS FINANCIERS LTD	26.18	27.59	24.78	18.84	NA
LIC HOUSING FINANCE	13.78	12.17	13.99	13.5	13.86
HDFC	9.75	16.79	10.62	9.02	14.41
AVERAGE	16.892	16.617	17.852	18.333	17.4175

(5) Calculation of Average Return on Net worth / Equity (%) of selected Housing Finance Companies

Return on Net worth / Equity (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	7.77	3.61	13.7	18.38	17.62
REPCO HOME FINANCE LTD	13.96	15.68	15.36	15.36	16.02
HOME FIRST FINANCE	7.25	8.52	8.74	7.56	2.84
CAN FIN	17.47	17.49	16.65	19.24	21.85
HUDCO	11.96	13.84	10.77	10.15	9.18
INDIABULLS HOUSING FINANCE	7.44	14.15	24.81	28.66	23.97
PNB HOUSING FINANCE	10.42	8.08	15.79	12.8	NA
AAVAS	12.03	11.87	9.58	7.81	NA

FINANCIERS LTD					
LIC HOUSING FINANCE	13.31	13.15	14.9	14.03	17.41
HDFC	11.95	16.94	14.52	13.03	18.4
AVERAGE	11.356	12.333	14.482	14.702	15.91125

(6) Calculation of Average Return On Assets (%) of selected Housing Finance Companies

Return On Assets (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	0.83	0.34	1.32	1.84	1.57
REPCO HOME FINANCE LTD	2.32	2.33	2.14	2.06	2.01
HOME FIRST FINANCE	2.22	2.28	1.84	1.83	0.88
CAN FIN	2.06	1.78	1.58	1.81	1.75
HUDCO	2.05	2.24	1.62	2.06	2.14
INDIABULLS HOUSING FINANCE	1.28	2.13	3.14	2.91	2.8
PNB HOUSING FINANCE	1.3	0.81	1.42	1.33	NA
AAVAS FINANCIERS LTD	3.22	3.25	3.12	2.3	NA
LIC HOUSING FINANCE	1.16	1.1	1.21	1.17	1.28
HDFC	2.25	2.93	2.45	2.11	2.33
AVERAGE	1.869	1.919	1.984	1.942	1.845

(7) Calculation of Average Current Ratio of selected Housing Finance Companies

Current Ratio	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	1.11	177.43	266.43	297.04	0.04
REPCO HOME FINANCE LTD	6.58	1.26	1.29	39.2	0.3
HOME FIRST FINANCE	1.44	1.36	1.26	0.37	1.49
CAN FIN	1.13	1.44	1.71	63.3	0.1
HUDCO	1.22	45.64	51.69	22.34	1.27
INDIABULLS HOUSING FINANCE	2.2	2.04	2.19	0.59	0.77
PNB HOUSING FINANCE	2.24	2.3	2.86	5.73	NA
AAVAS FINANCIERS LTD	52.31	49.05	68.81	44.3	NA
LIC HOUSING FINANCE	1.09	4.14	5	6.09	0.44
HDFC	2.37	2.43	2.5	2.81	0.42
AVERAGE	7.169	28.709	40.374	48.177	0.60375

(8) Calculation of Average Quick Ratio of selected Housing Finance Companies

Quick Ratio	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	1.11	177.43	266.43	297.04	0.04
REPCO HOME FINANCE LTD	6.58	1.26	1.29	39.2	0.3
HOME FIRST	1.44	1.36	1.26	0.37	1.49

FINANCE					
CAN FIN	1.13	1.44	1.71	63.3	0.1
HUDCO	1.22	45.64	51.69	22.34	1.27
INDIABULLS HOUSING FINANCE	2.2	2.04	2.19	0.59	0.77
PNB HOUSING FINANCE	2.24	2.3	2.86	5.73	NA
AAVAS FINANCIERS LTD	52.31	49.05	68.81	44.3	NA
LIC HOUSING FINANCE	1.09	4.14	5	6.09	0.44
HDFC	2.37	2.43	2.5	2.81	0.42
AVERAGE	7.169	28.709	40.374	48.177	0.60375

(9) Calculation of Average Debt to Equity of selected Housing Finance Companies

Debt to Equity	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	8.26	9.32	9.3	8.93	8.8
REPCO HOME FINANCE LTD	4.95	5.66	6.12	6.22	5.67
HOME FIRST FINANCE	2.21	2.67	3.68	2.61	1.8
CAN FIN	7.35	8.72	9.47	9.36	10.32
HUDCO	4.4	4.98	5.46	3.65	2.91
INDIABULLS HOUSING FINANCE	4.26	5.13	6.42	6.99	5.95
PNB HOUSING FINANCE	6.66	8.47	9.53	8.19	NA
AAVAS FINANCIERS LTD	2.64	2.55	1.99	2.3	NA
LIC HOUSING FINANCE	9.11	10.47	10.45	10.15	9.98
HDFC	2.85	3.36	3.47	3.66	3.4
AVERAGE	5.269	6.133	6.589	6.206	6.10375

(10) Calculation of Average 3 Yr CAGR Sales (%) of selected Housing Finance Companies

3 Yr CAGR Sales (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	5.29	11.68	18.35	23.22	26.65
REPCO HOME FINANCE LTD	11.38	13.51	16.21	26.47	39.82
HOME FIRST FINANCE	82.72	107.34	108.75	102.62	134.24
CAN FIN	15.31	22.5	26.28	36.36	53.04
HUDCO	31.69	46.72	31.57	11.65	5,815.11
INDIABULLS HOUSING FINANCE	-12.82	12.74	43.28	42.14	38.52
PNB HOUSING FINANCE	17.7	9,109.69	8,663.17	7,308.58	NA
AAVAS FINANCIERS LTD	49.51	2,904.25	2,564.90	2,121.64	NA
LIC HOUSING	15.61	18.7	18.38	17.94	23.29

FINANCE					
HDFC	32.27	29.1	34.24	28.25	22.38
AVERAGE	24.866	1227.623	1152.513	971.887	769.13125

(10) Calculation of Average 3 Yr CAGR Profit (%) of selected Housing Finance Companies

3 Yr CAGR Net Profit (%)	Mar-21	Mar-20	Mar-19	Mar-18	Mar-17
GIC	-28.35	-44.44	17.47	41.33	23.06
REPCO HOME FINANCE LTD	19.62	24.03	25.04	27.79	28.66
HOME FIRST FINANCE	99.34	201.18	175.81	173.86	85.82
CAN FIN	26.24	26.44	37.43	82.17	76.28
HUDCO	25.01	42.42	22.79	13.92	2,802.14
INDIABULLS HOUSING FINANCE	-43.96	-13.71	31.32	41.85	36.17
PNB HOUSING FINANCE	5.14	2,442.13	3,351.84	2,800.26	NA
AAVAS FINANCIERS LTD	76.22	1,478.10	1,226.76	864.57	NA
LIC HOUSING FINANCE	16.83	11.26	20.82	19.87	21.22
HDFC	37.51	40.69	13.05	1.6	15.33
AVERAGE	23.36	420.81	492.233	406.722	386.085

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Managerial Grid: A Brief-Up

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ABSTRACT

The present paper intends to know about managerial grid, various leadership styles, behavioural dimensions etc. The paper too projects how the grid model can be best utilized by a manager/leader. The secondary data sources are assessed to mapping of the concept. The analysis would be helpful to comprehend managerial grid for the managers/leaders or the persons related to it.

Keywords: Managerial grid, leadership, management, organizational behavior

INTRODUCTION

Leadership is an important capacity which assists in boosting efficiency to accomplish specified objectives in stipulated time. Leadership is an essential part of effective administration; leadership is characterized as the possibility to impact and drive the gathering efforts towards the accomplishment of objectives. Among various aspects related to leadership, Managerial Grid, or known as Leadership Grid, was developed in the early 1960s by management theorists Robert Blake and Jane Mouton. Managerial Grid Model assists managers to analyze their leadership flairs through a technique known as grid technique and helps to identify their concern for production and people. Indeed, the model is the zenith of discoveries in other leadership investigations and an endeavor to recognize the various ways to lead. Generally, the Managerial Grid Model has been a significant way to deal with organization development. It was, and keeps on being, one of the most broadly known intercessions in the field.

MAPPING OF THE CONCEPT

The studies of Blake and Mouton (1976), and (2000), pioneers of organizational development have developed an integrated system that represents a breakthrough in organizational development. This is the Managerial Grid, which provides a comprehensive framework for understanding the process of leadership and organizational behavior. Motivational problems have come into even sharper prominence in recent years, as corporations of all sizes and in all fields face up to issues of heightened dynamic competition, ever-accelerating technological demands, and shortages of key technical and management skills, (Kanter, 1983; 1989; Peters & Watelman 1982; Peters, 1992). In the absence of compensatory employee-focused practices, there is no doubt that these enforced changes would have significant potential to de-motivate remaining employees (Haymon & Mason, 1995). According to Blake and Mouton (1975), one of the challenges of modern times is that of developing greater managerial capability. The goal is to solve human problems of production where they originate among those who work together regardless of level. If it can be accomplished, it insures continuing "grass roots" vitality, because people remain in control of their fate. They have stakes in the outcome of their own efforts. It is likely to be the best way, long term, to preserve the right to autonomous action (Blake & Mouton, 1975). The idea that a qualified manager manages only the 'nuts and bolts' of production, without regard for people, now can be seen as a limited definition of his task, regardless of his level in the organization hierarchy (Blake & Mouton, 1975). The broader view, which maintains that production, takes care of itself when the perceptive manager manages people by motivating and communicating with them, also is a limited picture of the supervisory requirements necessary for achieving organization problem-solving competence (Blake & Mouton, 1975). Mature management demands a keen awareness of and an uncommon capability in dealing with the total complex of forces which constitutes the work culture of an organization. Yet in the final analysis, organizational culture determines the degree of effectiveness actually achieved (Blake & Mouton, 1975). How managerial style can be analyzed and categorized, whether 'style' is synonymous with behaviour and whether it is the same as, or linked to management strategy practices (Purcell, 1987). Does every organization have a managerial style by virtue of the need to employ people, or is the concept restricted only to those organizations where senior managers have taken strategic, considered decisions on the way employees are to be treated (Purcell, 1987).

According to Purcell (1987) pragmatic reactive responses to labour problems cannot be classified as management style. Style implies the existence of a distinctive set of guiding principles, written or otherwise, which set parameters to and signposts for management action in the way employees are treated and particular events handled. Management style is therefore akin to business policy and its strategic derivatives. Thus the

study of management style in employee or labour relations is not to be confused with analysis of management practices in each and every firm (Purcell, 1987). Even some years back, the Managerial Grid was introduced as a tool to gain knowledge of one's managerial style. But more recently, the Grid has become more international, and in recent research and discussion, (Yaeger, Sorensen, McKee ; 1999) have found the classical Blake and Mouton Managerial Grid is now stronger than ever, empowering people to create relationships built on candour, openness, mutual trust, and respect.

MATERIALS AND METHOD

Objective

- To comprehend about managerial grid.
- To know about various styles of leadership.

Design: The nature of the paper is descriptive, and data sources relies upon primary sources like journals, website, books, periodicals, edited volume etc. to comprehend the core and peripheral issues which are very pertinent for assessing managerial grid and leadership.

ANALYSIS

Tri-dimensional grid: A three-dimensional grid or Tri-dimensional grid is also known as 3-D management grid, borrowing some of the ideas from managerial grid. Three-dimensional axes represent task-orientation, relationship-orientation and effectiveness. Task-orientation (TO) be defined as the extent to which a manager directs his/her subordinates efforts towards goal attainment. It is characterized by planning, organizing, and controlling. By adding an effectiveness dimension to the task-orientation and relationship-oriented behaviour dimensions. Relationship orientation (RO) is defined as the extent to which a manager has personal relationship. It is characterized by mutual trust, respect for subordinates ideas to which a manager is successful in his/her position.

TYPES

- i. Missionary: S/he shows only interest in harmony; believes in the idea that was life should avoid conflicts and does not take initiative. His/her objective is to keep his/her colleagues, subordinates and superiors happy.
- ii. Autocrat: S/he is concerned with only the immediate jobs and has no concern for others; his/her decisions are unilateral and centralised, believes in suppressing and demands obedience of authority, relies more on negative motivation.
- iii. Compromiser: S/he uses a high task and relationship orientation in a situation that may not require a high concentration in either is a poor decision-maker and avoids decisions; is weak and yielding, allows various pressures in the situation to influence him/her too much.

When the style of a leader is appropriate to given situation, it is termed as effective when the style is inappropriate to given situation, it is termed as ineffective. Thus, the difference between effective and ineffective styles is often not the actual behaviour but the appropriates of the behaviour to the environment in which it is used.

Either degree of TO or RO, or a combination of both, are used by leader and on this basis, basically there are four styles as shows in following figure:

Fig: 1: Task and relationship orientation

RO	Related	Integrated
	Separated	Dedicated

There four managerial styles represent four basis types of behaviour such as:

- i. The related manager accepts other as s/he finds them, does not worry about times, sees the organisation as a social system, likes to work with others and obtains cooperation of others by setting the examples.
- ii. The integrated manager gets himself/herself and his/herself people involved with the organisation. There free two-way communication and strong identification and emphasis on teamwork.
- iii. The separated manager is concerned with correcting deviations. S/he frames rules and policies and enforces them.

- iv. Dedicated manager is domineering interested only in production, and does not identify with subordinates. S/he cannot work without power.

Furthermore, there are four corresponding effective managerial styles which are as follows:

- Bureaucrat: S/he has high orientation towards organisation rules and regulations are impersonal and less task and relationship protected produced only few ideas and does not take initiative.
- Developer: S/he tends to display implicit trust in people; relies on high relationship orientation and less task orientation believes in commitment to work openness, freedom to act self-expression and development of sub-ordinates.
- Benevolent autocrat: S/he is a directive manager who knows what s/he wants and one often gets in without creating resentment is high task and less people oriented, adopts positive economic motivation for getting things done and follow feudalistic approach in managing the organisation.
- Executive: S/he has a high task and high relationships orientations in a situation where such behaviour is appropriate; emphasizes team and manages mental task as interdependent and integrate. The style acts as a powerful motivational instrument in the organisation. This is basically a democratize leadership style.

BEHAVIORAL DIMENSIONS:

The Managerial Grid Model is based on two behavioral dimensions. These are as follows:

- i. Concern for People: The degree in times of deciding how best to achieve a task by focusing on needs have team members, their interests, and areas of personal development.
- ii. Concern for Production: The degree in times of deciding how best to achieve a task by considering high productivity, concrete objectives and organizational efficiency.

ADVANTAGES

Blake and Mouton's Managerial Grid Model was one of the most significant management models and it also provided groundwork for even more complex contingency approaches to leadership. It helps manager understand why s/he gets the reaction that s/he does from his/her subordinates. It can also suggest some alternative styles that may be variable to him/her. However it does not tell why a manger falls in one part or the other of the grid.

LIMITATIONS

The importance of internal and external bounds, matter and scenario are ignored by the model and many aspects of leadership cannot be covered in Managerial Grid Model. A Managerial Grid Model is influenced by many factors such as: including the superior, the kind of sub-ordinates supervises, and the situation in which s/he finds himself/herself.

CONCLUSION

A leader can be a manager, but a manager is not necessarily a leader. The leader of the work group may emerge informally as the choice of the group. If a manager is able to influence people to achieve the goals of the organization, without using his or her formal authority to do so, then the manager is demonstrating leadership (Alien, 1998). According to Grow and Gerald (1996), Blake and Mouton's Managerial Grid (1964) advocates a team approach as a way to maximize both productivity and personal development. This model has attempted to subsume one another and the debate between them is not over. The Grid Model provides a basis for comparison of styles in terms of two principle dimensions: concern for production and concern for people. Instead of presenting a manager with a dilemma of choosing one or the other alternative, the Grid Model shows how a leader can simultaneously maximize both production oriented methods and those that are people orientated (Blake & Mouton, 1975). Since management takes place within an organizational system, attention must be turned first to what an organizational system is. Then it will be possible to concentrate on an examination of the problems and possibilities involved in improving competence in managing it (Blake & Mouton, 1975). The Blake Mouton's Managerial Grid Model helps to think about leadership style and its effects on team's productivity and motivation. The model proposes when concern for both people and results are high, employee engagement and productivity will likely be excellent.

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Analysis of the Debate on United States Drone Program under International Law

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ABSTRACT

Virtual military technologies are taking law, war and military institutions into the enigmatic future at a breakneck speed. The demand for Unmanned Aerial vehicles (UAV) has established a great interest with many countries; especially in the United States (U.S.) in order to fight modern warfare. These advanced military technology like UAV have been instrumental in making international law relevant to armed conflicts. This relentless pursuit of new military technology has advanced the militarization of science in modern society.

This complex relations between law and use of the weapon systems, especially UAV has become a focal point of debate in the international community. Many legal scholars have debated on the conduct of United States drone program and its conformity in the international law. Further, the United States' use of drones as a means of force has questioned several legal aspects under the UN Charter. This eventually has brought new levels of transparency to question the legitimacy of military operations and related notions of what constitutes victory in war.

The relationship between modern war and modern law is made more complex by today's asymmetric conflicts, and by the loss of a shared vision about what the law means and how it should be applied.(Kennedy 2006). This paper analysis the rise of UAV drones and its implications in the modern warfare. The purpose of this paper is to study the United States' drone program from legal point of view. This paper critically analyses UN Charter and its interpretations provided by various international scholars that challenges the framework of international rule of law.

Keywords: Drones, International Law, Virtual Technology, United States, Modern Warfare, Unmanned Aerial Vehicles

1 EMERGENCE OF THE UAV DRONES

War is a product of its age, and the tools and tactics of how war is fought always evolve along with contemporary technology.

The UAVs have played a significant role in the military operations of more and more countries. The Intelligence, Surveillance and Reconnaissance (ISR) abilities of UAVs to move for long periods enabled the possibility for the conduct of persistent and real-time surveillance, tracking and rapid engagement. The currently designed and used, armed UAVs offer numerous technical advantages that make them attractive to many states, the most obvious being that they are unmanned and low cost. As compared to manned systems, systems like Reapers and Predators are relatively easy to learn to fly and use with at least some degree of effectiveness because they demand less extensive training and also the systems are relatively basic and proven.

Over the past several years, an increasing number of countries have been acquiring and developing UAVs for both civil and military applications. As per the report by Rand Corporation, more than 70 countries have acquired UAVs of different classes and for different purposes. Of these countries, the United States has the largest share of UAVs, indicating that they are also the largest spender in terms of UAV procurement and R&D with more than 10,000 systems in the U.S. military inventory alone as of July 2013.(Davis 2014)

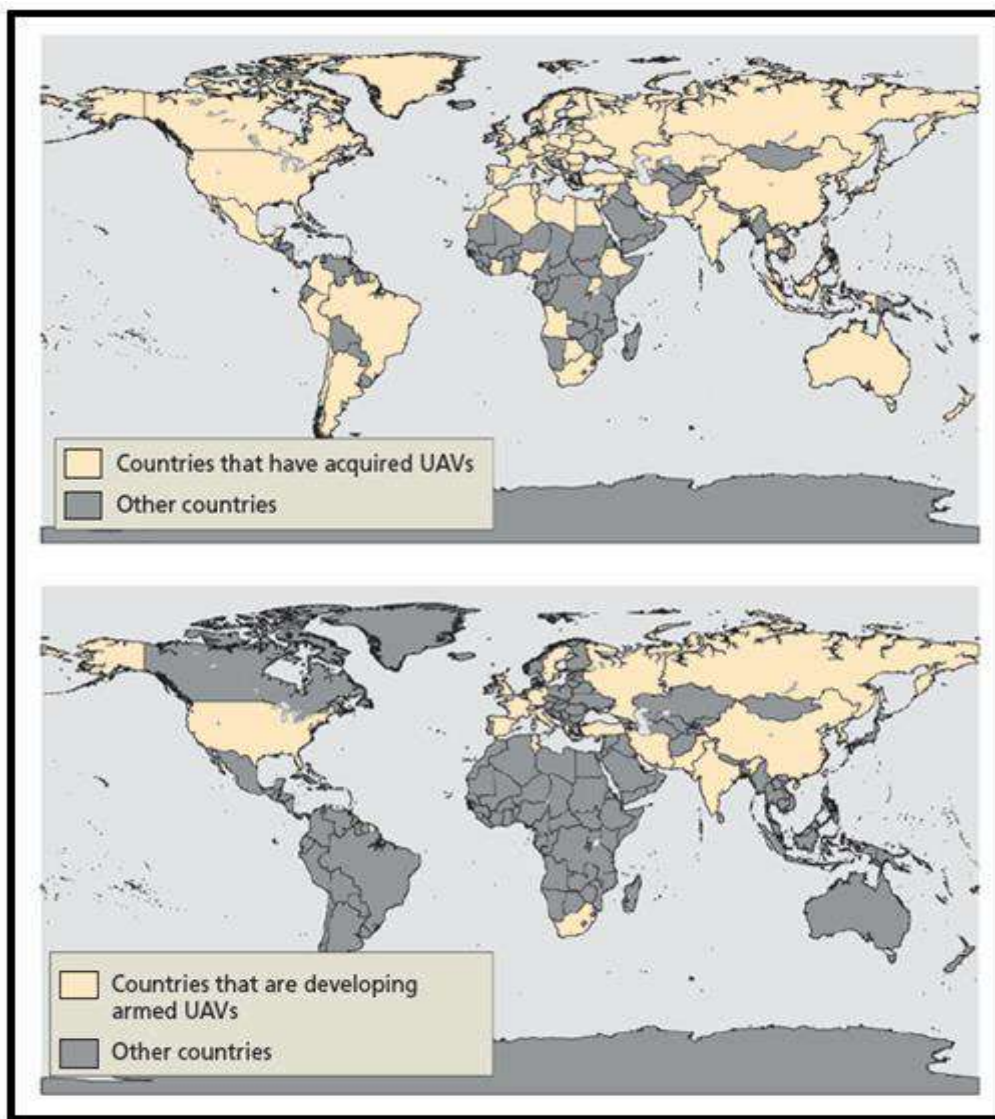


FIGURE 1. WORLD MAP OF COUNTRIES WITH UAV SINCE 2011
 Rand Corporation, 2014 (US)

DRONING ON
 The United States leads the pack, but it is far from alone in the race to obtain and deploy drone technology.

COUNTRIES POSSESSING DRONES

■ Algeria	■ Austria	■ Botswana	■ Canada	■ Croatia
■ Egypt	■ France	■ Hungary	■ Israel	■ Jordan
■ Lebanon	■ Mexico	■ Nigeria	■ Peru	■ Romania
■ Singapore	■ Spain	■ Syria	■ Tunisia	■ UAE
■ Angola	■ Azerbaijan	■ Brazil	■ Chile	■ Czech Republic
■ Estonia	■ Georgia	■ India	■ Italy	■ Kazakhstan
■ Libya	■ Morocco	■ Norway	■ Philippines	■ Russia
■ Slovakia	■ Sri Lanka	■ Taiwan	■ Turkey	■ United Kingdom
■ Argentina	■ Belarus	■ Bulgaria	■ China	■ Denmark
■ Ethiopia	■ Germany	■ Indonesia	■ Ivory Coast	■ Latvia
■ Lithuania	■ Netherlands	■ Pakistan	■ Poland	■ Serbia
■ Slovenia	■ Sweden	■ Thailand	■ Uganda	■ United States
■ Australia	■ Belgium	■ Burundi	■ Colombia	
■ Finland	■ Greece	■ Iran	■ Japan	
■ Malaysia	■ New Zealand	■ Panama	■ South Korea	
■ South Africa	■ Switzerland	■ Trinidad and Tobago	■ Ukraine	

Source: Government Accountability Office

A small fraction of the countries that have acquired UAV systems are now developing their own UAVs. In particular, more than 50 countries are developing UAVs, compared with more than 70 countries that have acquired various types of UAVs. Many of these projects exist only as proposals by commercial firms, and this does not necessarily indicate a commitment by a national government or any probability that the UAV will be built. Around 56 different types of UAVs are used in 11 different countries. Approximately, 807 drones are in active services around the world. There is a widespread manufacturing base across the globe and it is likely that the number of countries developing UAVs will continue to grow.

Worldwide spending on military UAVs is projected to rise in the coming years. The report by the Teal Group forecasts an increase in spending on procurement and research and development (R&D) from \$6.6 billion in 2013 to \$11.4 billion in 2022. The chart shows the global UAV budget forecast, with specific segments to indicate U.S. procurement and R&D compared to spending by the rest of the world in the same areas. U.S. UAV procurement and R&D currently accounts for more than 50 percent of the total amount expended worldwide on military UAV procurement and R&D. However, the total U.S. spending amount is not projected to increase significantly over time and remains relatively flat from 2018 through 2022. The regions with the largest UAV markets include North America, Europe, and Asia.

Due to the emergence of UAV drones, the military culture of US is struggling to negotiate the effects of removing individual soldiers from the dangers of traditional battlefield. United States drone program has finally deployed weapons that routinely remove the human risk entirely. Militaries that use drones to fight rely on technologies to carry out their will. There is no conceivable threat to the operator's personal security as events are relayed, watched, recorded and stored. However, this geographic distance from the battlefield has been widely debated. UAV introduces physical distance between operator and target, its cameras and sensors simultaneously bring the operator into proximity; and even prolonged intimacy with the target. This virtual distance from the battlefield has questioned whether it matters if the person who pulls the trigger is thousand miles away or in an aircraft directly overhead. To analyze this questions it surely requires an extensive study of technological aspects and its implication in modern warfare. It can be said that the use of such virtual military technology will continue to grow at an astounding pace. The persistence of UAVs for longer period in battle space has ultimately revolutionized the core air power role of the intelligence and situational awareness. The scope of unmanned missions and capabilities keep on expanding. The worldwide demand for UAVs led by US is dramatically rising each year, leading to a complex relation of law and war in this virtual era.

2 UNDERSTANDING MORAL AND LEGAL ASPECTS OF DRONE WARFARE

The world did not wake up in drone world in an overnight. Some series of historical events gave rise to this lethal atmosphere. The Vietnam War was America's 'first' war that witnessed extensive use of UAVs. Later in 1973 and 1982, in the first Persian Gulf War, the success of Israel Air Force led the United States to finally procure a new UAV of its own. In the Persian gulf war of 1991, UAVs became an indispensable tool in the targeted killing of key individuals in terrorist organizations, allowing military forces to strike a comprehensive key list of 'strategic' targets. The US carried out the first lethal drone strike, in Afghanistan in October 2001. Drones have emerged from obscurity to become the most contentious aspect of modern warfare. Armed drones or unmanned aerial vehicles (UAVs) are now the United States' weapons platform of choice in its military campaign against the dispersed terrorist network of al Qaeda. They offer an unprecedented ability to track and kill individuals with great precision, without any risk to the lives of the forces that use them, and at a much lower cost than traditional manned aircraft. But although the military appeal of remotely piloted UAVs is self-evident, they have also attracted enormous controversy and public concern. In particular, the regular use of drones to kill people who are located far from any zone of conventional hostilities strikes many people as a disturbing development that threatens to undermine the international rule of law.

The advent of virtual military technology has inaugurated an entirely new type of forward deployment for lawyers. It was the Kosovo conflict of 1999, a military operation in which NATO relied exclusively on air power. This ultimately marked an important stage in the increasing prominence and influence of lawyers in armed conflict. The direct involvement of lawyers in military operations further expanded and reflected emerging trends in the legalization of war. This created a greater impact on complexity of military-civic operation and utility of legal aspects supporting their multidimensional missions. The lawyers became a common fixture in this entire dimension and growing use of law became a strategic asset. However, the morality and legitimacy of the practices of war in terms of use of unmanned vehicles has undergone a fundamental transformation. It is whether the traditional practices and law of war defined the 'enemy' in terms of categorical, group-based depending on status; that a person was an enemy not because of any specific actions he himself engaged in, but because he was a member of an opposing army. This shift applies not to any one

particular type of military force, such as lethal force, but to all exertions of military power over enemies, including the ways in which they are captured, detained, incapacitated, or tried.

There are two principal sets of factors driving this transformation in the morality and practices of modern uses of military force. The first is simply inherent in the unique features of modern terrorism. The traditional, status-based regime of the laws of war was that conventional soldiers fought openly as members of an organized military under state control. In particular, they wore uniforms (except for covert operatives) and fought under an organized command structure. As a result, it was legally and morally accepted, that the opposing side could treat them on the basis of their status, as simply members of the opposing fighting force. Second, there was no need to determine whether such a soldier had committed any specific identifiable act that would legitimately make him a target for the use of military force. Whether a soldier had fired at the opposing side, or planted a bomb, or engaged in any specific act, was irrelevant because group membership in the opposing army was sufficient. Thus on the front end of the use of force (capture, detention, even uses of lethal force), there was no need to differentiate among soldiers and attempt to individuate personal responsibility for participation in the enemy's war machinery. It was only if someone was going to be tried for acts outside the permissible scope of the laws of war there was a need to determine individual levels of responsibility.

Terrorism inherently changes all that. Because terrorists do not wear uniforms, attributions of status based on group membership are far more uncertain and complex. Moreover, even apart from the issue of uniforms, the ability to know that an individual is part of a terrorist organization, based on anything other than his own individual acts of terrorism, is also difficult. Terrorists typically do not join the organization in some formal way equivalent to the wearing of uniforms. While some terrorists do swear oaths of affiliation to signify their membership in the organization but many do not. In addition, even if such an oath has been taken, obtaining proof of it is far more difficult than proof that a soldier was wearing a uniform. Indeed, it is often easier to prove that an individual committed a specific act of terrorism than it is to prove that they took an oath of affiliation. Attributions of status, through group membership alone, are therefore extremely difficult to establish. Most terrorists against whom military force is used, therefore, are not identified on the basis of membership per se, but because of the specific acts of terrorism in which they have engaged. Perversely, the act defines the status. This transformation is not yet directly reflected (or at least fully reflected) in the formal laws of war, but we anticipate that as the changes it evinces become embedded in the practices of states, especially dominant states, these changes in practice will eventually come to be embodied in the legal frameworks that regulate the use of force. (Pildes 2014)

3 UNITED STATES CONDUCT OF DRONE OPERATION

In the first half of the past century, tanks and planes transformed how the world fought its battles. The fifty years that followed were dominated by nuclear warheads and ICBMs, weapons of such horrible power that they gave birth to new doctrines to keep countries from ever using them. The advent of the armed drone upended this calculus: War was possible exactly because it seemed so free of risk. The bar for war had been lowered, the remote-controlled age had begun, and the killer drones became an object of fascination inside the CIA (Mark Mazetti, 2013).

In the wake of 9/11, and a new perceived threat from Iraq, UAVs emerged as a key technological factor for meeting the critical persistent surveillance requirement that US forces needed in such contingencies. President Bush, in his capacity as Commander-in-Chief, authorized the use of drones against leaders of al Qaeda forces, under the Authorization for Use of Military Force (AUMF)(National Defense Authorization Act 2001). The armed UAVs that offers advanced technical advantages, one particular being that they do not carry human operator and can be piloted remotely; and are cheap. In order to advance this shift of modern technologies in weapon systems, the US Congress in 2001, mandated that one-third of all essential U.S. military aircraft and ground combat vehicles to becoming unmanned by 2015. The technological advances supported by intelligence, surveillance and reconnaissance (ISR) data for targeting, experienced during the post war era made possible an antiseptic incursion in which the military are able to choose their objective and spare innocent lives.

The precision-guided munitions (PGM) were the chief weapon systems used in the first Gulf War that blasted buildings, roads, bridges and enemy troops with deadly accuracy. By then only 20% of the munitions were smart, but later rose to 70% during the conflicts in Iraq and Afghanistan in 2003. The United States was involved in almost every major military conflict during the twentieth century. The first Gulf War or Persian Gulf War in 1991, constituted a milestone in the efforts to enhance the power of US with the appearance of new technological advances in weaponry. US possesses two types of drones. The smaller ones predominantly carry

out surveillance missions; and the larger ones carried out hellfire missiles and have been used to conduct strikes and targeted killings.

The Bush administration ran two parallel initiatives under drone operation – one covert and other one publicly acknowledged. The majority strikes were carried out by Department of Defense strikes in the combat zones of Afghanistan, Libya and Iraq under USC Title 10 that governs the armed forces and requires public disclosure. Whereas the CIA secret program deployed drones outside combat zones, such as Pakistan, Yemen and Somalia. These strikes were authorized under Title 50, which gives CIA the authority to complete covert operations to influence in political, economy, military conditions abroad without the acknowledgment of involvement of US government. In 2013, the US government reported that it would shift all CIA drone operations to the US military to increase the transparency under Obama administration.

All legal authority for drone warfare would be centralized to Title 10, under which lethal missions would be considered ‘traditional military activities’ bound by Code of Military Conduct. The military operations within Title 10, maintains clear and accountable rules for military force under the consent of local government, which would ultimately exonerate US violation of airspace. Under this proposal, the drone operations would move to Joint Special Operation Command (JSOC), authorized by government. JSOC is a highly secretive program than CIA. This shift of drone operation to JSOC that assures greater transparency may not actually increase transparency but merely provide a legitimate cover for their drone operations. JSOC conducts highly classified missions such as, bin laden killing, operated under Title 50 that are unacknowledged. Various scholars have raised question of whether transparency necessarily improves by virtue of shifting to JSOC. The increased media scrutiny has been joined by civil and human rights groups that have pressured administration to increase its transparency on the drone operation.

However, it is a highly divisive topic to understand whether this modern weapon systems like drones perform the same role as existing systems or are some fundamentally new kind of weapon that need to be considered different from an existing legal or ethical perspective. Harold Koh, Legal Adviser of United States Department of State justifies the use of this advanced weapons systems, such as unmanned aerial vehicles, for lethal operations by stating, “the rules that govern targeting do not turn on the type of weapon system used, and there is no prohibition under the laws of war on the use of technologically advanced weapons systems in armed conflict, such as pilotless aircraft or so called smart bombs, so long as they are employed in conformity with applicable laws of war. Indeed, using such advanced technologies can ensure both that the best intelligence is available for planning operations and that civilian casualties are minimized in carrying out such operations. After the centuries of technical innovation, the traditional military tactics is finally replaced by the autonomous high tech weapon systems. This air force culture has encompassed the new realities of drone warfare.(Ann Rogers 2014) . However, with the advancement in military technology; and replacement of manned vehicles with the unmanned systems, the drone warfare has raised several questions to which many legal scholars have justified on several grounds.

4 ANALYSIS ON DEBATE ON THE UNITED STATES DRONE PROGRAM

The United States declared a ‘Global War on Terror’. On December 20, 2001, the entire world witnessed the dawn of this modern warfare, when former president Bush designated Afghanistan and its airspace as a combat zone.(2001b) . The article 2(4) of the UN Charter, refrains states to intervene in another states’ affairs.(www.un.org) Yet the US drone program involves the use of force on the territory of another state without its consent. US also carried out drone strikes outside the combat zones, such as Yemen, Somalia and Pakistan to target and destroy al Qaeda and associated forces. The UN Official has stated that the US has infringed Pakistan’s sovereignty by conducting a drone campaign without any consent of the elected representatives of the people, or the legitimate government of the state. However the Officials in the Bush Administration under the face of ‘global war on terror’ have defended the drone program as consistent and conforming to international law. In fact, the US approach for the use of drones is that members of al Qaeda forces may be targeted anywhere in the world; that the battlefield follows those individuals who have been designated as enemies due to their affiliation with al Qaeda.(2001a)

Many scholars in the international community have criticized the United States’ expansive geographical use of drones against al Qaeda forces. Mary O’Connell observes that since United States is not engaged in an armed conflict with Pakistan, Yemen and Somalia, it would rule out the legality of drone strikes in these countries. In other words, US cannot lawfully resort to military force outside the combat zone. The only place where drone strikes are plausibly legal is in Afghanistan.(O’Connell 2010) Even in Afghanistan, the act of self-defense ended in 2002 when the Afghans set up their own government. After this, United States has assisted the Afghan

government with its counter-insurgency efforts rather than prosecuting the original, legal authorized self-defense. The UN has declared that it would investigate the legality and procedures of drone strikes, specifically examining alleged civilian casualties.

Further, a number of nongovernmental organizations have criticized the US drone program. In April 2013, the American Civil Liberties Union, Amnesty International, the Centre for Civilians in Conflict, the Center for Constitutional Rights, Humans Rights First, the Human Rights Institute, Human Rights Watch, Open Society Foundation, and two global Justice centers at New York University Law School published a joint letter stating, "Our statement, attached, urges the administration to take essential steps: to publicly disclose key targeted killing standards and criteria- ensure that US lethal force operations abroad comply with international law; enable meaningful congressional oversight and judicial review; and ensure effective investigations, tracking and response to civilian harm."(HRW 2013). The joint letter was addressed to President Obama to outline their stance on and concerns about drone strikes and targeted killing. Until 2012, the Obama administration refused to acknowledge the covert drone program due to security concerns. However, in order to respond to the government and nongovernmental organization; and increase the transparency of the drone program, the Obama administration disclosed the information on practices of the drone operations that are compatible with the legal and moral obligations.

The former White House counter terrorism advisor John Brennan has stated, "In full accordance with law, in order to prevent terrorist strikes on the United States to save American lives, the united states government conducted targeted strikes against specific against specific al Qaeda terrorists, sometimes using remotely piloted aircraft, often referred as drones." The fact sheet published by White House outlined the policy standards and procedures for the use of force in counter terrorism operations outside the United States. It is quite significant that the law of recourse to force has changed over the last centuries. The Article 13(1) of UN charter duly recognizes 'encouraging the progressive development of international law and its codification'. Moreover, the use of drones as a means of force has intrigued many drone proponents and critics in analyzing how existing rules governing the use of force will ultimately accommodate the introduction of UAVs in the UN Charter.

USE OF DRONES UNDER PREEMPTIVE SELF-DEFENSE

Since the 9/11 incident, US has been in an armed conflict with al Qaeda and Taliban and associated forces. During this time, the Bush Administration promulgated the concept of preemption as a national security strategy (NSS)(House 2002). Under the regime of customary international law that was prevalent even before the UN Charter was adopted, it was generally accepted that preemptive force was permissible in self-defense. A preemptive force is usually launched by the state, based on the assumption of unavoidable threat posed by the adversary. In other words, it is accepted as a doctrine of anticipatory self-defense under the customary right to self-defense. The classic case that articulated this doctrine is the *Caroline* incident. But the precondition of Article 51 that entitles a state with the customary right of anticipatory self-defense does not explain the amount of force permitted in a legitimate exercise of self-defense.

The incident set the standard for permissible preemptive action under two criteria. Firstly, the state that seeks to exercise the use of force in self-defense, would need to demonstrate that the, necessity of the act of self-defense is instant, overwhelming, and leaves no choice of means, and no moment of deliberation. The state would need to show that the use of force by the other state was imminent and that there was essentially nothing but forcible action that would forestall such attack. Secondly, the state using force in self-defense would be obliged to respond in a manner proportionate to the threat. Throughout the pre-UN Charter period, a preemptive self-defense would be considered legal if a state could demonstrate the necessity and proportionality of the intended action.(Arend 2003)

This interpretation of self-defense has established two schools of thought under the international law. According to restrictionist school, the Article 51 asserts that there is no right of self-defense absent an armed attack. Under this logic, it excludes anticipatory self-defense and considers it unlawful to engage in any kind of preemptive actions and limits any type of intervention. The counter restrictionist school have a more permissive view of the circumstances under which intervention is legal, referring to right to humanitarian intervention in customary international law and broad understanding of Article 51 that allows for preemptive self-defense.

The restrictionist view opposes the use of drones for targeting individuals outside combat zone on several grounds. First, according to international law, the recourse of force must respond to state-on-state attack, The International Court of Justice (ICJ) has made clear that the term "self-defense" is a term of art in international law. "Self-defense" is the right of a victim state to use offensive military force on the territory of a state legally responsible for a significant armed attack on the defending state. In at least five separate cases, the ICJ has said

that the attack giving rise to the right of self-defense, must be attributable to the state on whose territory the defending states exercises its right of self-defense. Whereas, in case of 9/11 attack, non-state groups perpetrate terrorist attacks. Second even if the terrorist group were state-sponsored United States would have to be in a continuous conflict with the state sponsored for the attacks to be legal under international law. While United States government constitute terrorist targets as a “continuing imminent threat” to the people, but does not define “imminent”, which does not justify the United States’ drone operation with al Qaeda and associated forces as an armed conflict.(John Kaag 2014)

USE OF DRONES TOWARDS ‘IMMINENT THREAT’

According to restrictionist, the notion of anticipatory self-defense does not apply in the case of drone strikes because they do not meet a reasonable standard of imminence. Anticipatory means an impending attack must be instant, overwhelming and leaving no choice of means, and no moment of deliberation. The counter restrictionist maintains that the drone strikes is justified against an individual suspected of terrorist affiliation like al Qaeda or associated forces who pose an imminent threat to the United States. Such targeted killings, regardless of their location, are legally sanctioned as act of anticipatory self-defense intended to prevent future attacks by militant.

In 2008, Bush administration authorized “signature strikes” that targets suspected militants who bear the characteristics of al Qaeda and Taliban leaders or high value members on the run. Targets are selected on the basis of behavioral patterns, that are detected through signal intercepts, human sources and aerial surveillance, and that indicates the presence of an important operative or a plot against US interests. According to Koh, when a state that is engaged in an armed conflict or in legitimate self-defense is not required to provide targets with legal process before the state may use lethal force. Individuals who are part of such an armed group are belligerents and therefore are lawful targets under international law.

However, according to certain accounts, all military-age males counted as strike zones were considered combatants. Apart from the two percent high level targets, many targets that were attacked outside combat zones were lower level soldiers who did not even presented aggression or were about to aggress. According to Koh, “In this ongoing armed conflict with al Qaeda and Taliban, the United States has the authority under international law, and the responsibility to its citizens, to use force, including lethal force, to defend itself, including by targeting persons such as high-level al Qaeda leaders who are planning attacks.”

Further Senator John McCain has raised a question, “how do signature strikes square with a statement that targeted killing operations are only approved when a targeted individual poses a significant threat to US interests.” Moreover, it is unclear whether this principle applies to signature strikes because even the Obama administration has not clarified whether or not “signature” behavior must pose a direct and imminent threat to US persons.

Furthermore, US government has determined to target American citizens who are living abroad and providing aid to al Qaeda and Taliban. President Obama has continued this approach of drone strikes and has expanded the use of drones in the global war on terror. Moreover, high-level officials in the Obama Administration have offered detailed legal justifications for the legality of the American drone program. The Department of Justice White Paper that leaked in February 2013, summarized a legal groundwork and provided justification to congressional oversight committee for using lethal drone force against American citizen, if “the targeted individual poses an imminent threat to violence attack against the US”; the individual could not be captured and the action is consistent with the relevant laws of conflict(House 2013).

The Obama administration has also defended its drone policy by stating that United States will use lethal force only against a target that poses an imminent threat to the US persons. This again has raised question regarding ambiguity in determining which targets truly meet the various thresholds for lethal drone force. Many international legal scholars have questioned whether many targeted militants would have qualified under this liberal definition of imminence. Ken Anderson, an American University Law Professor has remarked that the administration has been vague in defining words such as “imminent” and unspecified conditions under which capturing an individual is more dangerous than killing him.

Although the traditional international law required being “an imminent danger of attack” before preemption would be permissible, the administration argues in its NSS (2002) that the United States must adapt the concept of imminent threat to the capabilities and objective of today’s adversaries.” From the above study, it can be concluded that Article 39 and Article 51 accepts use of force only under two conditions- force authorized by Security Council and force in self-defense.

United States justifies its use of force in Afghanistan as an inherent right to self-defense under Article 51. O'Connell points out that the Security Council did refer to Article 51 and to a United States' right of self-defense following the 9/11 attacks in Resolution 1368 (2001). However, the Council did not authorize the use of force in that resolution to the United States. The resolution was useful in making a finding that the 9/11 attacks could give rise to a right of self-defense, but the actual exercise of force was under Article 51, not the Council's authority in Articles 39-42 (O'Connell 2007).

Lastly, the ICJ has ruled that the armed attack giving rise to the right of self-defense must be an attack that involves significant force. It must be more than a mere frontier incident, sporadic rocket fire across a border, or a single terrorist attack. Terrorist attacks are generally treated as criminal acts and not as the kind of armed attacks that can give rise to the right of self-defense. Even where militant groups remain active along a border for a considerable period of time, their armed, cross border incursions are not armed attacks under Article 51 that can give rise to the right of self-defense unless the state or the group is responsible for their actions. It is widely accepted that international law takes precedence over the laws of nation-states, and breaches can be punished. But, in this realist world order dominated by states pursuing national interest, hegemony such as the United States can disproportionately influence the ways in which international law is interpreted. This break from legal tradition suggests a clear course of action. International legal norms need to be reconsidered in the light of challenges that these asymmetric warfare poses, and states should modify drone policy that conforms to international law.

UNITED STATES' DRONE STRIKES AND INTERNATIONAL RULE OF LAW

US drone strikes represent a significant challenge to the international rule of law. This is not because the recent US drone strikes has violated the international law. From the international rule of law perspective, US drone strikes cannot be easily categorized as blatant instances of rule-breaking. Rather, US drone strikes challenge the international rule of law precisely because they defy straightforward legal categorization. In fact, the post legal theories underlying the conduct of drone strikes constitute a serious, sustained, and visible assault on the generally accepted meaning of certain core legal concepts, including 'self-defense,' 'armed attack,' 'imminence,' 'necessity,' 'proportionality,' 'combatant,' 'civilian,' 'armed conflict,' and 'hostilities.' Understanding US legal arguments is made more difficult by the fact that administration spokespersons often appear to oscillate between putting forward a law of armed conflict framework and a self-defense framework when justifying drone strikes. At times, US officials appear to have suggested that the self-defense framework supplements the armed conflict framework. In recent months, however, their language has suggested that the United States has shifted entirely from an armed conflict framework to a self-defense framework. In any case, a self-defense framework possesses as many unknowns as an armed conflict framework: we do not entirely know how the United States understands the terms 'armed attack' or 'imminent', nor do we know how the United States evaluates issues of necessity and proportionality.

With regard to sovereignty issues, US officials have repeatedly stated that they only use force inside the borders of a sovereign state when that state either consents to the use of force or is 'unwilling and unable' to take appropriate action to address the threat itself. We do not know, however, how the United States evaluates issues of consent in situations in which consent is ambiguous. We also do not know precisely what criteria the United States uses to determine whether a state is "unwilling or unable" to take appropriate action. The public statements by U.S. officials, leaked government documents, and the existing evidence about past strikes and their targets, and practices by the United States represent a substantial challenge to international legal rules on the use of armed force with regard to both *Jus ad Bellum* and *Jus in Bello* rules.

It is difficult to evaluate U.S. drone strikes under these rules. Clearly, the Security Council has not expressly authorized the use of force by the United States in Pakistan, Yemen, or Somalia. The Council has, however, recognized that terrorist attacks can trigger a right to use force in self-defense, and the Council implicitly gave its approval to the November US military intervention in Afghanistan. In Security Council Resolution, passed one day after the terrorist attacks of, the Council stated that "such acts, like any act of international terrorism," constitute "a threat to international peace and security." In the same resolution, the Council also reaffirmed "the inherent right of individual or collective self-defense in accordance with the Charter." This resolution and those that followed were viewed by the United States (and by the international community generally) as sufficient to permit the lawful use of force in Afghanistan by the United States and NATO. Most commentators agreed that the initial, US and NATO campaign constituted a clear case of individual and collective self-defense after the attacks.

On December, the Security Council authorized the creation of the International Security Assistance Force for Afghanistan (ISAF), thus bringing the war in Afghanistan under the formal umbrella of Security Council authorized uses of force. In fact, from a rule-of-law perspective, the process leading to military action in Afghanistan was exemplary. The Security Council noted that an armed attack had occurred and that states had the right to use force in self-defense. The United States and NATO states then took action on their own “until the Security Council took the measures necessary to maintain international peace and security” by authorizing an international force. These subsequent uses of force by the US for counterterrorism purposes outside Afghanistan pose a more complicated question.

Security Council Resolution acknowledges that any act of international terrorism gives rise to a right to self-defense and calls upon UN member states to “work together to prevent and suppress terrorist acts” and “take the necessary steps to prevent the commission of terrorist acts.” The United States appears to regard such generic statements as sufficient international legal basis for discrete, ongoing uses of force against suspected terrorists around the globe. This view is not wholly implausible if all terrorist acts threaten international peace and security and give rise to a right to self-defense, and if the Security Council has tasked states with taking “necessary steps” to prevent future terrorist acts, this seems like a reasonable basis for concluding, at a minimum, that there is nothing manifestly unlawful about US drone strikes against terrorists (assuming drone strikes can plausibly be viewed as “necessary”).

From a broader rule-of-law perspective, however, this interpretation presents several difficulties. For one thing, it seems to be an open-ended invitation for states to engage in the unilateral use of force against suspected terrorists. But if it is open-ended, it renders meaningless the UN Charter’s provision that the right to use force in self-defense lasts “until the Security Council has taken [the] measures necessary to maintain international peace and security.” This is an important implied limitation on the right to use force: the Charter language clearly anticipates that the unilateral use of force in self-defense will be temporary in nature, undertaken as an emergency measure only. Once the emergency is over, the Charter appears to assume either that peace will have been restored or that the state under attack will have dispelled the imminent threat and be in a position to request that the Council take any measures needed to ensure its longer-term safety.

Regardless of whether the Council takes action to address a threat, a state’s right to respond to an armed attack is clearly subject to some temporal limitations; it does not last indefinitely. Thus, more than seventy years after the Pearl Harbor attacks, the United States no longer has a legal basis for using force in self-defense against Japan; similarly, from an international law perspective, it is doubtful that the attacks alone give rise to an indefinitely continuing right to use force in self-defense. This view is consistent with the traditional understanding of the right to self-defense in international law, which limits the unilateral use of force to situations in which a state is responding to a recent “armed attack” or to an “imminent” threat of future attack. And at least on a superficial level, the United States appears to accept this view: “We act against terrorists who pose a continuing and imminent threat to the American people,” President Obama asserted in a May speech. This does not help us determine the legality of US drone strikes, however, because it merely shifts the question to how we define “imminent threat.”

Moreover, even when there is substantial international consensus on the meaning of key concepts, the rule of law can be undermined as in the case of US drone strikes if the sole superpower consistently challenges the commonly accepted meaning of concepts vital to the regulation of violence. When one or more powerful states challenge the generally accepted meaning of core legal concepts, other states face a choice. They can accept the “new” interpretations, in which case (if a sufficient number of states will go along with it) international law will quietly change. Alternatively, they can take the opposite track, directly confronting those states seeking to reinterpret the law and demanding fidelity to previously shared interpretations. This route is risky: if it succeeds, legal stability is restored, but if it fails, legal disputes can escalate into open conflict.

Finally, states dismayed by new interpretations of once fixed legal concepts can take a middle ground, quietly questioning new interpretations of the law while reaffirming their own interpretations. This route reduces the likelihood of conflict, but by enabling disparate legal interpretations to coexist without any obvious means of reconciling them, it can also prolong or increase legal uncertainty. For the most part, the international community has so far taken this middle path in response to U.S. drone strikes. It remains to be seen whether this path will ultimately lead to a reemergence of international consensus or whether it will permanently undermine the international rule of law.

5 CONCLUSION

A decade or so ago, the use of armed drones was relatively novel and untested. Their human impact and further technological development were hard to predict. Among other things, they provide the strategic advantage of greatly reducing the time between the identification of a potential target that could be a great distance away and the deployment of deadly force against that target. Drones, it can safely be said, are here to stay. (Christof Heyns 2013)

There is broad agreement that drones themselves are not illegal weapons. There is, however, a notable lack of consensus on how to apply the rules of international law that regulate the use of force to drones. A vast body of academic and advocacy literature has now developed, and civil society watchdogs are tracking the issue and pursuing transparency. Armed drones have been debated in various forums of the United Nations, intergovernmental bodies and national Governments and courts. In the international domain, where there is no authoritative judiciary or legislature capable of rapidly clarifying the law, legality (or illegality) must still be inferred from the responses of other states. And so far, although few states have offered explicit support for US interpretations of international law relating to drone strikes, equally few have stated that they regard such strikes as unlawful. Most states have taken a middle path, either expressing somewhat muted concern about US interpretations of the law or refraining altogether from commenting on their lawfulness.

US drone strikes thus present not an issue of law-breaking, but of law's brokenness. The United States sustained assaults on the meaning of core legal concepts have left international law on the use of armed force not merely vague or ambiguous but effectively indeterminate. This has ultimately crumbled law's value as a predictor of state conduct and a means of holding states accountable. If there is no agreement on what constitutes an armed conflict, no agreement on who counts as a combatant, and no agreement on what constitutes an imminent threat, the law is no longer a guidepost.

Although the justifications for US drone strikes challenge the international rule of law, they also represent an effort to respond to gaps and failures in the international system. It is easy to insist that the United States should not use force without explicit Security Council authorization, for instance, but the Security Council is paralyzed by anachronistic membership and voting rules that are themselves arguably inconsistent with rule-of-law norms. Similarly, it is easy to point out the absurdity of the US definition of "imminent threat," but the United States is not wholly wrong to argue that traditional definitions of imminence are inadequate in the context of today's threats. And it is easy to condemn circular US arguments about sovereignty, but here again the United States is not necessarily wrong to argue that when many lives may be at stake, sovereignty surely cannot be an absolute bar to intervention. However destabilizing US counterterrorism legal theories are to the rule of law, they arose in response to real dilemmas, and it is not inconceivable that their very destabilizing qualities could ultimately help usher in a process of much-needed legal change.

Besides the international order is a fragile one, and when core norms relating to the use of force are in disarray, accountability and predictability are undermined. Ultimately, there is a substantial risk of fragmentation, conflict, and collapse. As it stands today, most states have been unwilling either to denounce or to praise the legal theories put forward by the United States to justify drone strikes. But even such a muted, ambivalent response may lead to a quiet diplomatic effort to articulate common ground or to develop compromise or alternative legal frameworks. Perhaps, for instance, the international community needs to develop a theory of *jus ad vim* to occupy the space between war and peace; a law and ethics relating to ongoing but discrete smaller scale uses of force. Perhaps we need new international institutions capable of refereeing such uses of force. If all or most states come to accept a new interpretation of key terms and concepts relating to the use of force, the international law on the use of force will change. If states cannot agree on how to interpret key concepts, the risk of conflict between states will go up, but the risk of conflict can trigger the creation of new dispute resolution mechanisms (judicial or non-judicial), which can in turn develop new authoritative interpretations of the law.

It is widely anticipated that law organizes and disciplines the military, defines the battlespace, privileges killing the enemy, and offers a common language to debate the legitimacy of waging war. Laws shape the institutional, logistical and even physical landscape on which military operations occur. But Law today rarely speaks clearly, or with a single voice. Its influence is subtle and it rules plural. International law is no longer an affair of clear rules and sharp distinctions. In fact, International law has become the metric for debating the legitimacy of military action. And in all these ways, law now shapes the politics of war.

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Study Need and Importance of Management Education & Its Impact on Society

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ABSTRACT

When we look back to the primitive Ancient days where we had a Gurukul system to educate the others. We didn't have the concrete buildings, the class rooms, the well-equipped books, libraries, despite all hurdles and odds the gurus encouraged their disciples to undergo studies. The Gurus took the lessons in the open Air, in grounds, below the trees. The famous Legendries Poet Rabindranath Tagore, Hon. PM .Mrs. Indira Gandhi took their education In West Bengal Shantinikatain. They were taught in open air below the trees. The system of studies were based on discussions, understanding the concepts, practically doing it. This is how the system of knowledge was spreaded gained and was in practice and in return the sheeshyas gave gurudakshina to their Gurus. Life was so simple .We also know in old eras the ladies were taught and made them understand their responsibilities as home maker to take care of their siblings , parents , grandparents , home affairs, they were taught to take care of home, food , family and kept aloof from studies, they were taught arts and crafts . Legendry Savitri Bai Phule was the first women Indian Teacher who educated millions of daughters of India. Savitribai Phule Along with her Husband Jyotiba Phule were the reformists who had an important role in improving the women rights during the British rule in India .There were other issues in India untouchables . They were kept aloof and deprived from many rights. Svitribai phule started the school for the untouchables. Thus the topic is study based on secondary data to understand the need of education its significance and Impact on society. How from the Ancient education system to Modern education system transformations kept happening for the betterment of the Individual, for the company, for the society.

Keywords: Gurukul system, Modern education system, Management, Education

INTRODUCTION

Knowledge and Education has significance in its own way. Having knowledge is a process of acquiring information's on subject, skills by one's own experiences and day to day learning, whereas Education is a process of learning in a systematic manner right from schools to colleges. Once Acquires education in their area of Interest specializations are acquired. Further Doctoral courses one can pursue. Thus Learning is a continuous process. One has to keep learning throughout his life to keep oneself abreast with system, with society, with company requirements.

Education plays a pivotal role in one's life, when one is educated one is knowledgeable, more confident, capable to understand between the right and wrong, understand the difference between ethical and unethical, good manner bad manner, follow the code of conducts of the society, understands ones rights, cannot be cheated, can take decisions towards betterment of the society, capable of earning, Improve oneself, better standard of Living, further enhance and spread knowledge. Understand not only self but also others. Can work in a company using their specialization knowledge.

OBJECTIVES OF THE STUDY

1. Need of Education
2. Significance of Education
3. Impact of Education on Individual, Company and Society

NEED OF EDUCATION:

As per the records of 2020 there are 14, 94, 052 schools In India as per the records of the central government. 15,07,708 are government schools (Including Government aided, private unaided and other schools) Thus after China India has the second Largest schools system in the world with more than 1.5 million schools and approximately about 260 million students as per the records of 2015-16 data . The richest and best of the schools are located in Dehradun, Bangalore Mumbai, Gwalior Ajmer and the Largest school in terms of Pupils are located In Lucknow. The school has 56000 pupils for 2019-20 Academic year is **the City Montessori School in Lucknow**, India. "As of 2020, India has **over 1000 universities**, with a break up of 54 central universities, 416 state universities, 125 deemed universities, 361 private universities and 159 Institutes of National Importance which include AIIMS, IIMs, IIITs, IISERs, IITs and NITs among others. Thus India is the

third Largest next to United States and China. “
Higher education in India – Wikipedia https://en.wikipedia.org/wiki/Higher_education_in_India. This is a chart of India as per Census 2001.

Degree	Holders
Total	37,670,147
Post-graduate degree other than technical degree	6,949,707
Graduate degree other than technical degree	25,666,044
Engineering and technology	2,588,405
Teaching	1,547,671
Medicine	768,964****
Agriculture and dairying	100,126
Veterinary	99,999
Other	22,588

Thus there is a need of education to make one self-capable of understanding which is possible when one is educated , education can make one capable to earn their livelihood , grow in their career , understand between the right and wrong, understand ones rights towards the society , enhance social and economical betterment .

SIGNIFICANCE OF EDUCATION

“There are over 1.26 million registered companies in India as per the records of 2020 Number of registered active companies in India by type 2020 <https://www.statista.com> › Economy & Politics › Economy.

The education systems, syllabus are structured based on the requirements of the company needs .The aspirants, students can acquire the education based on the specific field. This will help the students to gain the domain knowledge and apply the theoretical application in the company. Companies are now expecting the students to gain both theoretical and practical knowledge in Institution itself thus there is interface with company and Institution for better understanding, requirements of the company so that accordingly the syllabus can be framed and Knowledge can be imparted in that direction.so that the companies don't have to further avail time to train the newly recruited. They are expecting the passed out students to join and start with work as per the job description. Thus education will help the company to improve and grow fast. The passed out students are always having better prospects provided they meet the exceptions of the company requirements. Right candidate at the right time ,right place will not only help the recruiters for long term employability but also the candidate will be successful in terms of career growth, the company will grow with better people , economy of the nation will improvise and the Society will be befitted thus education is of utmost significance to grow in holistic manner . In India education rate is increasing but somehow there is dearth of the candidate who can meet up to the expectations of the company. The Universities , Institutions must unite with the companies specially with the companies they are tied up for placements to understand the requirements of theirs so that accordingly the Institutions can prepare the students , pchometric tests, domain knowledge, to face the interviews , how to practically do the job once appointed in a company. The institutions are now more focused with Summer internship projects where it is mandatory for the students to undertake their project only with the company so that they get maximum practical exposure and practical knowhow, first hand information's which can keep the students well equipped with better understanding of what exactly is expected from them in future, based on it they prepare their projects. Similarly they also have winter projects, desk projects which will help the students to study and gain knowledge in the area expected, future prospective.

IMPACT OF EDUCATION ON INDIVIDUAL, COMPANY AND SOCIETY:

<https://esrc.ukri.org/news-events-and-publications/evidence-briefings/the-wellbeing-effect-of-education/>:

Education has a positive impact on oneself by way of knowledge, wellbeing, better relationship, career advancement and growth, better standard of living, right decision making ability, confident in oneself, ones work, in the society, spreads goodness, knowledge. Education has an impact on society when the people in the society are educated the government selected are qualified , rational , good leaders , educated which in turn can frame better policies for public, for country , Less corruption. Great leaders makes great leaders, better place to

work. Impact of education on company, companies grow with best people recruited, long term employability, innovativeness, best people bring in best lot thus the company keeps growing, economic development, social development, Quality products, quality services, well manner and well behaved people in the company and society, quality exports. All can happen smoothly when the person is knowledgeable and educated, better ideas, positivity, great leaders makes others leaders, raises one to help grow, team work, win-win situation.

FINDINGS OF THE STUDY

The study is based on secondary data the findings were based on the census 2001 total number of schools and colleges in India. The study was extracted from websites

India is the Third Largest after United States and China in terms of education

India is coming up with Institutions in various fields. It was also observed education is made available through online courses, many are free of costs so it is affordable to the students those who are underprivileged, cannot afford, excellent online through digital platforms. Thus there is wide scope and opportunity for the students and aspirants to take education through these platforms and enhance their knowledge. Thus not only education is spreaded mass media, Teachers are available online, thus job opportunities are available. One can work from home. During the pandemic situation Digital platforms were the only source for the teachers and students to learn, study and appear for exams.

CONCLUSION

Thus from the Ancient times, Gurukul systems, touchable and untouchables and current education systems there were transformations in each stage and there is a drastic transformation. Earlier the female child born were a curse to the society, they were kept away from education, only trained since childhood to take care of home, untouchables were not allowed inside the class room slowly and gradually time changed, now in the 20th century all girls and boys are studying together, more and more schools and colleges are established, Digital platforms, online lectures, various Apps are available for the aspirants to enroll oneself and achieve Degrees and PG s and Doctoral courses, there are so many vocational courses, other courses to acquire better skills and make oneself employable, with education not only one is knowledgeable but Individuals male female are capable of earning, females are playing an important role to work shoulder to shoulder with male, support their family financially and stay tuned together.

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Mobile App's For English Language Teachers

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ABSTRACT

Education today has been able to change the life of many people and has been impactful with the help of mobile technology; mobile applications have made education more versatile and dynamic. A compact portable device mobile phone equipped with millions of features makes it the most used device. One of the most efficient features is its ability to download and use applications (APP's). The learners are using a variety of learning App's to upgrade their knowledge and skills. Teachers use mobile App's to make their class more exciting and participatory. Despite challenges and barriers, teachers use apps for teaching and learning English. Various English learning apps are available to help, equip, and upgrade the teachers' knowledge in vocabulary, grammar, pronunciations, etc. The use of mobile apps in teaching helps them motivate, grabs the learners' interest, and acts as instructional scaffolding.

Keywords: mobile technology, mobile application, teaching and learning, English language

INTRODUCTION

Mobile technology has a significant role to play in development of education, there is an extensive integration of technology in the process of education to meet the global standards (A.G, et. al., 2017). it has impacted the lives of all the stakeholders in the field of education. Due to its "uniqueness, comfortability, portability, versatility, social-networking, context-sensitivity, ease of accessibility, and many more multiple features and functions"(Seraj, et.al., 2021). Most importantly it has impacted the lives of the learners (teachers and students). Technology integrated education contributes to in the growth and development of a students (Ni & Yu,2015). It has also significantly changed the teaching methodologies of today, more teaching techniques are being added into the mobile devices, teaching and learning process has moved from being limited to textbooks and desktop to application based software's known as Mobile Apps , the teaching techniques added in the application software's had made teaching more easy and interesting, planning for a lesson is no longer based on textbooks and learning guides (Papadakis & Orfanakis, 2017). Teachers of today are using virtual space for teaching and understanding and upgrading their knowledge in course materials, upgrading their language skills, preparing for their lessons, understanding the diversified needs of the students, etc. There is also a wide range of interaction between them, and teachers can communicate and interact with their colleagues, parents, students irrespective of time and place through video conferencing, chats, and calls (Papadakis, et. al., 2019) in this way, they can share their knowledge with other colleagues, parents don't have to wait for parents teachers meeting to solve their problems, students don't have to wait for another class to clear their doubts. Teachers can be multitasking by being focused on their teaching goals and aims. They can access authentic and increased teaching materials and plan their lesson whenever they want (Shohel & Power, 2010). Lots of additional supplements and reading materials are helping them increase their knowledge, but it is making them more dynamic in their profession. Teachers can understand the increasing demand for expertise. To understand the learning needs of the students and help them satisfy their learning needs, teachers can equip themselves with various educational technologies. Learning to use them allows teachers to be more effective (A.G, et.al., 2017).

Mobile applications can develop and enhance the skills of the teachers as well as the learners; hence, using technology in their teaching and learning process will effectively improve the communication skills of the teachers, which is of utmost importance for the teachers (Seraj, et. al., 2021) to be effective and impactful. In a classroom with many students and limited teachers, the use of traditional teaching methods is high because of time constraints and pressure. Their responsibilities include completing the syllabus, including mobile-based application software in their classroom to make learning more meaningful. As students of today's generation love learning with the help of technology because of its entertainment features (Ni & Yu,2015), there is also a high demand for learners to be technologically savvy to remain competitive in the global market (A.G, et.al., 2017) and to bridge the gap between learners and technology the teachers have to be confident in using technology themselves. To meet the current need, teachers need to have advanced ICT skills to use all kinds of application software (Seraj, et. al., 2021). during today's teachers this time of COVID-19 pandemic, the situation is such that without knowing how to use technology, teaching will be of no value, the school of today has gone online, and the demand for teachers to be well equipped with advanced technology knowledge is

essential. However, there is a great digital divide that exists between the teachers and the technology, the mobile application software's were never used among the learners and teachers as to how it has been used now, and this is mainly due to the COVID-19 pandemic situation (Seraj, et. al., 2021) which has highlighted the challenges faced by the teachers and learners in using technology. It has also brought in the need for training teachers in technology and enhancing their ICT skills by allowing them to use as many mobile applications as possible in their lesson planning and teaching process.

English is a foreign language that needs to be acquired, and teaching English as a Foreign language (ELF) is a challenge. One needs to be well versed in something they have learned. Traditional methods of teaching English is a long-gone history, technologies especially mobile application software's are being used to teach ELF (Seraj et.al., 2021) as the language consist of words, phrases, difficult pronunciations, extensive vocabulary which needs to be learned correctly and accurately, many teachers have found that mobile apps help in improving their pronunciation and helps in learning new vocabulary which they might miss while preparing a lesson for the class with the help of textbook (Sohel & Power, 2010). Teachers are aware of the importance of using mobile apps in making their classes engaging and interactive. Most teachers use either some already established social networking platforms like telegram, Whatsapp, etc., or various applications for learning the English language (Kacatl & Klimova, 2019). Whichever platform they use, they need guidance to choose it and use it correctly.

IMPORTANCE OF MOBILE APP'S

It is impossible to imagine life without a mobile phone today, and all mobile phones are equipped with various mobile application software, be it for entertainment or knowledge, it is in the default setting of a phone, whenever a smartphone has updated the software of the phone by default gives application software's which can be uninstalled or used. In a study conducted by Powell in 2019, it was found that 64% of the learners found accessing training materials essential through mobile phones, 43% of mobile users found themselves to be more productive as compared to non-mobile users, 89% of the users' downloads Apps and 50% of them use it for learning and interestingly it is also found that a person using a smartphone can complete course material 45% faster than a computer user. Undoubtedly, mobile learning App's users are increasing day by day because of various benefits like accessibility, portability, exciting features of edutainment, wide-open platform of interaction, communication facilities such SMS, call, individual/group video conferencing, etc. (Klimova & Polakova, 2020; Papadakis, et. al., 2018; Ni & Yu, 2019). Both students and teachers are more motivated to learn through mobile phones. 85% of the students and 100% of the teachers think that using mobile phones for learning is a motivational stimulus and makes learning interesting (Klimova & Polakova, 2020). The inclination of students interest towards mobile devices are so much that it has begun to shape their personalities, it shapes their communication skills (listening, reading, writing), it dramatically affects their cognitive development, it stimulates and motivates them to remain engaged in some of the other work, and hence the teachers who are the prime influences of students must realize and think about the purposes of using mobile application software's effectively in the classroom (Seraj, et. al., 2021; A.G, et. al., 2017; Klimova & Polakova, 2007).

Users who use mobile phones for learning purposes find mobile application software's to be self-learning material, and it acts as a motivational stimulator. More than 90% of the users find mobile apps interesting, motivating them to learn English (Jamaldeen, et. al., 2018). Using a mobile phone as a source of learning is appreciated and accepted because the mobile apps' content is brief, concise, refined, and gives a practical learning experience (Liu, et. al., 2018). The importance of using mobile Apps for teachers is that it helps them understand the learning needs of the slow learners in their class (Kacatl & Klimova, 2019) and allows them to work accordingly. Many teachers can explore the 'alternative methods' (Shohel, et al., 2010) of teaching English by watching various demonstrations or videos available in the app. It also helps them be more precise and accurate, allowing them to put their ideas into practice. In the study conducted by Shohel many teachers reported that after using the mobile App, they have gained more confidence and have introduced more "active learning practices" in the classroom. Changes and improvements have been seen in teaching practices and have also contributed to their appearances, behavior, and speaking styles. Using mobile apps has made them productive, and hence, the preference for using them is more despite many challenges.

TEACHERS PERSPECTIVE IN USING MOBILE APP'S IN TEACHING ENGLISH

A considerable number of apps have been developed for the learners to learn the language to mention few which are available at the play store are ELSA Speak, teachmint-manage classroom and teach online live, Cambly, Hello English, etc. these apps are used by the teachers as a learner or as a platform to teach English online. The reviewers of language learning apps say that there are many benefits of using these apps. The language learning apps help in improving communication, developing vocabulary, building confidence, improving grammar, improving speaking skills, etc. language teachers can update themselves with new trends

in the English language like they can get ideas on how well they can engage students in the English language activities as the apps are equipped with many activities, quiz games. New, as well as experienced in-service teachers, can learn many vocabularies and pronunciations through these apps. However, there is still a gap realized between the app developers and the language teachers. This can be due to the lack of pedagogical knowledge (Sweeney & Moore, 2012). Despite all the drawbacks and technological challenges, teachers still use mobile Apps as an instructional scaffolding to learn various language concepts, communication skills, the ability to build on prior knowledge, organize new concepts, etc. (Zou & Li, 2015; Ozan & Kesim, 2008). Teachers' perspective towards teaching English in an intelligent environment by using mobile apps makes the classroom more interactive, efficiently improves the interest and motivation of the students, and changes and widens the scope of teachers' activities (Tu, 2021). Hence, the need for pedagogical rich English apps is growing, and there is an ocean of apps being developed by the developers.

CHALLENGES FACED IN USING THESE MOBILE APPS

Using mobile application software can sometimes be challenging and might irritate the users, and if not implemented strategically, it may add no value to learning (Awadhiya & Miglani, 2016). Anxiety, lack of confidence are some of the few challenges teachers face while using technology in their teaching process (Shohel et. al., 2010). Many barriers make integrating technology into the teaching and learning process a challenging task. Among many barriers, cultural and technical barriers are the dominant (Panda & Mishra, 2007). Cultural barriers make teachers limited in their resources. They get limited with their knowledge and remain limited to the textbook and reference materials. The teachers' attitude, motivation, beliefs, and values make it challenging for them to accept the changing technology. Lack of confidence prevents them from switching on the camera (Berge, 2015), making the online classless effective. Since technology has been included in the teaching practices, there has been no adequate training received by the teaching. A digital gap demotivates the teachers from incorporating technology in the classroom (Berge & Mrozowski, 2016). Technological barriers are the most important ones that significantly affect the teaching and learning process.

Poor network causes significant disruption in online classes and technology-rich classrooms, disturbing the class (Panda & Mishra, 2007). There is always one constant issue with mobile phones is poor battery life (Livia, 2017). There has been a constant issue with using a mobile phone "poor battery life" (Livia, 2017), during this time of COVID-19 hours is being spent in mobile phones as both teachers and students are engaged in online classes, and most of them go out of battery mid-way during their lessons. Smartphones are hi-tech smart devices, and low-tech smart devices have relatively larger screens than the other. The storage capacity of the phone varies in both the devices, and power consumption might be less or more depending upon the type of phone. Its software's all these technological barriers affect the learners' online learning ability (Khaddage, et. al., 2011). despite all this, teachers make efforts to learn and continue to get engaged with technology because of the rewards it brings and the positive changes that it brings in students.

As the world has begun to depend more and more on technology as it makes life easier, it is important to minimize the challenges as much as it can be by providing adequate training to the teachers in how to use technology effectively (Khaddage, et. al., 2011), training should be such that they develop the ability to hold students attention online as well during blended learning classroom. It is important to learn how to effectively incorporate technology into their teaching (Klimova & Polakova, 2020). Infrastructure facilities like good networks and effective learning environments are essential to meet the challenges faced while using mobile application software. "Effective strategies" (Khaddage, et. al., 2011) need to be made by the school authorities to equip teachers with better teaching facilities.

CONCLUSION

Technologies provide teachers with many exciting tools which can help them make their class effective and help them to improve themselves professionally. Teachers report that they prefer using technology as it makes them more active, which makes their students also active (Shohel & Power, 2010). As the need for using mobile devices at home for learning purposes increases due to the COVID-19 Pandemic situation, there is an urgent need to equip and encourage teachers to use mobile application software's to make their class interesting and compelling, as teachers still lack confidence in using technologies (Khaddage, et. al., 2011). Training in how to use mobile technology and application software will help them become effective teachers. Still, it will also enable them to reflect on their own learning process (Shohel & Power, 2010). It is up to teachers to become role models of their students, for which they need to get into the shoes of the students. It is important for them to understand the technological needs of the students and must learn how to incorporate technology effectively into their classroom (Klimova & Polakova, 2020). Hence, choosing appropriate mobile applications for themselves and students is important to bring the best output by satisfying their learning needs.

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A Cross Sectional Study on Buyers Behaviour for E-Pharmacy in Selected Areas of Pune District: A Pilot Study

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ABSTRACT

Background-Due to advancement in technology and digitalization, online purchasing of products through the digitalized platforms becoming common practices in now days due to the personalized benefits. Online purchasing of medicinal products is also not exception for it. But E-buying of medicines through the digitalized platforms is not a common practice yet, which is at introductory stage in Indian context. The study on online/E-pharmacy and Buyers behavior is also limited in Indian perspective. **Objectives-**The study aim to analyses the buyer's behavior for E-Pharmacy in selected areas of Pune district. **Material and methods-**Cross sectional study of 199 respondents from selected areas of Pune district was conducted to analyze the buyer's behavior for E-Pharmacy. Data collection instrument for the study was questionnaire. Data entered in MS Excel and analyzed through the SPSS. **Results-** Out of 199 respondents' 108 respondents (54.27 per cent) found regular buyers of medicines. 81.5% of respondents are aware about online pharmacy. 61 %(121) respondents are preferring medical store to purchase the medicines, 39 %(78) respondents purchase the medicines from medical store as well as from E-Pharmacies. 37.5 %(74) respondents reported that they have used the online pharmacy before and presently they are user of it, 38.55 %(77) Respondents had considered the E-Pharmacy but not using it and 24 %(48) respondents reported that due to lack of awareness online pharmacy is not considered. More than 70% of respondents are agree on various parameters of online pharmacy like trust on quality, time saving, happy with online buying, ease of access, awareness, customized benefits etc. More than 50% respondents are hesitate to online shopping due to risk of receiving wrong products, difficulties in dispute setting, on availability and reliability issue, chances of misuse of credit card details and personal informations, chances of overcharging, frauds. **Conclusion-**E-Pharmacy is at introductory stage in India. The awareness of E-Pharmacy is good but users are less. E-Buying of medicines is not a common practice yet in Indian context. Online pharmacy is advantageous in many ways also it is disadvantageous. The E-pharma industry have the greater opportunities in coming years but we also need to develop the strong regulatory support system to monitor the E-Pharmacies.

Keywords: E-Pharmacy, Buyers Behaviour, Perception, Awareness

INTRODUCTION

An investigation into buying behavior of the customers from selected areas of Pune district for buying pharmacy products through websites, web portals of digital platforms is the core aspect of the present research. In this view of the matter, present research is expected to study the concept of Pharmacy and identify various companies that are working in E-pharmacy. Moreover, present research is expected to study the perception of buyers towards e-pharmacy in selected areas of Pune. Apart from studying the buying behavior, present research is also expected to contribute in terms of evaluation of the promotional activities of companies implementing pharmacy for their products. The SWOT analysis of a Pharmacy product also required for suggesting a concrete solution for understanding the awareness and utilization of the E pharmacy platforms in selected areas of Pune district. With this intention a comprehensive research tool has been prepared and circulated in the population under consideration. It is to be noted that the entire study is proposed to be carried out with the help of a structured questionnaire.

Initially, total 199 responses have been considered to be valid for further analysis under this pilot study.

OBJECTIVE OF THE STUDY

1. To study the perception of buyers towards E-Pharmacy in selected areas of Pune district.
2. To analyze buyer behavior towards E-Pharmacy in selected areas of Pune district.
3. To test the reliability and the validity of the research tool.
4. To test the hypothesis of study.

HYPOTHESIS

H1-0: There is NO significant association between perception of buyers for E- Pharmacy and buyer's awareness regarding the E-Pharmacy.

H1-a: There is a significant association between perception of buyers for E- Pharmacy and buyer's awareness regarding the E-Pharmacy.

MATERIAL AND METHODS

- Type of Study: Cross Sectional
- Instrument Used: Questionnaire
- Sample Size: 199
- Sample Unit: Buyers of E-Pharmacy from selected areas of Pune district
- Area of Study-Urban and Rural area of Pune district
- Duration of Study: Septeber 2021 to December 2021
- Sampling method-Convenient and simple random sampling

Results

Table 1: Distribution of the Respondents according to Gender

Do you buy medicines regularly?	Gender		Grand Total
	Female	Male	
No	23	68	91
Yes	21	87	108
Grand Total	44	155	199

It is seen from the table that 44 (22.11 per cent) females participated in the survey. Though out of 199 respondents' 108 respondents (54.27 per cent) found regular buyers of medicines. It is worthwhile to note that these 54.27 respondents who buy medicines regularly are comprised of almost one half of the female respondents.

Table 2. Awareness of medicines can be purchased online-

Sr.no	Parameters	Responses %(n)
1.	Not at all aware	18.5(36)
2.	Slightly Aware	19(38)
3.	Somewhat aware	9(18)
4.	Moderately aware	17(34)
5.	Extremely Aware	36.5(73)

n-No. Of respondent

It can be interpret that 81.5% of respondents are aware about online pharmacy at various level of awareness. Only 18.5 %(36) respondents are completely unaware that medicines can purchase online. From above data we can say that awareness regarding online pharmacy is excellent but users are less.

Table 3.Medicines purchasing from-

Sr.no	Parameters	Responses %(n)
1.	Medical store	61(121)
2.	Online Pharmacy	Nil
3.	Both Store & Online	39%(78)

n-No. Of respondent

61 %(121) respondents are choose medical store to purchase the medicines, 39 %(78) respondents purchase the medicines from medical store as well as from E-Pharmacies. No one prefers only online platforms to purchase the medicines. It can be interpret that offline Pharamcy is more convenient option to consumers compared to online pharmacy.

Table 4. Opinion regarding Consideration of Online pharmacy purchase Model (E-Pharmacy)

Sr.no	Parameters	Responses %(n)
1.	Yes, Have used one before/am using now	37.5(74)
2.	Have considered it, but never used one	38.55(77)
3.	Not considered due to lack of awareness	24(48)

n-No. Of respondent

37.5 %(74) respondents reported that they have used the online pharmacy before and Presently they are user of it, 38.55 %(77) Respondents had considered the E-Pharmacy but not using it and 24 %(48) respondents reported that due to lack of awareness online pharmacy is not considered. We can say that online pharmacy is at introductory stage in India.

Table 5. Perception for the following parameters of online pharmacy (E-Pharmacy)

Sr. No.	Perception	Agree	Neutral	Disagree
1	Trusts the quality	143	43	13
2	It is not time consuming	140	41	17
3	Happy with online shopping	129	53	17
4	Have easy access to internet	156	34	9
5	Aware that online pharmacy is exist	146	40	13
6	Online pharmacy is better option due to customized benefits	139	43	17

From the above data we can interpret that more than 70% of respondents are agree on various parameters of online pharmacy like trust on quality, time saving, happy with online buying, ease of access, awareness, customized benefits etc. 20% of the respondents has given the neutral response and less than 10% respondents are disagree on mentioned parameters of online pharmacy.

Table 6. Buying behavior

Sr. No	Parameters	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	I hesitate to shop online as there is a high risk of receiving wrong product	18	86	38	48	09
2	I feel that there will be difficulty in settling disputes when I buy From E-Pharmacy	23	83	40	45	08
3	I might not get what I ordered through E- Pharmacy	22	80	46	44	07
4	I do not shop online because of non- availability of reliable & well-equipped shipper.	80	80	46	44	07
5	I feel that my credit card details may be compromised and misused if I shop online	19	73	07	46	10
6	I might get overcharged if I shop online as the retailer has my credit card information.	20	70	79	49	11
7	I feel that my personal information given to retailer may be compromised to third party.	26	74	41	47	11
8	Shopping online is risky because of a lack of strict cyber laws in place to punish frauds and hackers.	23	86	34	41	15

From the above data it is observed that more than 50% respondents are hesitate to online shopping due to risk of receiving wrong products, difficulties in dispute setting, on availability and reliability issue, chances of misuse of credit card details and personal informations, chances of overcharging, frauds. 20% respondents shown the neutral response and less than 30% reported disagreement for mentioned parameters of online pharmacy. Online pharmacy is beneficial in many ways also it is inconvenient.

Reliability testing

Table 7. Test of reliability-Case Processing Summary

		N	%
Cases	Valid	199	100.0
	Excluded	0	.0
	Total	199	100.0

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.896	.911	26

The test of reliability has been offered in this pilot study using Cronbach's alpha test. The detailed calculations are presented in below tables. In the test procedure only hypothesis related variables are considered. Now considering the Cronbach' alpha value accounted for .896 which is considerably higher than the .750. Thus it may be inferred that the questionnaire tools prepare is reliably expressing internal consistency within items under investigation.

Validity testing

Table 8. Test of Validity-

Sum Correlations
** Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).

Correlations between all the hypothesis related variables and the variables of 'Sum' that is arrived after summation of all the data responses observed in the pilot study is calculated and calculated output is analyzed.

Now, based on the test statistics listed in the row called 'Sig. (2-tailed)' observed between all the variables and the variable of 'Sum' has been found significantly lower than 0.05. This lead to interpret that the piloted questionnaire is valid for further data collection.

Hypothesis testing

H1-0: There is NO significant association between perception of buyers for E- Pharmacy and buyer's awareness regarding the E-Pharmacy.

H1-a: There is a significant association between perception of buyers for E- Pharmacy and buyer's awareness regarding the E-Pharmacy.

Now keeping inmind the present research hypothesis two set of parameters need to be studied, namely,

(a) Perception of buyers and (b) awareness regarding existence of e-pharmacy.

Now, former parameter of perception has been considered and quantified with five variables covering, (1) quality, (2) time needed for purchase, (3) Happy with online shopping, (4) easy access to internet and (5) customized benefits.

Keeping this entire thing in mind, present hypothesis has been tested using correlation coefficient and the related significance test. The necessary calculations have been tabulated in below Table no. 8.

**Table 9. Hypothesis testing
Correlation Coefficient with test of significance**

		Awareness-Aware that online pharmacy is exist
Perception-Trusts the quality	Pearson Correlation	.529**
	Sig. (2-tailed)	.000
	N	199
Perception-It is not time consuming	Pearson Correlation	.489**
	Sig. (2-tailed)	.000
	N	199
Perception-Happy with online shopping	Pearson Correlation	.581**
	Sig. (2-tailed)	.000
	N	199

	Pearson Correlation	.765**
Perception-Have easy access to internet	Sig. (2-tailed)	.000
	N	199
Perception-Online pharmacy is better option due to customized benefits	Pearson Correlation	.496**
	Sig. (2-tailed)	.000
	N	199

Interpretation-

On scrutinizing the results mentioned in the table above, it may be observed that the correlation coefficient accounted between perception and awareness are significant and observed to be more than .40 in case of all the variables. Moreover the value Sig. (2- Tailed) also observed to be less than 0.05 resulting in accepting the alternate hypothesis and the interpretation can be provided as there is a significant association between perception of buyers for E-Pharmacy and buyers awareness regarding the E-Pharmacy.

DISCUSSION

Due to development in technology and digitalization, E-Buying of products from the online sources becoming ordinary practices at the present time owing to the tailored benefits. Online buying of medicinal products is also started in recent times. But purchasing of medicines through the internet sites/E-Pharmacies is not a familiar practice yet, which is at preliminary phase in Indian context. There is deficiency of extensive research on online/E-pharmacy in Indian viewpoint. With these perspectives this research is focused on the study of buyer's behavior towards online pharmacy in Indian context.

In this study 81.5% of respondents are aware about online pharmacy and 39 % (78) respondents purchase the medicines from medical store as well as from E-Pharmacies which is similar to findings of the study conducted by Ravinder K. Saha, Rakhamaji D. Chandanea(2018).

Further 37.5 % (74) respondents reported that they have used the online pharmacy before and presently they are user of it, 38.55 % (77) Respondents had considered the E-Pharmacy but not using it and 24 % (48) respondents reported that due to lack of awareness online pharmacy is not considered .This findings are somewhat matching to outcome of the study conducted by Sumit Agarwal (2020).

Anand Navin Baid and Arijit Ghosh (2021) also showed the comparable results which focus on strengths and weakness of online pharmacy. According to present study more than 70% of respondents are agree on various parameters of online pharmacy like trust on quality, time saving, happy with online buying, ease of access, awareness, customized benefits etc. More than 50% respondents are hesitate to online shopping due to risk of receiving wrong products, difficulties in dispute setting, on availability and reliability issue, chances of misuse of credit card details and personal informations, chances of overcharging, frauds.

Presently 1mg, Netmeds, Pharmeasy are the major players of Indian E-Pharma Industry which is similar to the findings of the latest study of Deepa Raghunath, Dolly Mehta (2021).

The awareness of online Pharmacy is good but its use is very less due to late technical initiation and late grasp of this trend. Overall, online paharma industry in Indian context is yet untapped segment which has enormous potential and expansion opportunities in coming years.

FINDINGS

1. Out of 199 respondents' 108 respondents (54.27 per cent) found regular buyers of medicines. It is worthwhile to note that these 54.27 respondents who buy medicines regularly are comprised of almost one half of the female respondents.
2. 81.5% of respondents are aware about online pharmacy at various level of awareness. Only 18.5 % (36) respondents are completely unaware that medicines can purchase online.
3. 61 % (121) respondents are preferring medical store to purchase the medicines, 39 % (78) respondents purchase the medicines from medical store as well as from E-Pharmacies. No one prefers only online platforms to purchase the medicines.

- 37.5 % (74) respondents reported that they have used the online pharmacy before and Presently they are user of it, 38.55 % (77) Respondents had considered the E-Pharmacy but not using it and 24 % (48) respondents reported that due to lack of awareness online pharmacy is not considered.
- More than 70% of respondents are agree on various parameters of online pharmacy like trust on quality, time saving, happy with online buying, ease of access, awareness, customized benefits etc. 20% of the respondents has given the neutral response and less than 10% respondents are disagree on mentioned parameters of online pharmacy.
- More than 50% respondents are hesitate to online shopping due to risk of receiving wrong products, difficulties in dispute setting, on availability and reliability issue, chances of misuse of credit card details and personal informations, chances of overcharging, frauds. 20% respondents shown the neutral response and less than 30% reported disagreement for mentioned parameters of online pharmacy.
- It may be inferred that the questionnaire tools prepare is reliably expressing internal consistency within items under investigation.
- Piloted questionnaire is valid for further data collection.
- The alternative hypothesis is accepted and the interpretation can be provided as there is a significant association between perception of buyers for E-Pharmacy and buyers awareness regarding the E-Pharmacy.

CONCLUSION

E-Pharmacy is at introductory stage in India. The awareness of E-Pharmacy is good but users are fewer. E-Buying of medicines is not a common practice yet in Indian context. Online pharmacy is beneficial in many ways also it is harmful. The E-pharma industry have the greater opportunities in coming years, but we also need to develop the strong regulatory support system to monitor the E-Pharmacies. Consumers are shifting towards digitalized platforms due to customized benefits to purchase the medicines but there is need of consumer education regarding risk and rewards of online pharmacy.

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A Study on Awareness for Information Security among Working Women from Pune City

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ABSTRACT

Information security is an interdisciplinary field of study and work by experts who use and implement security tools of all kinds (specialized, trustworthy, human and legal) to protect information as a whole (inside and outside of associations) and for information frameworks. Where information is prepared, processed, stored, sent, deleted and risk-free. The present study explained the awareness for information security among working women from Pune city. A structured and un-disguised questionnaire was developed and used to collect the primary data from 396 respondents. Study revealed that working women from Pune city do not lack in general security awareness, information security awareness and resource security awareness.

Keyword: Information security, general security awareness, information security awareness and resource security awareness

1. INTRODUCTION OF THE STUDY

Information security, sometimes referred to as infosec, is the protection of information by controlling information risks. It is important for risk information on the board. This usually includes preventing or reducing the likelihood of unauthorized / inappropriate acceptance of information, illegal use, disclosure, interruption, deletion, misuse, modification, review, recording or deterioration of information (Joshi and Singh, 2017). It also includes activities that have been suggested to minimize the negative impact of such events. Secure information can have any structure, for example electronic or physical, intrinsic (like office work) or volatile (e.g. information). Central to information security is adequate assurance of privacy, reliability and access to information (known as the CIA trio), while at the same time focusing on an effective approach without compromising the benefits of the community (Daniel and Titman, 2001). This is generally accomplished through an organized danger the executives' interaction that implies:

- distinguishing information and related resources, in addition to likely dangers, weaknesses, and effects;
- assessing the dangers;
- concluding how to address or treat the dangers for example to keep away from, moderate, share or acknowledge them;
- where hazard relief is required, choosing or planning fitting security controls and executing them;
- checking the exercises, making changes as important to resolve any issues, changes and improvement openings.

Different meanings of information security are proposed beneath, summed up from various sources:

- Conservation of secrecy, honesty and accessibility of information. Note: moreover, different properties, like legitimacy, responsibility, non-disavowal and unwavering quality can likewise be included (ISO/IEC, 2009).
- The security of information and information frameworks from unapproved access, use, revelation, disturbance, change, or obliteration to give classification, uprightness, and accessibility (Committee on National Security Systems, 2010).
- Guarantees that lone approved clients (privacy) approach exact and complete information (honesty) when required (accessibility) (ISACA, 2008).
- Information Security is the way toward ensuring the protected innovation of an association (Pipkin, 2000).

Information security is a multidisciplinary area of study and an expert action on the role of events and implementation of security tools for each individual (specialized, reliable, human and project) to maintain information in their fields (inside and outside the edge) disturbing It is from associations), and as a result of the frames of information gap, information, preparation, provided, editor and risk editor. Threats can be adjusted on

the information and information framework and the security objective of each risk can be disrupted. A series of special safety goals should be reviewed due to risk, alternately to ensure their interests and in accordance with the developing environment. Important regulations of security can now include: Confidentiality, integration, access, protection, validation and reliability, non-fiction, responsibility, and appeal. (Cherdantant and Hilton, 2013).

At the heart of information security is information security, which is a mark of awareness, respect and access to information and ensures that information is not compromised in any way when fundamental problems arise. These issues include catastrophic events, personal / professional computer crashes, and actual theft, among others. The area of information security was recently created and fully developed. The site offers several sites for specialization, including networking and structured collaboration, acquisition of applications and data sets, security testing, information systems analysis, organization of business transactions, electronic document identification and computational rules.

2. LITERATURE REVIEW

The term network security is often used instead of the term information security. Von Solmes and Van Niekerk (2013) emphasized that although there is a large gap between network protection and information security, the two ideas are not exactly alike. In addition, network integrity goes beyond the boundaries of traditional information security to include the security of information resources as well as the security of various resources, including the individual. In information security, the reference to the human factor generally corresponds to the role(s) of the individual in the security interaction. In network security, this factor has an additional statistic, in particular that people are more focused on digital attacks or even accidentally succumb to a digital attack (Whitman and Mattord, 2011). This additional analogy has moral implications for society as a whole, as securing some vulnerable communities, such as children, can be seen as a cultural obligation.

The financial aspects of information security has as of late become a flourishing and quick control. As appropriated frameworks are gathered from machines having a place with chiefs with different interests, Anderson and Moore (2006) found that motivating forces are turning out to be pretty much as significant as specialized plan in accomplishing reliability. The new field gives important experiences not simply into "security" subjects (like bugs, spam, phishing, and law implementation procedure) yet into more broad regions, for example, the plan of distributed frameworks, the ideal equilibrium of exertion by developers and analysers, why protection gets dissolved, and the governmental issues of advanced rights the executives (Peltier, 2013; Stamp, 2011).

Information security is important in relation to associations that rely on information innovation. The use of innovations in the area of information security becomes clear when relevant information is compromised. Current innovations in information security, however, only address a small fraction of the information risk problem. Truth be told, the proof progressively proposes that information security innovation doesn't diminish information hazard successfully. Blakley, McDermott and Geer (2001) contended that individuals should re-examine their way to deal with information security from the beginning in the event that we are to manage the issue of information hazard, and proposes another model roused by the historical backdrop of medication.

The improvement of information security throughout the last 40 to 50 years, can presumably be portrayed from multiple points of view (Solms, 2000). One way isolates the improvement into three waves. The First Wave can be viewed as the Technical Wave, fundamentally described by an exceptionally specialized way to deal with information security. The Second Wave can be viewed as the Management Wave, portrayed by a developing administration acknowledgment of and contribution with the significance of information security, enhancing the Technical Wave. From the most recent couple of long stretches of the 1990's, the Third Wave began, portrayed by perspectives like prescribed procedures and codes of training of information security the board, global information security certificate, developing information security as a corporate culture, and dynamic and constant information security estimation (Tipton and Krause, 2004).

3. PURPOSE OF THE STUDY

Since ages, women were trained how to be protected and how to keep up with securities. They were made mindful about distinguishing positive and adverse of the contrary individual to ensure themselves. With these practices, women developed further and got free. In the present age women are driving as business visionaries – making occupations for other people, as home producers keeping the family protected, as Bank Managers-overseeing individuals and assets and furthermore in other driving jobs.

Despite the fact that this is current circumstance in this advanced world, women are as yet discovered to be casualty by and large and are bearing torment and misfortune in both individual and official lives. A deep rooted practice is as yet proceeding with today as badgering, coercing and so forth. The present digital world or virtual world have open up better approaches to connect women and assault them. The utilization of the internet and its chaperon secrecy keep on impacting contrarily the social and social parts of society.

While there are numerous security apparatuses and spaces accessible where women can appreciate the advantages of the digital world, absence of awareness on the most proficient method to utilize things securely and safely is making women more defenceless against digital assaults than men. In digital world women are exposed to provocation by means of email, transforming, digital maligning, long range informal communication, hacking, digital following, digital sexual entertainment, digital being a tease and digital tormenting.

Some awareness best practices and tips can assist women with being protected from these digital assaults and secure them and their families.

4. OBJECTIVES OF THE STUDY

The present study is aimed to study the awareness for information security among working women from Pune city. Thus, with reference to the theme of the research, researchers have established following objectives of the study:

- I. To identify the level of general security awareness among working women from Pune city.
- II. To identify the level of information security awareness among working women from Pune city.
- III. To identify the level of resource security awareness among working women from Pune city.

5. HYPOTHESES OF THE STUDY

From the literature study and arguments above, following hypotheses are proposed for validation:

- I. H_1 : Working women from Pune city do not lack in general security awareness.
- II. H_2 : Working women from Pune city do not lack in information security awareness.
- III. H_3 : Working women from Pune city do not lack in resource security awareness.

6. RESEARCH METHODOLOGY

For the present study, researchers have adopted descriptive research design through survey method with a large sample size. At the outset, data set was screened for incorrect data entry and missing values. Data set was checked for normality and outliers. One-sample t-test analysis was used to validate the hypotheses, as proposed above.

6.1 Measures

Researchers have developed and used structured and un-disguised questionnaire as research instruments with items from validated scales for measuring General Security Awareness, Information Security Awareness and Resource Security Awareness (Appendix A). Researchers used a pilot study to test the questionnaire for the relevance of the questions, respondents' willingness to share information, respondents' understanding of the questions, the ease and time it took to complete the questionnaire, and the range of possible answers.

6.2 SAMPLING METHOD AND SAMPLE SELECTION

Research has used simple random sampling technique to select the samples from 396 working women from Pune city. The data was collected from the period of January 2021 to March 2021.

Researcher has distributed 700 questionnaires with the help of field reviewers and Google forms. In response to that, researcher has received 396 appropriate responses, which is 56.57% rate of response. As stated by Hair, Anderson, Tatham and Black (1998), this sample size exceeds the recommended minimum.

7. RESULTS

For the present study, researchers have used One-Sample t-Test to validate the hypotheses as proposed in the study. However, before that to ensure the appropriateness of the research instrument, researchers have tested for content validity and reliability statistics.

7.1 Content validity

Content validity is ensured through the relevant literature review on the subject of the study. Pilot study of questionnaire was conducted with the help of panel of expert consisting of professors and due changes were incorporated to improve the content and clarity of questions in the instrument. Further, pilot test of the questionnaire was carried among the sample respondents, separated from those were included in the final study.

7.2 Reliability statistics

The researcher used Cronbach's Alpha method to assess the reliability of all items in the questionnaire. The value of the reliability coefficient was very significant at 0.887 and indicates the high reliability of the questionnaire. The reliability test was implemented with the SPSS software and the statistics of the reliability test are described below:

Table 1: Reliability Statistics

<i>Cronbach's Alpha</i>	<i>No. of Items</i>
.887	15

7.3 Validation of Hypotheses

I. **H₁**: Working women from Pune city do not lack in general security awareness.

Table 2: One-Sample Statistics

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>
General Security Awareness	396	4.0758	.77904	.03915

Table 3: One-Sample One-tailed Test

	<i>Test Value = 4</i>					
	<i>t</i>	<i>df</i>	<i>Sig. (One-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
					<i>Lower</i>	<i>Upper</i>
General Security Awareness	1.935	395	.027	.07576	-.0012	.1527

One-sample One-tailed t-test is utilized to validate the hypothesis H₁. The One Sample One-tailed t Test determines whether the sample mean is statistically different from a known or hypothesized population mean. General Security Awareness is estimated with 08 items. Table 2 presents the sample statistics. Mean impression score (4.07 ± 0.77) is greater than the population 'typical' impression score of 4.0. The One-Sample One-tailed Test table reports the result of the one-sample t-test. The top line offers the benefit of the known or hypothesized population mean looking at sample data. Moving from left-to-right, table presented with the noticed t-esteem ("t" section), the levels of opportunity ("df"), and the statistical importance (p-esteem) ("Sig. (One-tailed)") of the one-sample t-test. Calculated t-esteem is 1.93 which is greater than the one tail table of t-esteem for example 1.64 at 5% degree of importance and 395 levels of opportunity. Besides, p < .05 (it is p = 0.027). Therefore, it can be inferred that the population implies are statistically significantly different. Thus, the alternate hypothesis as 'working women from Pune city do not lack in general security awareness' is accepted.

II. **H₂**: Working women from Pune city do not lack in information security awareness.

Table 4: One-Sample Statistics

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>
Information Security Awareness	396	3.9141	.73791	.03708

Table 5: One-Sample One-tailed Test

	<i>Test Value = 4</i>					
	<i>t</i>	<i>df</i>	<i>Sig. (One-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
					<i>Lower</i>	<i>Upper</i>
Information Security Awareness	2.315	395	.0105	-.08586	-.1588	-.0130

One-sample One-tailed t-test is utilized to validate the hypothesis H2. The One Sample One-tailed t Test determines whether the sample mean is statistically different from a known or hypothesized population mean. Information Security Awareness is estimated with 05 items. Table 4 presents the sample statistics. Mean impression score (3.91 ± 0.73) is lesser than the population 'typical' impression score of 4.0. The One-Sample One-tailed Test table reports the result of the one-sample t-test. The top line offers the benefit of the known or hypothesized population mean looking at sample data. Moving from left-to-right, table presented with the noticed t-esteem ("t" section), the levels of opportunity ("df"), and the statistical importance (p-esteem) ("Sig. (One-tailed)") of the one-sample t-test. Calculated t-esteem is 2.31 which is greater than the one tail table of t-esteem for example 1.64 at 5% degree of importance and 395 levels of opportunity. Additionally, $p < .05$ (it is $p = 0.0105$). Therefore, it can be reasoned that the population implies are statistically significantly different. Thus, the alternate hypothesis as 'working women from Pune city do not lack in information security awareness' is accepted.

III. **H₃:** Working women from Pune city do not lack in resource security awareness.

Table 6: One-Sample Statistics

	<i>N</i>	<i>Mean</i>	<i>Std. Deviation</i>	<i>Std. Error Mean</i>
Resource Security Awareness	396	4.3510	.77002	.03870

Table 7: One-Sample One-tailed Test

	<i>Test Value = 4</i>					
	<i>t</i>	<i>df</i>	<i>Sig. (One-tailed)</i>	<i>Mean Difference</i>	<i>95% Confidence Interval of the Difference</i>	
					<i>Lower</i>	<i>Upper</i>
Resource Security Awareness	9.071	395	.000	.35101	.2749	.4271

One-sample One-tailed t-test is utilized to validate the hypothesis H3. The One Sample One-tailed t Test determines whether the sample mean is statistically different from a known or hypothesized population mean. Asset Security Awareness is estimated with 02 items. Table 6 presents the sample statistics. Mean impression score (4.35 ± 0.77) is greater than the population 'ordinary' impression score of 4.0. The One-Sample One-tailed Test table reports the result of the one-sample t-test. The top column offers the benefit of the known or hypothesized population mean contrasting sample data. Moving from left-to-right, table presented with the noticed t-esteem ("t" section), the levels of opportunity ("df"), and the statistical importance (p-esteem) ("Sig. (One-tailed)") of the one-sample t-test. Calculated t-esteem is 9.071 which is greater than the one tail table of t-esteem for example 1.64 at 5% degree of importance and 395 levels of opportunity. In addition, $p < .05$ (it is $p = 0.001$). Therefore, it can be presumed that the population implies are statistically significantly different. Thus, the alternate hypothesis as 'working women from Pune city do not lack in resource security awareness' is accepted.

8. COMMENTS ON VALIDATION OF THE HYPOTHESES

Based on the output of the analysis, following observations were made on the validation of hypotheses as proposed in the study:

- Results of the study confirmed that working women from Pune city do not lack in general security awareness and provided support for H_1 (alternate hypothesis).
- Results of the study indicated that working women from Pune city do not lack in information security awareness and provided support for H_2 (alternate hypothesis).
- Results of the study confirmed that working women from Pune city do not lack in resource security awareness and provided support for H_3 (alternate hypothesis).

9. DISCUSSION

PC-based violations are nothing new to us. This infection has been with us for over 20 years. Spyware has been around a long time since the first events. The widespread use of phishing scams dates back to at least 2003. One commentator concluded that the pace of the information structure is accelerating and that the security support

program of the actors is lagging far behind. Surprisingly, the impression arises that the quick selection of online areas is not synchronized with the adoption of a corresponding security culture.

Supportive information security is a selection of information security that is emphasized to provide insight into the potential dangers of rapid access to types of information and rapidly emerging threats to information targeting human behavior. With the advent of risk and the diffusion of information in the assessment, attackers broadened their capabilities towards more precise targets, developed more attack strategies and systems, and returned to more diverse thought processes.

When information security controls and cycles are in place, attacks are created to bypass controls and cycles. Attackers map and manipulate the human behavior of individuals to harm corporate organizations and platforms. Some people unaware of the information and risks may inadvertently bypass routine controls and security measures and break the link. There are also concerns about information security. Cyber security as a business topic dominates the ranking of most CIOs and shows the requirements to deal with today's digital dangers.

10. LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

The researcher is aware of the following limitations of his work and also the scope for further study:

- Researcher is fully aware that the primary data is likely to be affected directly or indirectly as it is collected through survey method which represents opinion of individual respondents.
- The present study has more qualitative orientation. However, output can be more précised with quantitative approach of data collection.
- Statistical analysis performed by the researcher can further be refined to predict the outcome and case study approach can be adopted to get insight into subject.

11. APPENDIX A

Items used for survey

Item code Item description

General Security Awareness

- 01 I am familiar with information security policies
- 02 I always lock my PC and employ system's password protected screen saver
- 03 I understand the requirement for strong password
- 04 I never share my password
- 05 I know how to protect against phishing and cybercrime
- 06 I only use trusted site for browsing data from internet
- 07 I abide all license / copyright laws while downloading softwares
- 08 I am careful when opening email attachments

Information Security Awareness

- 09 I am familiar with appropriate methods for transmitting sensitive information
- 10 I always encrypt sensitive data when sending through emails
- 11 I ensure that sensitive data is protected on mobile device
- 12 I do not leave sensitive data unattended
- 13 I am aware that posting sensitive data on social sites violates regulations

Resource Security Awareness

- 14 My computing devices are virus protected
- 15 I physically secure my computing devices

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An Analytical Study of Effective Structure of Management Education in India

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ABSTRACT

The Covid-19 has deleterious high-flown over all universe as well as the field of education. Academics over all stages like preprimary, primary, secondary, and higher levels of education have end in one hundred eighty eight sovereign states over the universe. Protracted end of schools and colleges has mandatory the academic field to endorse the online way of learning, but a question comes in mind of all educationists is: Can this online way of learning autonomous in the long period of time? The reply of this question, our journals has presented a substitute design of transferring education in the time of coronavirus pandemic. This research supports to investigate and analysis various techniques of course hand over. It's also an objective to analyze and variation different techniques of academic through SWOT means Strengths, Weaknesses, Opportunities, and Threats compares. This study restricted its compare to education of management fields. An in detail standard exploration from different research articles, papers, cases was completed for this study to propose the techniques. I noticed that the education of management in India requires a fundamental change in mode of teaching, and evaluation and as has been the mode. The study concluded that the academic faculties, management and administration should plan or design new curriculum in such a mode of structure which is more convenient, has enough training hours and where data gets evaluated and make an effort in the sector.

Keyword: COVID-19, management, education field, method of delivery

INTRODUCTION

The Covid-19 is a disaster that has high-flown all universe as well as the field of education. Education fields all over states like preprimary, primary, secondary, and higher education have ended in one hundred eighty eight sovereign states over the universe, affecting near about 93 percent of the globe, population of students. Academies over the universe have been mandatory to put back conservative teaching with online teaching or learning and distance perspective, online teaching is a details delivery system. Corona pandemic has compulsory universities and colleges globally to face to face lecture room to online sessions. Due to pandemic, in India, some places in the middle of March- 2020, preprimary, primary, secondary, higher education, schools, colleges, and universities commenced closed because of college campuses areas as an estimate to assess the layout of Covid-19. Sometimes a network connecting issues in teaching and most of two hundred eighty five lacks students were impacted at various levels of teaching, admission and examination.

Expansion of Management Education

The education method in ancient India hundred years back where the students were learned in Ashrams, gurukuls, sammelan Takshshilas and parishads. All Gurukuls were the home based pathshala's and the children's had to survive there during the lives of their basic education. It commences the Guru-Shishya heritage in schooling. Parishads means the colleges or educational campus of the present scenario where teachers taught various courses. Sammelan means the conferences where scholars come together at one place for sharing, competitions and discussion generally on the summons of the head of state and they were happily rewarded also. The structure of Indian education method developed in an enlightened and systematic way with the commencement of academics such as Vikramshila, Ujjain, Takshashila, and Nalanda. *Chanakya*, who was the ancient Indian academies and advisor is well known for his teaching to Mauryan emperor Chandragupta. His believed on teaching as a means to knowledge, virtues character, and strength, to developed one's personality and a person's dependability. Ramayana and Mahabharata are Ancient Hindu scriptures; it's also broadly adopted as an example or reference to learn management thoughts and principles.

In the era of 1990 saw an important replacement in the field of management education in India starting its financial turf to Privatization, Globalization, and Liberalization, which develop of the various courses in the higher education fields. , Sydenham College Mumbai is the first Business level college and it was established in 1913. Second College Shri Rama College of Commerce established in Delhi in 1920. In 1948, Indian Institute of Social Science was India's first management college to educate human and worker to build and enhance the skills and knowledge need for managing industrial enterprises in India. Indian Institutes of Management Ahmedabad as biggest management college in those periods introduced the case studies of learning in India. All

multinational industries set foot in India that generated the golden chance for management people for superior job placement.

In current times 2019 to 2020, there are 3,070 institutions with addition on 73 new institutions and subtraction of 33 closed institutions. The total intake in this year is 3,73,456 students. These students are working under the guidance of 44,006 faculties. The present structure of Indian management education is divided into six categories as follows:

1. Indian Institute of Management set up by the Government of India.
2. University Departments of Management studies, distance/correspondence, and part-time courses as well.
3. Colleges and Institutes affiliated to universities.
4. Private or Government Institutes approved by AICTE.
5. Private Institutes or colleges with no affiliation by any university or AICTE.
6. Private colleges or Institutes offering Master of Business Administration (MBA) courses in India in collaboration with foreign universities.

METHODOLOGY

This study has taken on a qualitative perspective. In-detail study through different research papers, research articles, cases from refereed journals and publications such as Springer, Elsevier, JStor, Wiley, Taylor and Francis, and so on, is done. The authors have also referred to numerous blogs, news articles, higher education news, websites, reports on COVID-19, and its impact on the education sector. Information from diverse university websites, Indian government websites such as AICTE, Ministry of Human Resource Development (MHRD) is also used in this manuscript. A systematic analysis of various learning modes was done through Strengths, Weaknesses, Opportunities, and Threats (SWOT) and a model was recommended thereafter.

OBJECTIVES OF THE STUDY

1. To study and analyze various methods of course technique.
2. To compare and variation tools of education through SWOT analysis.
3. To recommend the exploratory model of hand over for maximum persuasiveness.

Transformation of models of Academic interference

Face to Face Model

In Face to Face the academic model, the course is transfer in a conventional classroom setting which is a primary feature of the Indian education structure. A classroom experience creates ample scope for teacher to experiment with behavioral, social, and interpersonal dimensions of the student. This includes roleplays, collaborative projects, presentation, theatrics, and many other such interventions. The educational system can create efficiencies by allowing students to collaborate, perform, and complete learning activities and assessments in the physical classroom (refer Table 1).

Table 1. SWOT Analysis of Face-to-Face delivery.

Strengths: Independent learning, better student engagement, connected both in and out of class, meaningful use of study material, instant results and feedback, adjustable timings	Weaknesses: Dependence on internet connectivity, expensive resources, incompatibility of hardware and software, stressful when time-limited assignments are given
Opportunities: Flexibility while scheduling classes, Uniform reach of content handles, faculty shortage, easier to understand content especially for international students, user friendly	Threats: Internet shorthand in assignments, Chat sessions and other distraction, Exchanging Identification (IDs) and passwords for assignments

Source: Hande. 2014.

Correspondence/Open or Distance Education

Distance education has also opened a new window of opportunities for those who craved for further studies and in India, and correspondence education has a very long history. Current data show that most universities such as University of Delhi, Jamia Millia University, Amity University offer distance learning degrees or certificates (undergraduate, graduate, doctorate, and certificate programs). Some universities offer distance learning in mostly all field every year and have become very popular such as Indira Gandhi National Open University, Symbiosis center of distance education, and so on.

Table 2. SWOT Analysis of Correspondence/Distance Education Delivery.

Strengths: Students are more active and self-directed in the learning environment, well-planned instruction design and material, easy schedule, students can engage course at home, affordable, can pursue a job along with education	Weaknesses: Interaction between the instructor and the student is limited, lack of infrastructure, potential for fraud or plagiarism, cost of computers.
Opportunities: Quick response, differentiation (temporary), New technologies can allow for a more enhanced learning environment for students, Increased equality and diversity in education for students.	Threats: The number of enrolled students is increasing the amount of offering degrees, difficulty recruiting and keeping quality instructors, Assessment, Competition among colleges and universities.

Regular MBA/PGDM/Executive MBA

MBA or equivalent Post Graduate Diploma in Management (PGDM) is one of the most popular postgraduate programs in India because a student with a diverse background such as science, commerce, or humanities can pursue it. The 2-year program is meant to be a professional course meant to be a gateway for job opportunities in the corporate world as indicated in Table 3. A regular MBA or PGDM is generally a 2-year course divided into four or six semesters/trimesters and includes theory classes, practical projects, and internships meant for increasing the employability of the students, whereas in Executive MBA students can maintain the balance between their full-time jobs and attend classes on weekends or any other arrangements of contact classes as decided by the college.

Table 3. SWOT Analysis of Regular Delivery

Strengths: Faculty and staff support, proactive student, learning communities, enhances interaction, dedicated and expert faculty	Weaknesses: Lack of pride of the internal community, high and unequal workloads faculty and staff, student's preparedness at the entrance, biasness.
Opportunities: Growth potential, new trends, diversity of the region in students and staff, increase demand for mid-career redirection and lifelong learning, technological advances.	Threats: Negative public perception, lack of knowledge, concept and questions within students.

Online Mode of Delivery Because of COVID-19

The orders of Stay Home and social distancing have spared no one. Students have been caged in their homes since lockdown 1.0. India has the largest population in the world in the age bracket of 4 to 25 years which presents huge prospect in the education sector. The demand for online courses and learning has seen a huge surge since the lockdown. Online learning has been adopted in various countries as the primary mode of education. The e-learning method requires only a good internet connection and computer/Mobile as essentials. The session can also be recorded for later use. With global pandemic, education all over the world is trying to build systems and practices around online learning, yet this can be just a temporary arrangement. A look at the SWOT of online learning in Table 4 indicates certain gaps which need serious pondering.

Table 4. SWOT Analysis of Face-to-Face delivery.

Strengths: Learning opportunities that suffice the need of students, process and transfer of information is digitally and safe, reduce the feeling of students leading behind, more flexible, more fluid	Weaknesses: Lack of relationship and direct communication missing, practical courses, unsystematic manner of knowledge transfer, internship and experiential learning missing
Opportunities: Successful combination of education and technology, learning capacity increase, virtual training and conference	Threats: Background noise, connectivity issues, attention span, Cluttered space

Gap Analysis

Coronavirus has fractured a large chunk of India's education. AICTE released guidelines related to the ban imposed on hiking fee, online mode of teaching, conduct of pending exams as per University Grants Commission (UGC) guidelines. As already B-schools were questioned for their inability to generate employable graduates. According to Harvard Business Review, the cause of today's crisis in management education is far broader in scope and can be traced to a dramatic shift in the culture of business schools. During the past several decades, many leading B-schools have quietly adopted an inappropriate and ultimately self-defeating model of academic excellence too. According to the Businessworld (2019) online bureau, around 65% of the management graduates are employable. This does not go well for the B-School eco-system in the country. The recent initiative by AICTE makes it necessary for every B-school to get National Board of Accreditation (NBA) accreditation, will pull out poor performers. Demand for management graduates from these B-schools shows that companies create a pipeline for top leadership from Indian B-school graduates. Although the faculty members of Indian B-schools develop case studies and deliver executive education program along with industry engagement and collaboration, yet the output is not at par with International standards done by Warren and James (2005)

The New Education Mandate

According to AICTE academic guidelines (2020), all institutions must start the academic classes for existing students and new students as per the academic calendar released by it in online mode only. Institutes can shift to F2F or classroom teaching only after MHRD issues the necessary directive in this regard. To prevent the academic loss of students, MHRD directed academic institutes to impart education using multiple modes of communication and technology such as the internet calls, SMS, email, E-learning platform, and so on, which may not prove to be as effective as claimed by many B-schools. Campus Technology (2020) states that higher education's current shift to online learning may leave a sour taste in the mouths of students and faculty across the country if not done right but every cloud has a silver lining.

Change in cost is institution-specific depending on the obligations of each college and in some cases, B-schools have denied any fee reduction to manage the operational cost of online infrastructure. But this unrest is evident on social media platforms where students have questioned why should they pay a hefty amount if they have to study online using their internet and they have demanded discount in fees from universities and educational system (UGC and AICTE). This factor will also become a reason for B-Schools downfall and less number of admissions.

An Alternative Model for MBA/PGDM Course Delivery During and Post Covid-19

Most of the B-Schools work with a standard batch size of 60 students in a specific section. The current pedagogy and curriculum are predominantly classroom-based as suggested by AICTE (refer Table 5) with limited scope for innovation. These pedagogical interventions include case studies, role plays, group activities, simulation, field-based projects, guest session, and so on. Unlike medical education where teaching and practical learning go hand in hand, in B-schools business studies is delivered away from the sight of action, in classrooms with theory at the core of learning. In the entire duration of 2 years, a student typically spends 8 to 10 weeks in a corporate as interns and rest in the classroom. The skill gap widens with every hour spent in the classroom where student grows intellectually but remains poor in handling real-world business problems.

Table 5. Program Structure and Credits According to AICTE.

MBA course	Number of credits
1st year(I and II semesters)	54 credits of core courses
2nd year (III and IV semesters)	42 credits of electives
Internship/Fieldwork	06 credits
Total	102 credits
PGDM course	Number of credits
1st year(I, II, III trimester)	54 credits of core courses
2nd year(IV, V, VI trimester)	42 credits of electives
Internship/Fieldwork	06 credits
Total	102 credits

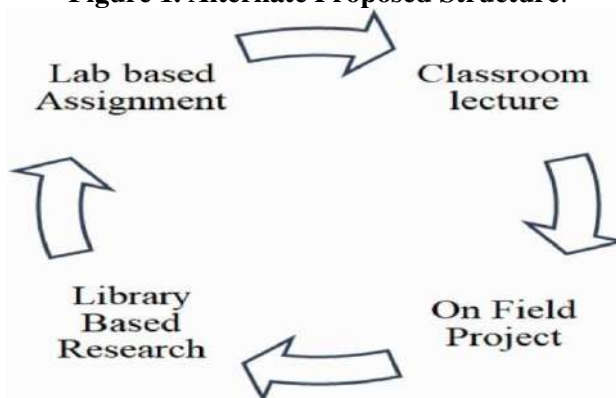
Note. AICTE = All India Council for Technical Education; MBA = Master of Business Administration; PGDM = Post Graduate Diploma in Management.

Table 6. SWOT Analysis of Online Learning in time of COVID-19.

Group	Module	Task	Follow-Up
Group A	Class room teaching	Discussion on history, theory, and perspectives of management	Quiz, extempore, and discussions
Group B	On-field project	Visit and gather data on small businesses, Corporate meetings, and interviews	Weekend review and experience sharing (can be evaluative)
Group C	Library-based research	Research on work done in the management field, book review or seminal work by scholars in the area	Paper writing and presentation (paper submission can be done for evaluation)
Group D	Lab-based assignment	Web-based assignment, website search of corporates, and benchmarking best practices	Submission and discussions

Keeping in view the current pandemic, we propose an alternate model as suggested in Figure 1, which may be used by B-Schools postpandemic as well. This model keeps the essence of management learning at the core and is best suited in current times where F2F teaching is not possible. With concerns of health and social distancing, we have to rework on defining learning cohorts in smaller subgroups and reimagine the canvas of learning.

Figure 1. Alternate Proposed Structure.



This model helps the students as well as a teacher to deliver education more efficiently and effectively. The faculty along with relevant stakeholders needs to rethink and redesign the course curriculum and delivery plan. The pedagogical approach needs to be more experiential and industry oriented. B-schools can run a pilot project for a few subjects to test the efficacy of the proposal.

For subsequent week similar plan can be designed by the faculty where groups are rotated in different Modules in support to Table 6. Besides the sample modules, the faculty can be creative in introducing more modules such as online courses, Group Presentations, Corporate visits, 1-week internship, field interview, live case studies to enrich the student learning. The management and teaching fraternity has to be creative and collaborative in designing these modules. Intense collaborative efforts are desired where a group on the field can work simultaneously on multiple dimensions studied in various subjects.

CONCLUSION

The thought of learning in nature or field study is wide and flexible because it includes different types of field concentrate as indicated by its idea, objectives, yields, areas, the time required, and so on (Rickinson et al., 2004; Scott & Gough, 2003).

1. Educators should always try some new ways to motivate and encourage students to learn and enjoy side by side like an active participant in the teaching process (Jensen, 2003).
2. To motivate students, universities and institutes offer internship programs (60 hours or 6 months) that help students to relate their studies to corporate life but the current model of 6 to 10 weeks of internship in PGDM/MBA program is not sufficient.
3. And with Covid-19 situation, most of the internships were found to be in virtual space such as digital marketing, edutech industry, e-commerce, and so on. It is time and again proved by researches that internships and projects can help students to develop desired skills such as critical thinking, and verbal and nonverbal communication (Maskooki et al., 1998; Raymond et al., 1993).

4. In support, Rothman (2007) found several factors that related to satisfaction of students with internship experiences such as clear tasks, challenging assignments, ongoing feedback, exposure to different parts of the business, and respectful treatment. Narayanan et al. (2006) proposed that internships were more satisfying when students had a voice in project selection.
5. Abrahams (2009) researched how practical work influences motivation and student emotional commitment.
6. After inculcating these skills, the college helps in making the learning process more interesting and colleges had changed the internal assignments into mini-projects or live cases (Kennedy et al., 2001).
7. To conclude, Dewey (1897) stated that Education must be conceived as a continuing reconstruction of experience the process and goal of education are the same things. And with a professional course such as MBA/PGDM, it becomes the responsibility of College administration and faculty to design such a system which is more practice-oriented, has more intern hours and where theory gets tested and tried in the field. The management education in India needs a paradigm shift in design, delivery, and assessment and as has been the trend, the trend-setter has to be the faculty in association with the learner.

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Portrayal of Enigmatic Psychology in Education and Problem Solving

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ABSTRACT

Today, in 21st century the concept of Problem solving is gaining more and more importance. Earlier most of the problem used to be created by the challenges of the nature and hence finding solution was either by invention or by used of resources available in nature only. Now situation is changed as now most of the problems are created by mankind for the excessive benefit or wrong use of natural resources and excessive use of natural resources.

Business is also done by the mankind, for the mankind. Business is sustainable because it is beneficial for both, who does it and for whom it is done. Though, business is not that easy, as it has lot of challenges and problems in its way. In business most of the challenges are manmade and management of the business has to handle it with the help of its team. As most of the challenges are manmade and lot of people are involved in it, we have to consider the psychological aspects involved in problem solving process and the quality of Education people getting since their childhood. In problem solving, processes like brainstorming, team work, and decision making by the management are most important and all these process have enigmatic factor of psychology involved.

Alex Osborn, introduced and developed the concept of creative problem solving in the 1940s, along with the term "brainstorming." The concept of Brainstorming seems easy and simple, actually its simple, but human beings involved in management and performance make it difficult due to reason like -- Self-interest, Ego, Groups with common interest and so on. In Education, Cognition process is most important and hence during education process we have to give importance to develop process of cognition which has -- areas such as giving attention, try to remember, we can see or hear, expressing and understanding by us, being oriented to our surroundings that we can travel from place to place, doing multiple tasks, and reasoning through problems.

The following areas should be studied in any comprehensive neuropsychological battery:

- Speed of Attention and Processing - capacity to sustain focus in any mental activity : In the process of Education, the capacity of developing focus and sustain the focus on learning is most important, this capacity is key for quality learning and then comes in picture the processing speed. Brain is nothing but a super computer, the best part of the brain is that you can develop the speed of processing just by practice and even you can slow down the speed by your lethargy. More the processing speed of the brain and longer the focus period, more the quality learning.
- How we Learn and Memorize - ability to encode, store, and retrieve information: Our brain has capacity to encode, decode and store the information. This system plays important role in learning and even decision making. Accurate encoding and decoding results in better quality learning and better quality decision making.
- Managerial Functions - how to achieve insight and self-awareness, initiate, evaluate, and control thinking and behavior, and to generate feedback: When we gather information with help of process of encoding and decoding, the further function of brain is to process this information based on the previous experience and future needs and evaluate and develop insight to regulate the behavior. We behave means brain works rigorously and then we get the direction to behave.
- Abstract Thinking - ability to use generalized information and apply it to specific, new situations: A gift is given by nature is Abstract thinking to we Human beings. Most of the animals do not have this ability. Ability to understand concepts that are real is nothing but Abstract thinking, but which are not directly connected to concrete physical objects and experiences. Abstract thinking is ability to grasp information from our senses and relate to the wider world.
- Language - ability to verbally comprehend, repeat, express, and write : Language is facility which is developed by all not all the animals, only difference is that humans have developed it to great extent and use of language is to ultimate / farthest stage in human world. Animal also have language but they do not have the words, mostly they use different sounds and sound tracks, by which they communicate meaning to others. Humans have developed words so the meaning is specific and clear.

h. Emotional control - How to behave in various situations or life-situations depends on one's mood, temperament, and personality traits: Emotional control is also the important gift given by nature to human beings. We try to understand the given situation and then decide how to react and express.

EDUCATION AND PROBLEM SOLVING

Problem solving is result of the process of creative thinking hence we have to first discuss the process of creative thinking.

Skinner, the famous psychologist says creative thinking means that the prediction and inferences for the individual are new, original, ingenious and unusual. The creative thinker is one who expresses new ideas and makes new

observations, new predictions and new inferences. Characteristics of Creative Thinking:

- a. Creative thinking, in all its shapes and forms is absolutely an internal mental process and hence should be considered as an important component of one's cognitive behavior.
- b. We all Human beings are capable of thinking creatively and hence it is a universal phenomenon.
- c. In the production of something new or novel including a new form of arrangement of old elements can be called as Creative thinking.
- d. We can think two ways, one thinking with considering present situation and references and two having new dimension entirely hence Creative thinking in all its dimensions involve different and new thinking instead of the routine kind of thinking.
- e. The area of creative thinking is quite comprehensive and huge. It covers all the aspects of life of human beings.

Human beings have Cognitive abilities like thinking, reasoning and problem-solving which are the chief characteristics which distinguish human beings from other species including the all the animals. The challenges and problems faced by the human beings or by society, in general, are solved through series of efforts involving thinking and reasoning. Hence we can say that the powers of thinking and reasoning are essential tools for the welfare and meaningful existence of the individual as well as society.

Psychological process is very important in the education and problem solving process. We learn, means our brain is functioning the way we have seen above. In Problem solving process we have to undergo all the above stages to take decisions to resolve the problem. Generally, stages in problem solving can be –

- Exact identification of the Problem.
- Defining and Understanding the Problem.
- Identify and finalize the Strategy.
- Organizing Information.
- Allocating Resources.
- Monitoring Progress.

If we really go for deep-thinking, we will find that all the above explained psychological stages are involved in all the stages of problem solving. Now if we think of methods of problem solving such as – Psychology includes various methods of problem solving such as introspection, behavior analysis and behaviorism, simulation, computer modeling, and experimentation. A problem-solving strategy is a plan of action used to find a solution and hence it can be a strategy for problem solving. In psychology it is called a 'Cognitive Psychology'. Cognitive psychology involves the study of internal mental processes—all of the things that go on inside our brain such as perception of happenings, thinking, memory, attention, language, and learning. Hence it is very clear that for better learning and better problem solving the functioning of cognitive Psychology is most important factor.

CONCLUSION

Both, education and Problem solving are the processes and in both the processes the role of psychology is important but this role is enigmatic and hence we tend to neglect it or we do not consider it at all. In Organizational Management, we must have separate consideration for Psychology so that it will be easy for us

to resolve the Problems in Organization and it will provide us better solutions and in a less time span. In Europe and USA, organizations have already started taking help of Psychological experts and started involving them in decision making and problem solving processes. It is found that most of the Management Problems occur due to human behavior, human being may be from either inside organization or outside organization, for example – Market situation and consumer behavior, investment decisions, creations of urgency due to negligence or wrong judgment and so on. Situations beyond control of human, may create problems such as Corona / Covid 19, Natural calamities, war etc. but such reasons are very less and they occur rarely. Hence use of psychology in education and decision making is a need of time.

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Assessing the Protagonist Influence and Impact of Universal Human Value Education on Management Graduates

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ABSTRACT

The world is once again on the verge of war, cold-war has become more realistic and prominent amongst the world super powers. India v/s China, Russia v/s the US, Israel v/s Iran has been long standing in each other's faces more than often with each country aiming to dominate the world economy, Countries like Afghanistan, Iraq, Syria are in re-building process; however the significance of human capital economy still lives in fear hoping and praying NO MORE WARS. Holistically each and every human life on this planet earth is and should be governed by UNIVERSAL HUMAN VALUES. Objective: The research paper aims track the laid down road map of human values and also see if it is actually being accepted as yardstick to measure the living standard across the world. The study focuses on management graduates as they are being taught of accepted universal human values across the globe. Tomorrow the youth and students' are the future of this world so it is the prerogative of the education system to shape and build them mentally and psychologically to value human lives more than ever. It is also in their hands to be eco-sensitive towards the eco-system in which we live with the aim that if there is a planet earth there will be human lives living on it.

Keywords: Universal Human Values (UHV), Human Value Education, Human Value Sustainability, Value Education, Human Capital, Universal Values.

INTRODUCTION

Theoretical Perspective Role and Impact of Universal Human Value Education

School children who were blind had observed struggling with a value system plus a decision making process that is unrealistic. The study looked into the effectiveness of rational emotive behaviour intervention (REBT) in diminishing damaging self-belief/personality in upper elementary school students with blindness. With 56 blind primary school students, the study used a group-randomized trial strategy. The Participants were assessed three times with the PVS and ABS-2-AV after completion of a value-based rational emotive behaviour programme. Between the control groups and treatment there was no significant difference in initial negative self-belief/maladaptive value utilising ABS-2-AV and PVS, according to ANCOVA results. Given the intervention's significant impact, rational-emotive specialists working in school can use rational emotive behaviour intervention (REBT) tactics to assist blind persons in changing their maladaptive value systems (Ede et al., 2021). Environmental issues put our planet's long-term sustainability and lifespan at jeopardy. Environmental education is one way for raising future generations' understanding of the gravity of the current environmental predicament and teaching proactive decision-making that prioritises the environment. This study assesses nine primary and secondary school textbooks to determine what environmental education students in Spain receive as part of their mandatory geography instruction. These textbooks, which are produced by three major publishing houses, are an excellent example of how the official curriculum has been rewritten. The research was carried out using a coding sheet that included both quantitative and qualitative (format) analyses (qualitative). The findings demonstrate that environmental education in Spain has a lot of potential for improvement. The architecture of the curriculum and its subsequent translation into textbooks should be the first steps in this growth. As a result, if we are to establish a civilization capable of properly addressing the threat posed by current environmental concerns, a number of reforms are required (García-gonzález et al., 2021). To facilitate character-based learning, certain values obtained from learning sources are required. Religious, educational, moral-ethics, intellectual, economic (practical), and social-political concepts are all covered in the curriculum. In this work, the Borg and Gall paradigm was used to modify R&D. a pilot product was implemented for X learners 30 grade. Questionnaires, written tests, and documentation have been used to collect data. Following a needs analysis, it was discovered that the number of character-based learning modules accessible is restricted. The module is very likely to be reviewed for learning, as seen by the 84.94 percent competency score. A brief survey of MGMP chemistry professors found that module feasibility was 85.29 percent, validating the percentage. As a result, because it improved students' learning outcomes, the character values-loaded module is ideal for testing and learning (Haryani et al., 2021). Taking an interdisciplinary approach to social studies and

creating a programme around it means that the social studies curriculum may be applied in the actual world because of its multifaceted nature. The social studies course covers topics such as human rights in general, in plus obligations and citizenship right. In this light, social studies can be viewed as a subject that teaches citizenship rights and responsibilities in order to produce human rights-aware individuals. four major values of equality , culture , worthiness, democratic education of coexistence that can be taught in social studies classes as part of citizenship and human rights (Yigit, 2021). Immigration and the flood of refugees have resulted in social transformation (political and financial reasons), and attempts to realign themselves with modern life's social, Political and economic demands. the reason behind this is for improved transport, failing economies, better communication, permeable borders, pandemics etc. though it has limited scope for the comparison of the state of citizenship education in two geographically and socioeconomically diverse countries. the study was successful in demonstrating that education systems, and consequently citizenship education delivery approaches, are theoretically comparable. This is owing to the fact that human beings will always remain human beings no matter where they go and they face comparable or equal issues in general. The current scorn for citizenship instruction in these two educational systems may have negative consequences for future citizens in both countries. Citizenship education in both countries has to be overhauled (Broer et al., 2021). The purpose of the study is to compare and contrast the educational systems of two countries i.es Tunisia and Egypt. In addition to this researcher was interested to study their implications in the education of U.S.A and citizen education. This study also examined a huge body of literature to determine how historical, geographical, political, economic factors influence above two countries education system i.e Egypt's and Tunisia's. These African countries are clearly smaller, have insufficient political and security protections, and have lesser annual revenue than the USA. Regardless, they make a concerted attempt to educate their citizens! According to the survey, these countries value education more than the wealthy United States of America and invest more in it. Despite its greater advantages, the United States does not invest more in education. Despite this, the leaders give large sums to government departments such as defence, housing, health and human services, and veteran's benefits (Mbuva & Muli, 2021). This study, which is based on a synthesis of 6 school-based student values enhancement programmes that describes the development of the Children's Values Questionnaire. They are listed as below

1. Self-Concept
2. Behaviour
3. Healthy Life
4. Social
5. School Climate
6. Emotional Intelligence

The World View along with 26 related sub-dimensions with reference to 848 co-educational students were analysed. The Cronbach alpha coefficient for the questionnaire was 0.94 it means that it was internally consistent. The inter-correlation between its seven dimensions was grouped using Pearson $r = 0.55$. Females have higher rating than boys on items related to Playing by the Rules, Accountability, Creativeness, Empathy, and Communication ($p < 0.001$), but men rated themselves higher than girls on items related to Physical Activities ($p < 0.001$). When comparing older students (i.e. Years 6 and 7) with younger students (i.e. Years 4 and 5), older students (i.e. Years 6 and 7) showed better context discernment ($p < 0.05$), an increasing impact of peer relationship on their value beliefs ($p < 0.001$), and an increase in social confidence ($p < 0.001$). The study discusses the CVQ's relationship to Schwartz's Universal Valued Goals, as well as examples of CVQ implementation in schools (Fyffe & Hay, 2021). Character qualities improve performance and enjoyment, but they're rarely studied in early life. After receiving a character strength application intervention, in-service those who are early childhood educators overcome workplace challenges in this qualitative study. Teachers were taught how to establish action plans to solve challenges using character attributes during professional development (such as perseverance and kindness). Using this strategy, educators reported a 71% success rate in entirely or partially addressing difficulties. With children, employees, and parents, this study looked at how teachers linked character attributes to personal circumstances. Some abilities were indicated as being used primarily with children (e.g. love, forgiveness), others as being used primarily with adults (e.g. teamwork, boldness). others as being used by all teachers (e.g. kindness, leadership). In 31% of cases where teachers were seeking to remedy a workplace problem, they reported modelling or teaching character strengths to their students. Teachers reported the intervention boosted their chances of modelling or teaching character traits including kindness, forgiveness, social intelligence, and collaboration to their students. Both educators and children will benefit from proficient development that focuses on the claim of character traits in the workplace (Haslip & Donaldson, 2021). Because character and learning outcomes are components of student competency performance, they are important standards for educational development in schools. The instructor takes a number of steps to improve his or her

students' character and academic performance at school. The purpose of this study is to see if a local wisdom-based neuroscience technique may improve student learning and character. The participants in this study were chosen from a Sima Regency high school. The research sample included 50 students from class X who were divided into two groups: the experimental and control groups. The study used both test and non-test instruments. Character and student learning results had a higher percentage value in the experimental class than in the control class. This shows how a neuroscience approach based on local wisdom can assist kids in improving their character and academic achievements (Asriyadin et al., 2021). The goal of this study was to learn more about STEM teacher training, classroom activities, preparation methods, challenges and activity assessment strategies and approaches. A total of 20 preschool teachers participated in the study. Criterion sampling, a type of purposive sampling, was used to find participants. This was a qualitative research project in the form of a case/ situation study. A semi-structured interview was used to collect data. Inductive content analysis was used to explore qualitative data. Themes, classifications and codes were generated in accordance with the research goal based on the content analysis results. Participants used a number of tactics, methods, and approaches to conduct a variety of preschool STEM activities, according to the findings of the content analysis. They also mentioned that while participating in those activities, they encountered a lot of problems. They reported that the STEM training helped them advance in their careers. However, they struggled to create lessons that linked with STEM education due to a lack of content competence (Yıldırım, 2021). The study tour's perceived worth by students is an important factor in determining its effectiveness. To examine the notion and connotation of a study tour's perceived worth among elementary and middle school students, the study looks at both domestic and international literature. Second, the study develops a conceptual model and provides a scale for measuring the perceived worth of a study trip. The firm then conducts a poll of 260 Chongqing elementary and middle school students and statistically analyses the results. The findings suggest that primary and intermediate school students' opinions of the value of a study tour in Chongqing are in the upper-middle range, but that ability and emotional worth can still be improved. Finally, the study presents two perspectives on how to improve primary and middle school students' perceptions of the value of study excursions in Chongqing (Li, 2021). The purpose of this study, which took place at a medium-sized university, was to look at the virtue of tolerance in relation to an often-overlooked facet of diversity: diversity of conscience, which is described as "legitimate variances of moral and religious conscience". Tolerance is critical for cultivating civility in our increasingly diverse society and promoting the open interchange of ideas that is at the heart of higher education's mission. In a humorous fashion, a short whiteboard animation film was developed to explain the notion of tolerance of conscience diversity. The cardinal virtues were also given as accountability boundaries for healthy conversation in this video, which was part of an online event. According to questionnaires, learners improved their self-reported understanding of the concerns. They were able to apply what they had learned, representing that this modality could be a useful first step in teaching tolerance of conscience variety (Van Fossen et al., 2021). This research aims to not only comprehend the Qur'anic concept of peace, but also to investigate Muslims' contestation in Salatiga in order to promote religious believers living in peace. Using a combination of 2ndary data ie literature review and semi-structured interviews. This study collects hypothetical data based on community responses and modern Qur'anic interpretation literature. Tolerance is also an important aspect of social interaction that leads to collaboration. Many ideas, such as harmonisation, tolerance, and cohabitation, as well as deeds like cooperation and camaraderie, could be considered prevailing notions within the groups. As a result, this study shows how a Muslim majority may encourage tolerance and accept variety as a way of life (Kuswaya & Ali, 2021). The study looked into the role of tolerance in the association between cultural intellect and nationalism as a mediating element. Gender had a moderating effect on the links between cultural intellect, tolerance, and nationalism. Using data from the, a structural equation modeling-based mediation and multi-group analysis was undertaken 543 teacher candidates. According to the findings of the mediation analysis, tolerance moderates the relationship between cultural intelligence and xenophobia. The relationships between cultural intelligence, tolerance, and xenophobia ranged significantly by gender, according to the findings of a multi-group study (Karataş & Arpacı, 2021). The goal of this study was to see how potential teachers' professional concerns and the quality of their university life influenced their attitudes toward teaching. A working group of 580 aspiring teachers enrolled in a state university's college of education participated in the study. The study was conducted using relational research, a quantitative research method. At the conclusion of the study, prospective teachers' professional attitudes were found to be positive, their concern levels were low. also they had the most "Appointment Centred Concern" and "Adaptation Centred Concern". their satisfaction with university life quality was medium. they had the least satisfaction with "Social Facilities." It was revealed that professional worry and attitude toward profession had a negative relationship, and that as professional concern declined, positive professional attitude improved. It was also revealed that there was a positive

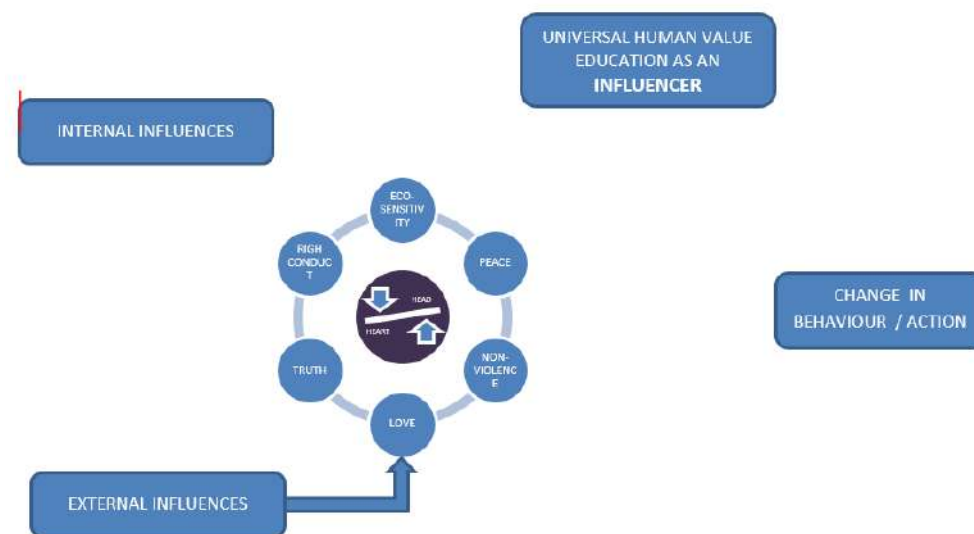
association between professional attitude and university life quality. with positive professional attitude improving as satisfaction with academia life quality improved. Professional worry was found to have a negative connection with university life quality and professional concern decreased as university life quality improved. Prospective teachers' professional interests and satisfaction with the quality of university life were found to predict their attitude toward teaching by 13.9 percent. Based on the study's findings, a number of recommendations were made (Atabey, 2021). Personal values have a significant impact on how students approach learning during their education. These principles have a significant impact on the character of individuals within their learning communities and, as a result, on their academic results, particularly in higher education. The drive of this study is to analyse how individual values influence one's learning methods and, as a result, how academic performance is affected. It also considers how vital it is to develop a person's individual values as part of their overall education. Linking them to alumna attributes and matching them with information and expertise in order to generate successful graduates in society (Gamage et al., 2021). The impact of the Peace Education Program on 8th grade students' acceptance and human values was analysed in this study. During the 2018–2019 academic year, 8th grade students were participated in the inquiry. The outcomes of the experimental, control, and placebo groups were tracked using a semi-experimental approach that included both pre-post test monitoring. The control group did not participate in any activities while the experimental group carried out the research's Peace Education Program. A curriculum was offered to the placebo group to assist them deal with exam anxiety. There were a total of 51 students in the study: From among the existing groups. the Experiment, Control and Placebo groups were chosen at random. The findings of the study showed that the experimental group's peace education programme was effective in growing students' tolerance and human values (Tanyel & Kiralp, 2021). This study intends to develop multi-dimensional child well-being indicators that are suitable for urban areas such as Attica, Greece. Personalized to the new form of child poverty that has emerged as a result of the country's recent financial crisis. According to the study, child well-being is a multi-faceted phenomena, and the financial crisis necessitated the development of new scientific instruments tailored to the unique characteristics that evolved as a result of the situation. With these definitions child well-being and child poverty as a foundation, a tool containing many indicators to track child well-being was developed, and it was tested in Attica through questionnaires sent to 27 public schools . also to the three The Smile of the Child support centres, covering two time periods: the school years 2010–2018 together and the school year 2018–2019 separately. The survey comprised of 878 students from three distinct school types. The information was divided into seven groups. To confirm the study's theoretical and methodological foundation, a Principal Component Analysis was employed. Despite concerns about joblessness and whether the schooling people receive is relevant to the kind of people they should be, the data reveal that kid well-being improved between 2018 and 2019. Finally, an action plan concentrating on these dimensions and some of the groups has been provided, as well as a fuzzy logic-based decision-making auxiliary tool (Leriu et al., 2021). Values and attitudes are intricately linked. It's worth noting that the person hasn't won anything or had anything to do with the circumstances that have resulted in these feelings. As a result, the purpose of this study is to understand how gender roles perspectives influence university students' value orientation. Study conducted for the academic year 2020-2021, 252 undergraduate students. The test sample was calculated using the needed non random sampling technique. Result found there was a statistically significant positive meaningful link between attitudes toward gender roles and meaning orientations. It was found to have a positive relationship (Çimen & Serin, 2021). The goal of this research is to raise awareness of the Olympic Education Program that the Portuguese Olympic Committee has been doing since 2015. Based on a review of the practices and execution of similar programmes in supplementary countries on an Olympic Education Program was built using international approaches and best practises. The activities undertaken in 2020, which aimed to make the Olympic Education Program more flexible and lively by making fresh sets of content and action suggestions available online, are also discussed in order to address fresh challenges faced by schools as a result of the emergence of the COVID-19 pandemic (Nunes, 2021). Ethics are statistically important predecessors to education styles in a cohort of predominantly ie in Bulgarian, German, and Romanian etc students studying at a German university. In thus English is the language of instruction in all subject areas, according to the findings of this study (1987, Biggs). The findings imply that in instances when learners have left their family nations to pursue university degrees in a foreign social, cultural, and educational setting, values can be related to learning methodologies (Matthews et al., 2007). The relevance of practical activities in moral instruction is emphasised in a philosophical argument, leading to the conclusion that athletics is an appropriate medium for this pedagogical aim (Mujica Johnson & Orellana Arduiz, 2021). The evolution of values education across time and gave a definition of the idea of values from contemporary literature in this study. To provide a full picture of the ideas that the Croatian educational system fosters, a review of the Social Sciences and Humanities curricula is employed. According to

our findings, knowledge is the most important component of all academic curricula. Other values are reflected as well, albeit to a lesser level. The findings suggest that while teaching and learning processes are primarily focused on the acquisition of factual knowledge, they also provide opportunities for values education (Brković et al., 2021).

Table 1: Grid of Human Values and Sub-Values

GRID OF HUMAN VALUES AND SUB-VALUES					
PEACE	TRUTH	LOVE	NON-VIOLENCE	RIGHT CONDUCT	Eco-Sensitivity
Composed	Faithfulness	Kindness	Consideration	Manners	Agreeableness
Focused	Inventiveness	Friendship	Cooperation	Health awareness	Conscientiousness
Confident	Morality	Forgiveness	Global stewardship	Helpfulness	Openness
Self-Recognition	Determination	Generosity	Loyalty	Responsibility	Neuroticism
Self-controlled	Impartiality	Empathy	Active citizenship	Independence	Environmental stewardship
Appreciative	Trust	Tolerance	Justice	Persistence	Extraversion
Contented	Reflection	Service	Respect	Courage	Humility

Figure 1: Proposed Model:



Scope of Study:

The scope of the study expands to evaluation of individual characteristics mentioned in the above grid. Each of the universal value stated in the proposed model can be studied individually and quantification of each human value can be measured using modeling techniques to measure the association and relationship of each characteristic with one another. The study will also help to measure and evaluate if the programs and course outcomes are met and in case of deviation the teaching methodology and/or contents of the programs will be updated as required. The study can broaden its scope not only to management and post-graduate students but also to the primary, secondary and higher education courses. These universal human values have to be inculcated in this new generation to make the world a better living place.

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Structural Analysis of Fiber-Filled Thermoplastic material Using FEA

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ABSTRACT

The aim of this study is to analyse the fiber-filled plastic component to predict its behavior under static loading conditions. In this study, the starbase of the office chair leg was fabricated using fiber-filled thermoplastic material, with has anisotropic material propertie , by the injection molding process. The chair base was tested as per standards under static load and its responses like deformation, strain and stress were analysed. The product was modeled by CREO software and analyzed by the FEA method using ANSYS software, by providing both isotropic and anisotropic material properties. The simulation results were compared with experimental results, in which it has been found that the simulation results were found to be in good agreement with experimental results, with regard to anisotropic material properties. Hence, this study is useful to predict the behavior of fiber-filled thermoplastic material with anisotropic material properties.

Keywords: Isotropic, anisotropic, mold flow simulation, Design, FEA, static, structure, polyamide, glass filled

I. INTRODUCTION

Product design plays an important role in product development and it requires a systematic path for the successful development of the product. The product design activities also play an important part in engineering, technology, and business studies for the vast range of applications. The most frequent applications are aerospace industries, automobile industries, consumer and heavy engineering industries. In these applications, products are on the brink of a revolution, and the plastics industry is poised to play an important role. In particular, the plastic design plays an important part in the research and development of a product and also useful in predicting the behavior of the product under actual loading conditions.

A. Design Consideration

The manufacturing defects in plastic products are difficult to predict using traditional methods and it also consumes more time and is expensive in nature. Plastic mold analysis using mold flow software is useful to analyse the injection molding process more efficiently. The various input parameters are provided to understand the defects that usually occur in a typical injection molding process. In this work, the fiber-filled thermoplastic composite is analysed using the ANSYS software [5].

In this work, the starbase of the office chair has been considered as a case study to predict the behavior of fiber-filled thermoplastic composite under static loading conditions. Considered the load as per the BIFMA standard, the total load acting on the chair for analysis to obtain the deformation due to the load.

B. Linear And Non-Linear Analysis

Appropriate input data are given as input to obtain results using ANSYS. Initially, the simple tensile test was used to obtain the behavior of a material under static loading conditions. The stress and strain of the FE simulation results were compared with the results of the linear method.

The results, based on the inputs provided, depending on the material properties. The general matrix equation based on Hooke's law is given as $[K]\{x\} = F$, Where "K" is the stiffness matrix, "x" is the displacement and "F" is the Force (Load) applied [16]. The components of the young's modulus ($E = \sigma / \epsilon$ Mpa) address the factor of proportionality in Hooke's law, which relates the stress and strain. Nevertheless, Hooke's law is just valid under the assumption of elastic and linear response. In a real scenario, Any material will eventually fail and break when extended over an extremely huge distance or with a huge load. However, all solid materials have exhibit almost nearly to Hookean behavior for small enough stress and strain.[citation], a stress-strain curve is a linear behavior as shown in fig 1.[17]

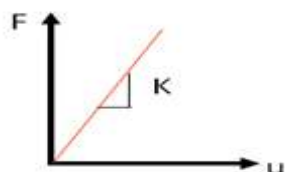


Fig. 1. Linear Analysis Curve

Generally, non – linear applications are involved in the real-world scenario. But, this analysis is very complex to analyze using FEA. Usually, isotropic material properties are considered for analysis by designers owing to the complexity posed by anisotropic material properties[16].

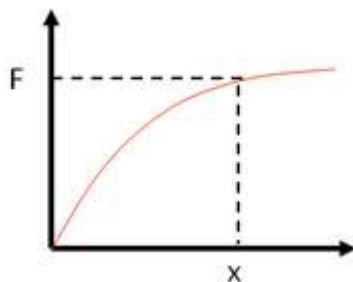


Fig. 2. Non-Linear Analysis Curve

C. Anisotropic Analysis Using Moldflow Simulation

The mold flow simulation method helps to understand the feasibility of design without using physical resources like injection molding machines and other injection molding processes. Hence the simulation saves time and reduces the cost of the molding design. Injection molding simulation plays a vital role in the outcome of the design. In recent times, many manufacturers have proven that moldflow analysis is the medium between perfect design and manufacturing process or production [5][13].

The fiber-filled material plastics mainly uses a combination of low weight and high stiffness strength for high-performance applications. The key is to identify the potential of plastics in fiber orientation. The orientation of the fibers is important to determine the mechanical properties of the part which is manufactured by an injection molding process[5][12][13].

II. LITERATURE REVIEW

Several researchers have studied anisotropy material properties using mold flow simulation in fiber-filled thermoplastics material. From the literature review, it has been understood that the researchers have used isotropic material properties for analysis, as using anisotropic material properties leads to complex analysis and time consumption.

Satheesh Kumar et al have carried out a linear orthotropic analysis on ashtray door component by coupling Moldflow with ANSYS. Following are the findings of their study. 1) The anisotropy caused by the manufacturing process has a significant impact on the mechanical properties of the components. 2) The density is controlled by the flow pattern in the mold, resulting in different modulus values in the main three directions at different points on the part and at the same point. 3) Anisotropy can change the stiffness of the parts by more than 50%. 4) The anisotropy of the material is affected by the flow structure in the mold. [12].

Joseph Bensingh et al predicted the linear anisotropic bending analysis that was performed on the CRC push rod of the hydraulic clutch drive system by coupled Moldflow and ANSYS. The results of nonlinear isotropic and nonlinear anisotropy analysis were compared with experimental test data to understand the mechanical properties of the part [5].

III. Identification Of The Problem

Based on the literature survey, it has been understood that short-fiber reinforced composites plastic materials are used for many applications where high impact loads are involved. It is used for its high strength-to-weight ratios and has enhanced physical properties when compared with virgin or non filled polymer products. For example, Glass fiber-filled polyamide has high strength when compared to unfilled polyamide (Nylon). Injection molding is a process that is used for fabricating components made up of short-fiber reinforced composites. The orientation of the fibers in the final mold depends on the kinematics of the flow[15]. Fiber-reinforced composites typically show anisotropic mechanical properties, whereas the material data does not accurately represent the actual properties of the molded part made up of the composite material obtained directly from the material supplier.

The Addition of glass fibers to plastic will significantly increase the material's Young's modulus with a negligible effect on the component mass. The mechanical properties of the molded plastic depend on the glass fiber orientation[13]. The mechanical strength is more at the region where the orientation of the fibers is more [7]. During the injection molding process, the glass fibers will align in different orientations under the influence of mold parameters[5][12]. So these parameters need to be predicted for the structural analysis in

FEA. The identified problem can be performed in virtual analysis for obtaining a process-induced anisotropic property. In the Industries, the above-identified method results in fewer trial tests performed for physical validation of the preferred component, ultimately leading to minimization of cost and time for the industry.

IV. METHODOLOGY

The proposed methodology for this work has been explained below,

First, the starbase of the office chair leg made of fiber-filled thermoplastic material was fabricated using an injection molding process. The starbase fabricated was subjected to the static load which it would experience under normal loading conditions. The load and deformation values were recorded for further comparison with FEA simulation results. The starbase was modeled in CREO software and the model was imported to Ansys for analysis. The simulation was initially carried out using both isotropic and anisotropic material properties. It was found to be in good agreement with the experimental values, under anisotropic material properties. The methodology of workflow is shown in fig 3

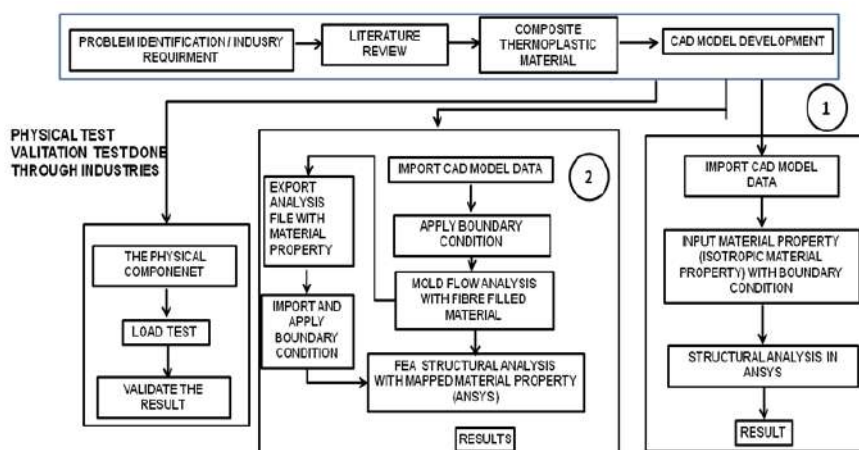


Fig. 3. Methodology

V. DESIGN PROCESS

A. CAD Model Development

The 3D CAD model of the starbase of the chair leg was modeled using the creo 5.0 version. The leg dimensions is dia 690 X 134.5 X 6.4 mm (Thick.). the details are shown in fig7. The CAD model was develop based on the master sketch that is shown in fig.5.

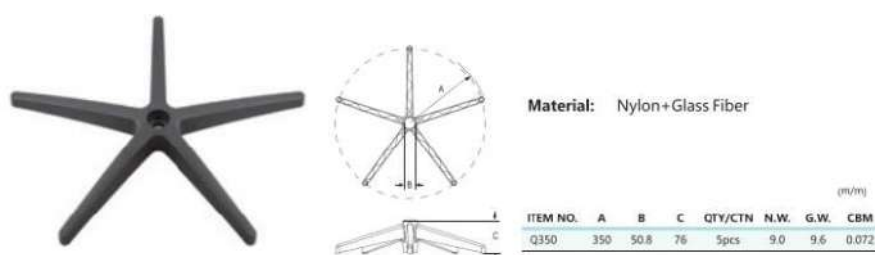


Fig. 4. Office chair star base leg with dimensions

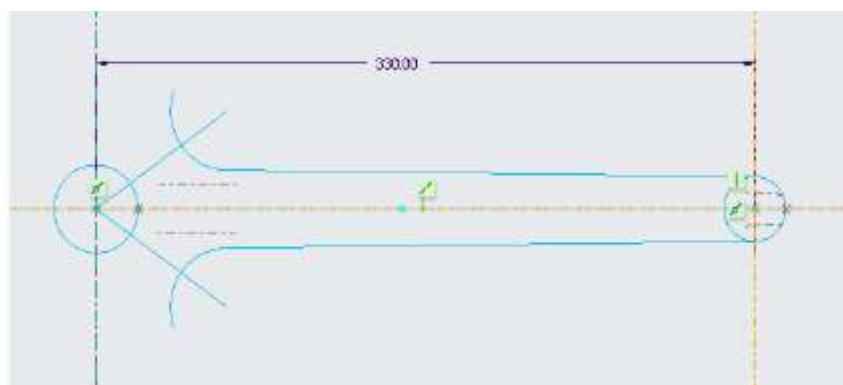


Fig. 5. Master Sketch of chair Leg design



Fig. 6. 5-Star Leg physical model

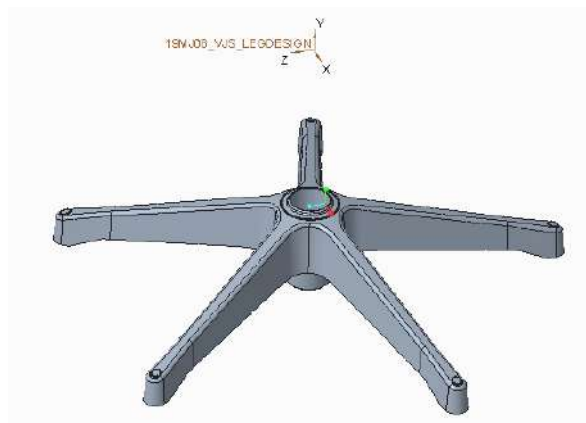


Fig. 7. Leg design CAD Model Development

VI. TESTING STANDARD

The starbase of the chair for tested based on BIFMA standard, which has been prescribed by the Business and Institutional Furniture Manufacturing Association. The purpose of this test is to determine whether the pedestal can withstand the vertical force of 11,120 N. The load test setup illustrated by fig.8.

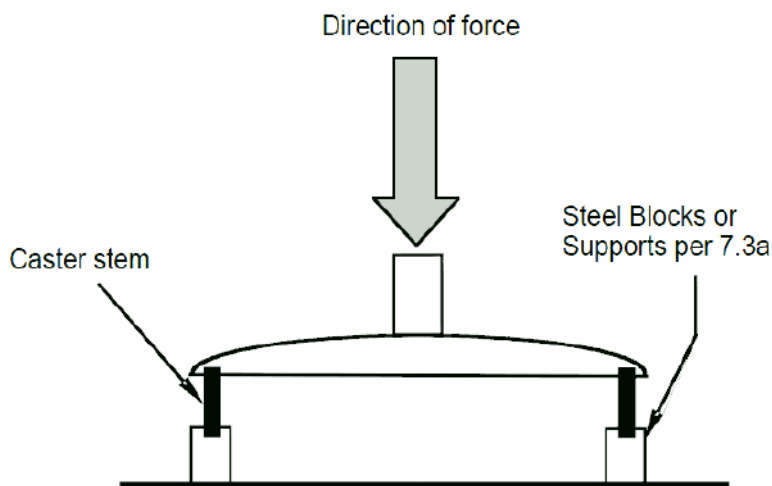


Fig. 8. Load setup - BIFMA X 5.1

B. Load Calculation

The load calculation for the above tests are as follows the vertical force is taken from the BIFMA X5.1 standard test no 7, for the Base test.

The Vertical force = 11120 N

The force acting on each leg = $11120/5 = 2224$ N

The total bending moment action on each leg = $F \times L$

711680 N mm

The bending moment load and the torsion load acting on each leg is calculated by keeping the leg caster in two different orientations. The caster orientation bends the leg concerning axis AA.



Fig. 9. Physical Validation Setup

VII. FEA SIMULATION

FEA is a numerical technique that is used to validate design under the prescribed loading conditions. The main objective of the process is to reduce the number of physical experiments and prototypes to optimize the part in the design stage to develop better products for engineers. FEA is used in many applications like structural or fluid behavior, thermal transport, vibration, etc. Most of these processes are described with the help of partial differential equations. However, for a virtual computer to solve these PDEs, several numerical methods have been developed over the last few decades in which FEA plays a major role.

A. Structural Analysis

In this work structural analysis by FEA method, was performed using the ANSYS software. The CAD model that was generated by CREO was imported to ANSYS and boundary conditions were given. SOLID186, a higher-order polynomial element was chosen as the element during meshing. The SOLID 186 perfectly approximates the intricate geometry contours in the CAD model. As it is a 3D solid element, it is useful to analyze the quadratic displacement behavior that is exhibited by the model. The element has 20 nodes, which is useful to solve problems related to plasticity, creep, large strain and deflection.

B. Pre-Processing

Initially, the product was analysed with isotropic material properties in ANSYS using FEA. Subsequently, the product was analysed using anisotropic material property (PA6 GF 35%) in ANSYS. The stiffness value that was obtained from the mold flow software was given as an input to the ANSYS in the preprocessing stage.

C. Linear Analysis – Isotropic Material Property

The software generates the element as stiffness matrices from its characteristic load vectors; assembles them to generate the systems equations. It also automatically implements specified boundary conditions to solve the equations, and to find the nodal values of the field variable of displacements, and computes the element resultants of stresses and strains.

Linear Analysis

$$[K] \{u\} = \{F\}$$

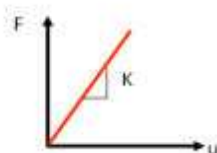


Fig. 10. Linear - Stiffness matrix equation

Table 1. Linear Isotropic Material Property

Material	Property	Values	Units
PA6 35% GF	Density	1400	kg/m ³
	Modulus of Elasticity	11500	N/mm ²
	Poisson's Ratio	0.32	
	Tensile Strength	198	N/mm ²

D. Non-Linear Analysis – Isotropic Material Property

The test specimen was prepared using the injection molding process. The standard shape of the specimen made of PA6 Glass-filled 35% was molded to the ASTM D638/ISO 527-2 type 1V standard specification. The tensile test was carried out using the tensile test machine (Instron-3400 series). The yield and fracture points were collected from the test results and are used to plot the engineering stress-strain curve by using the excel worksheet.

Experiments and trials are conducted for determining the optimum parameters of the injection molding process. In this study, Taguchi L18 (21 X 37) orthogonal array was used to conduct experiments. The input design parameters considered in this work are melting temperature, mold temperature, and injection pressure. The input parameter details are shown in table 2.

Table 2. Input Parameters

Injection molding input parameters (4 cavity mold) Specimen						
Parameters						
Level	Mold Temperature, °C	Melt Temperature, °C	Injection Pressure, Mpa	Injection Time, Sec	Hold Pressure, Mpa	Hold Time, Sec
1	80	265	80	12.4	40	6.5
2	90	280	180	15.5	50	7.3
3	100	300	140	18.6	75	9.2

E. Experiments And Trials

The output parameters of the Injection Moulding Process Parameters were determined using the Taguchi orthogonal array method. The input parameters used in the injection molding process are shown in table 2. The non-linear material property data is shown in table 3. The output parameters considered in this process were flash, sink mark, and warpage. The output parameters obtained from the orthogonal array are shown in table 4. To find the optimum levels of mold temperature (factor A), melt temperature (factor B), injection pressure (factor C), injection time (factor D), Hold on pressure (factor E), and Hold on time (factor F) for the desired multiple quality characteristics of the PA 6 Glass filled material molded specimen, the results in Table 3 are normalized[10].

F. Test Specimen

The dumbbell-shaped type 1V specimen was manufactured by the injection molding process. The dimensions were assigned as per ASTM 638/ISO 527-2 standards and the prepared specimen is shown in fig.11. The specimen material was molded using the injection molding process as per ISO-294, ISO-293, and ISO-295. The identified flash in the process was removed without damaging the molded surface.

G. Stress-Strain Curve For Non-Linear Material Property

The stress-strain curve obtained from the tensile tests were used to plot the curve using an excel worksheet. The engineering stress-strain curve which helps to calculate the true stress-strain values for the non-linear analysis in the FE Ansys simulations. The curve plot is shown in fig.12.



Fig. 11. Test Specimen

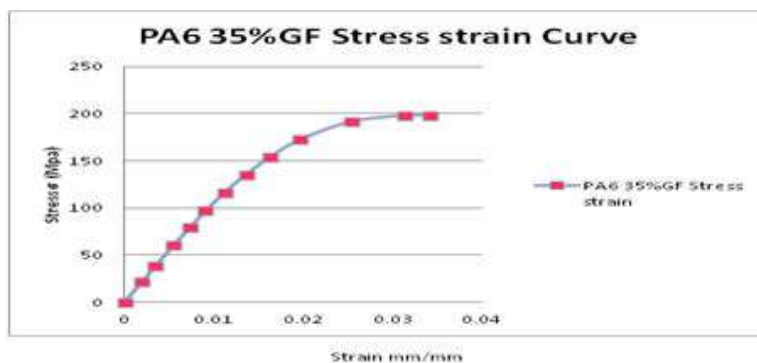


Fig. 12. Engineering Stress-strain curve plot

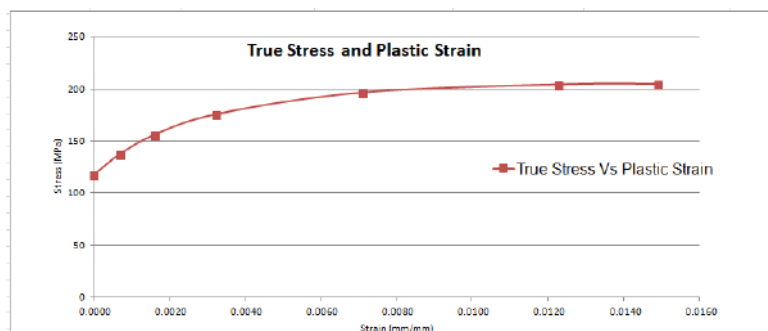


Fig. 13. True stress - Plastic strain Curve

H. Formula

$$\sigma_t = \frac{P}{A} = \frac{PL}{A_0 L_0} = \sigma_e \frac{L}{L_0} = \sigma_e (\epsilon_e + 1) \quad \text{True stress} \quad (1)$$

$$\epsilon_t = \int_{L_0}^L \frac{1}{L} dl = \ln(1 + \epsilon_e) \quad \text{True strain} \quad (2)$$

$$\text{Young's Modulus (E)} = \sigma / \epsilon \quad (3)$$

$$\epsilon_{\text{elastic}} = \sigma_{\text{true}} / E \quad (4)$$

$$\epsilon_p = \epsilon_t - \epsilon_{\text{el}} \quad \text{Plastic Strain} \quad (5)$$

Eq (5) is used to calculate the plastic strain value.

Table 2 Non-Linear Material Property Curve Data

E Young's Modulus 11500 Mpa							
Strain %	ϵ_e	σ_e , Mpa	ϵ_{true}	$\epsilon_{\text{elastic}}$	σ_{true} , Mpa	$\epsilon_{\text{plastic}}$	Plastic Strain points
0.2	0.002	21.812	0.001998003	0.001821302	21.86	0.00018	
0.35	0.0035	38.625	0.003493889	0.003230016	38.76	0.00026	
0.55	0.0055	60.22	0.00548493	0.005045934	60.55	0.00044	
0.73	0.0073	78.76	0.007273484	0.006611246	79.33	0.00066	
0.91	0.0091	96.82	0.009058844	0.008141755	97.70	0.00092	
1.12	0.0112	116.37	0.011137744	0.009806112	117.67	0.00133	0.0000000
1.36	0.0136	135.27	0.01350835	0.011425806	137.11	0.00208	0.0007509
1.62	0.0162	153.42	0.01607018	0.012992117	155.91	0.00308	0.0017464
1.96	0.0196	172.2	0.019410394	0.01463126	175.58	0.00478	0.0034475
2.54	0.0254	191.56	0.02508278	0.016368802	196.43	0.00871	0.0073823
3.14	0.0314	197.86	0.030917103	0.017006067	204.07	0.01391	0.0125794
3.42	0.0342	198	0.033628181	0.0170643	204.77	0.01656	0.0152322

Table 3: Doe L18 Orthogonal Array

Design of Experiments - L18 (2 ⁴ X 3 ⁴) ORTHOGONAL ARRAY										
S.No	Parameters						Defects			
	Mold temperature in °C (A)	Melt Temperature °C (B)	Injection Pressure in bar (C)	Injection Time in Sec (D)	Hold on Pressure in bar (E)	Hold on Time in Sec (F)	Flash	SinkMark	Warpage	Filling %
1	80	265	80	12.4	40	6.5	-	-	-	30
2	80	280	100	15.5	50	7.3	Yes	Yes	-	-
3	80	300	140	18.6	75	9.2	Yes	Yes	Yes	100
4	90	265	80	15.5	75	9.2	-	-	-	35
5	90	280	100	18.6	40	6.5	ND	ND	ND	100
6	90	300	140	12.4	50	7.3	Yes	Yes	Yes	99
7	100	265	100	12.4	50	9.2	-	-	-	40
8	100	280	140	15.5	75	6.5	Yes	Yes	ND	40
9	100	300	80	18.6	40	7.3	Yes	Yes	ND	100
10	80	265	140	18.6	50	6.5	-	Yes	-	60
11	80	280	80	12.4	75	7.3	ND	Yes	ND	100
12	80	300	100	15.5	40	9.2	Yes	Yes	ND	100
13	90	265	100	18.6	75	7.3	-	Yes	-	75
14	90	280	140	12.4	40	9.2	ND	ND	ND	100
15	90	300	80	15.5	50	6.5	yes	ND	ND	100
16	100	265	140	12.4	40	7.3	-	Yes	ND	95
17	100	280	80	15.5	50	9.2	ND	Yes	ND	100
18	100	300	100	12.4	75	6.5	ND	ND	Yes	100

I. Anisotropic material Property from Mold flow simulation

$$\begin{pmatrix} \sigma_1 \\ \sigma_2 \\ \sigma_3 \\ \sigma_4 \\ \sigma_5 \\ \sigma_6 \end{pmatrix} = \begin{pmatrix} D_{11} & D_{12} & D_{13} & D_{14} & D_{15} & D_{16} \\ D_{21} & D_{22} & D_{23} & D_{24} & D_{25} & D_{26} \\ D_{31} & D_{32} & D_{33} & C_{34} & D_{35} & D_{36} \\ D_{41} & D_{42} & D_{43} & C_{44} & D_{45} & D_{46} \\ D_{51} & D_{52} & D_{53} & C_{54} & D_{55} & D_{56} \\ D_{61} & D_{62} & D_{63} & D_{64} & D_{65} & D_{66} \end{pmatrix} \begin{pmatrix} \epsilon_1 \\ \epsilon_2 \\ \epsilon_3 \\ \epsilon_4 \\ \epsilon_5 \\ \epsilon_6 \end{pmatrix}$$

Compliance Matrix (6)

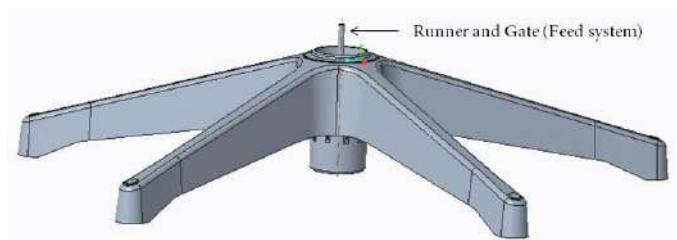


Fig. 14. Mold flow Simulation Component

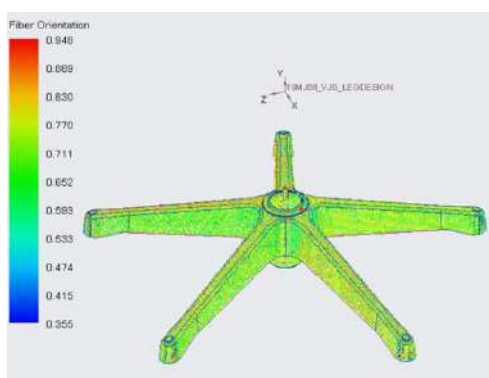


Fig. 15. Fiber Orientation Plot

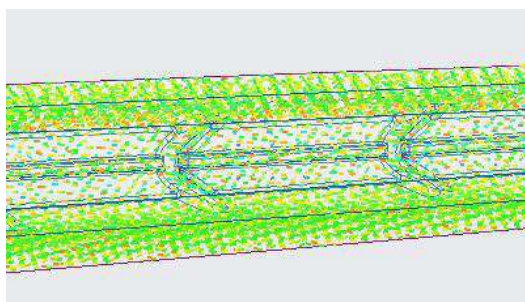


Fig. 16. Fiber Orientation on Ribs

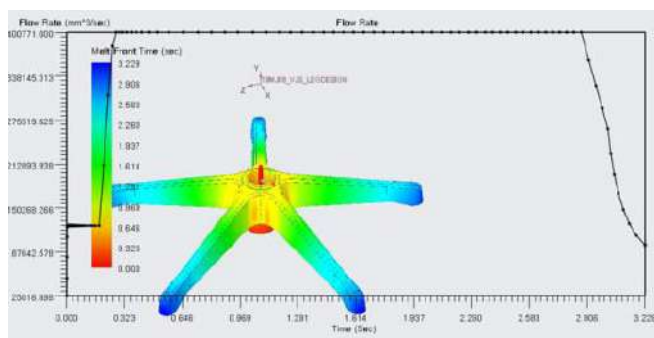


Fig. 17. Filling Flow plot

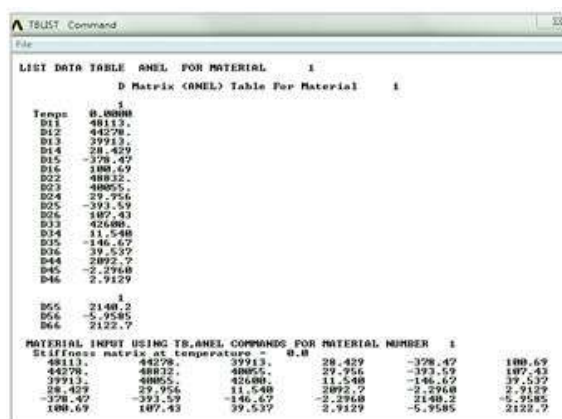


Fig. 18. Anisotropic material property

VIII. RESULTS AND DISCUSSION

The anisotropic material properties are coupled with the mold simulation that was done using Moldex3D & ANSYS software. These properties were used to validate the model. It is evident that results are more accurate when the anisotropic material properties are considered for analysis. The maximum displacement and stress obtained in the simulation are found to be 9.064 mm and 212.20 MPa respectively. It is closer to the experimental results, which is 10.87 mm.

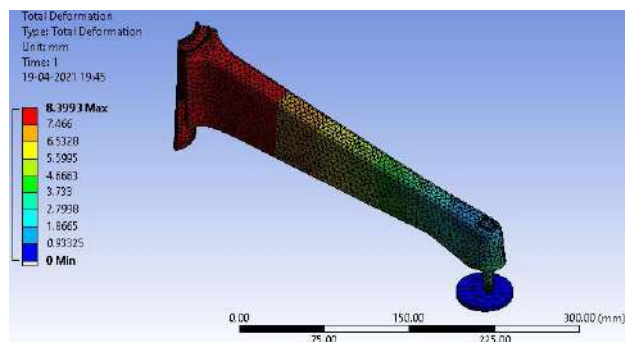


Fig. 19. Deformation Plot _ Linear (Isotropic)

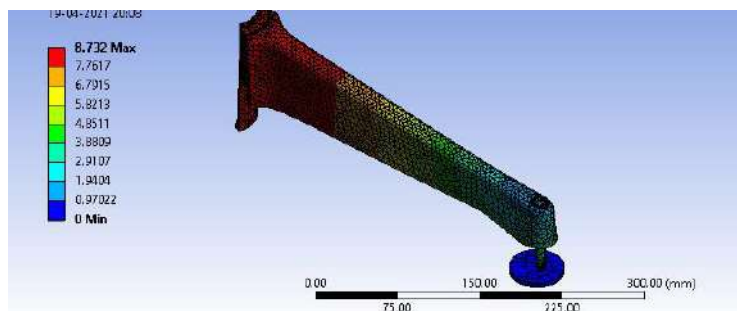


Fig. 20. Deformation Plot _ Non-Linear (Isotropic)

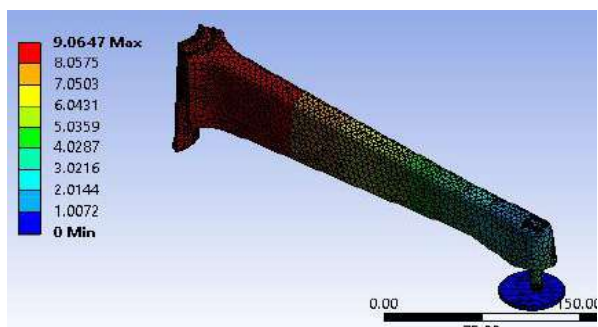


Fig. 21. Deformation plot – Anisotropic

Table 4 Result Table

<i>Material Property</i>	<i>Deformation Actual</i>	<i>Deformation in FEA</i>
Linear Isotropic	10.87 mm	8.39 mm
Non-Linear Isotropic		8.732mm
Anisotropic (Injection Molding Simulation data)		9.067mm

IX. CONCLUSION

In this study, the starbase of the office chair made up of fiber-filled plastic material was fabricated using an injection molding process. The product was subjected to static loading conditions and the results were compared with FEA results obtained from ANSYS, with regard to both isotropic and anisotropic material properties. From the comparison, it is found that the FEA analysis results, were found to be in good agreement with the experimental results, especially for anisotropic material properties than isotropic material properties. Hence, the currently proposed technique can be used in the future studies for accurately predicting the behavior of fiber-filled thermoplastic materials by providing anisotropic material characteristics itself instead of isotropic material conditions, which is currently carried out now.

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Production Process and Safety Improvement in Manual Assembly Line at Valve Industry

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ABSTRACT

The industrial environment has to adopt rapid change in customers demand and market fluctuation. To compete in global market, companies must be flexible for the market needs at the same time safety of the operator needs to be considered and for achieving these, the focus should be in reduce the non-value-added time, increase the value-added time and continuous improvement on both the operation and safety in the plant. Production facility must deliver the products continuously but the productivity along with safe environment to the operator are the key criteria for the companies in global competition. This paper describes the systematic way of problem solving in the production facility and also the safety enhancements developed in the industry. For improving the production process Takt time is determined and compared with cycle time. Value stream map is generated for current and future state of the process. The safe environment is attained by designing fixture valve assembly. The results show that the efficiency of plant is improvised by decreasing the lead time and cycle time and safety of the operator is ensured by developing a fixture for the safe assembly of components.

Keywords: Value added, Non value added, Safety, Productivity, Lead time and Cycle time.

1. INTRODUCTION

When it comes to business metric productivity is the ultimate aim of any industries, every industry wishes to utilize the least resources to achieve the maximum results. But on the contrary real time scenario is totally different. In any production firm there is 'n' number of problems and uncertainties are encountered while each and every day to produce the component and supply it to the customers. The waste due to unwanted processing in the firm is said to be the one thing that the manufacturing industry is constantly trying to avoid so that productivity can be improved, and every product in its production stage gets passes through a process called as the assembly process. In some industry the automation is the key to achieve the superior productivity in the firm, there are some places where the automation is not feasible like high verity and low volume that places majorly utilizes the manual assembly process. In that places where there is enormous improvisation by implementing the lean approach are required so by implementing lean in that areas not only improvise the productivity; it also improvise the safety and health of the human work force also by improvising the process that reduce the fatigue of the worker who is constantly engaged with the tedious repetitive work can be reduced. This paves the way to improvise the manual assembly line by using lean approach has to be introduced into the assembly line to minimize the waste due to unwanted process in the assembly line that results in increasing the efficiency of the assembly line.

Research papers relevant to productivity improvement, optimization of cycle time and time study analysis were reviewed which were useful in giving background for the present investigation.

Abdul Talib Bon et al (2018) has conducted series of time study experiment at automobile manufacturing industry to find out the process time taken to complete the assembly at that particular station and they found and reduced the total time at that assembly station by modifying the some of the unwanted processes. The methodology used in this work is stop watch time study which determines the time taken to complete the assembly process and the outcome of that study results in reducing the cycle time of the assembly process by 11 %.

Sai Nishanth Reddy (2016) has conducted a study on a small-scale solar manufacturing industry in order to increase the productivity of the firm and to meet the global competition. The time and motion study are conducted for the assembly line each and every step in that assembly line is studied stage by stage, then the time and motion study data are collected for each stage. And then by using that data the line efficiency and line balancing are done and the unwanted activity in the production line are eliminated.

Ahmad Naufal Adnan et al (2016) has conducted study on the production line of an automobile jack assembly line. Assembly line is studied effectively and the optimization of the line is obtained by using the line balancing method and implementing lean tools in the assembly line.

From the abovementioned literature survey, it was understood that assembly lines in automotive industries, solar appliances manufacturing industries and automobile jack assembly are optimized with respect to cycle time. It is also noted that limited research was attempted to improve the production process and safety in valve industries. To deal with shortcoming, Production process and safety improvement in manual assembly line at valve industry is attempted in this study.

2. PROBLEM DEFINITION

MODULE 1

This work focused on improving the efficiency of valve assembly line by identifying bottle neck process in the assembly line and improve the productivity of the plant which is getting affected by longer assembly time. In valve manufacturing industry to overcome these difficulties the line has to be studied and the bottle neck stage has to be identified and eliminated.

MODULE 2

The manual assembly line of heavier and larger valves safety is always concern. So, the work space should be safer and user friendly. The fixture for the valve has to be designed and developed.



Fig. 1 Image of the existing valve holding set up

The Fig. 1 shows the holding mechanism of the valve assembly. The safety is main concern and the handling of the valve also becomes more difficult. To overcome the above-mentioned difficulties a fixture has to be developed for assembling the valve.

3. DATA COLLECTION

Initially, the product assembly line is studied thoroughly and quarter demand of various product plotted in pie chart which is shown in the Fig.2. From the figure it is understood that major influencing valve is identified as 8-inch valve and data for the valve has to be captured to determine the abnormalities and divination in the process.

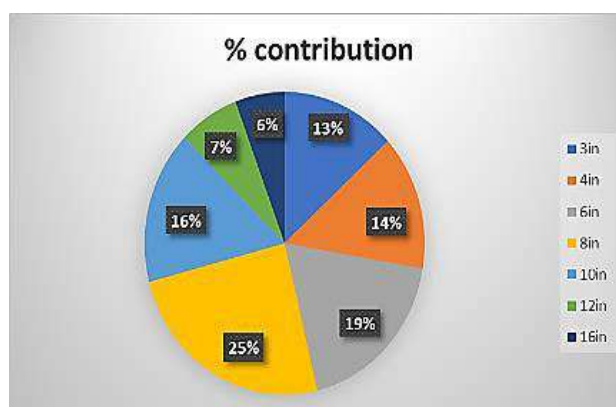


Fig. 2 Product Mix

The cycle time for each stage in the assembly line is calculated and each separate element in the assembly line is noted. One of the primary Data plotting technique is Value Stream Mapping (VSM).

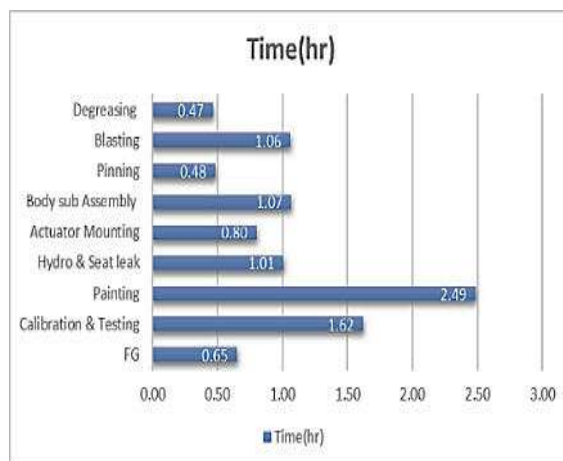


Fig. 3 Process time

Fig.3 explains about the time taken for the valve in the product mix ratio and each stage of the process is studied thoroughly every element are captured along with the time so that the cycle time for the value stream can be identified.

Another important data in plotting VSM is the inventory between stations, that data is observed for a specific time period for the valve movement from first stage till the last stage.

$$Takt\ time = \frac{Avaliable\ time}{Customre\ demand}$$

Here the takt time is considered for a quarter, so the available time is 1200 hours and the customer demands are 560 units.

$$Takt\ time = \frac{1200}{560}$$

Takt time = 2.14 hrs. (128.5 min)

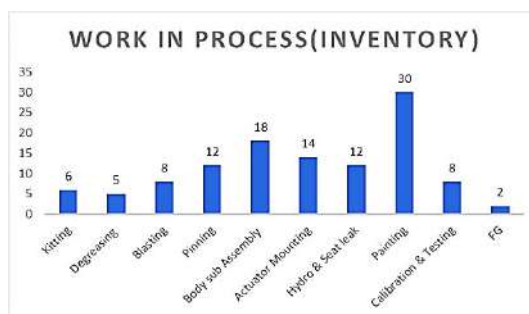


Fig. 4 Work in process inventory

Inventory between each station is piled up and are measured over a period of time. During that time period, it was noticed that the painting process which has high work in process inventory which is shown in the Fig. 4.

The waiting time of component produced is one of the main thing in the VSM. The efficiency of the layout can be increased by optimizing the waiting time between stations.



Fig. 5 Waiting time

The Fig. 5 shows the waiting time between stations that was observed for a period of time. So, the collected data are used in plotting the VSM for the assembly line. Since it is a pull system there are high number of uncertainties. The VSM data helps in solving the uncertainty in a systematic way.

4. CURRENT STATE MAP

Current state map which gives the overall view about the assembly line and helps to understand the area in which the process improvement needs to be taken.

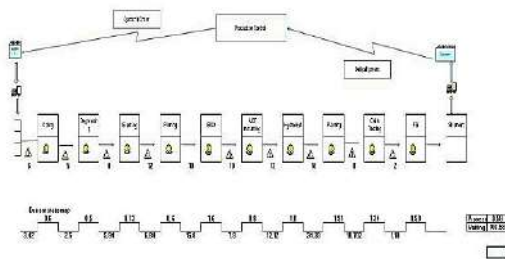


Fig 6. Current state map

The current state VSM is shown in the Fig.6 which explains about each stage and their actual time, inventory and waiting time of the valve. This helps in determining the area where the improvement is mandatory.

$$\text{Process cycle efficiency} = VA \times \frac{100}{\text{Lead time}}$$

$$\text{Process cycle efficiency} = 574.67 \times \frac{100}{6609.60}$$

PCE = 8.6%

5. ROOT CAUSE ANALYSIS

By using VSM, bottle neck process is identified which is painting process. So, the painting process has to be studied in detail to improve its efficiency with the help of fish bone analysis. The reason for the less efficiency is plotted under various main causes like man, material, machine and method.

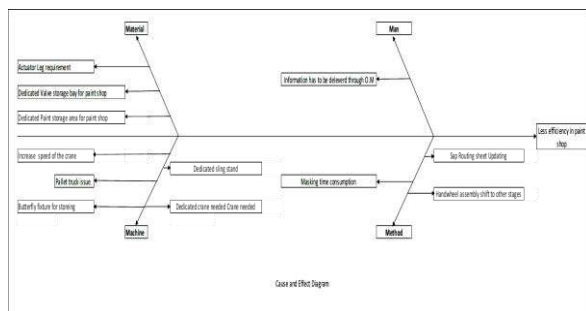


Fig. 7 Cause and effect diagram

The Fig. 7 describes about what is the cause for less efficiency in the paint shop and that is done using fish bone diagram.

6. PICK CHART

While implementing or changing the process in the production line, the performance of the line is drastically affected. By knowing the impact of each cause in the production line has to be determined and the causes which has less effective can be eliminated.

	Low pay-off	High pay-off
Easy	<p>Possible</p> <ol style="list-style-type: none"> Crane moving speed to be increased Paint unloading avoidance 	<p>Improvements</p> <ol style="list-style-type: none"> Material can be RTU ready Need better truck Communication from all supervisors about cooperation to paint shop through operations manager Think about using solvent Acuator Lag equipment Issue in Paint shop PC
Hard	<p>Risk</p> <ol style="list-style-type: none"> Dedicated crane needed crane needed 	<p>Challenges</p> <ol style="list-style-type: none"> From wheel use fully shift to other shops Dedicated valve storage bay for paint shop Issue in the paint shop PC Relatively transfer storage for painting

Fig. 8 Pick chart

Fig. 8 explains about picking the action which has higher impact while implemented is determined. The chart is segregated into four segments as high pay off, low pay off, easy to achieve and hard to achieve. So, the easy and high payoff is directly implemented and secondly hard to achieve and high pay where implemented so that most of the element for the improvement is covered.

7. KAIZEN

The kaizen approach is adopted to increase the cycle efficiency of the process in station, by continuously improving the station the cycle time. The waiting time of the station starts decreasing that leads to increasing the process efficiency of the station.

Kaizen 1: Over Processing Reduction

Masking time is one of the NVA that is observed in the station. Since it can't be fully eliminated, the time for masking is reduced by optimizing the process cycle time. Cycle time reduction by implemented masking body is shown in the Fig. 9.

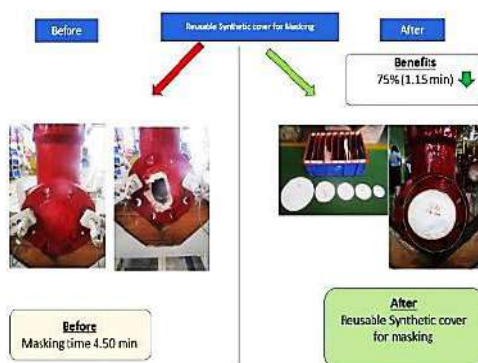


Fig. 9 Synthetic side cover

Kaizen 2: Unwanted Motion Elimination

Movement of operator from one place to another to collect Actuator leg is eliminated by changing the process as moving the leg along with the actuator. Assembly leg is provided along with the actuator shown in the Fig. 10.

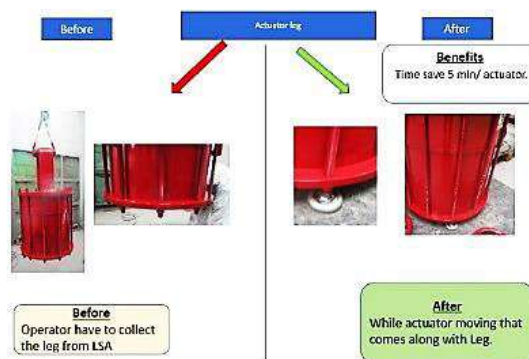


Fig. 10 Actuator leg

Kaizen 3: Waiting Elimination

The waiting time in the paint shop is completely eliminated by providing a dedicated sling stand to the paint shop along with the required sling. Separate belt stands and belt is provided to the paint booth is shown in the Fig. 11.

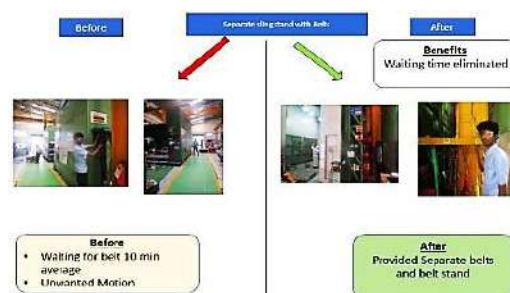


Fig. 11 Dedicated belt stand

Kaizen 4: Searching Elimination

Searching for things in a production unit is not desirable. By providing a bin to place the components which completely eliminates the searching for the spec sheet. Spec sheet bin is provided so that searching is eliminated shown in the Fig.12

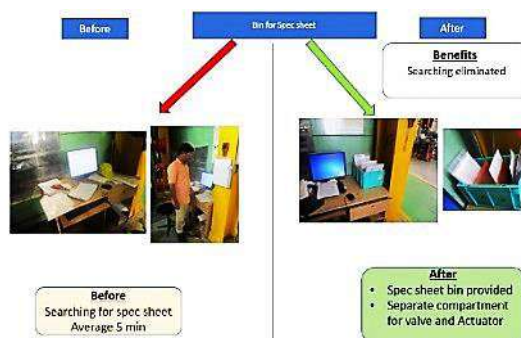


Fig. 12 Spec sheet bin

8. FUTURE STATE MAP

The future state map describes about the area where the improvement is made or have to be made are indicated by using the kaizen burst. It gives the overall understanding about the layout before implementing the improvement.

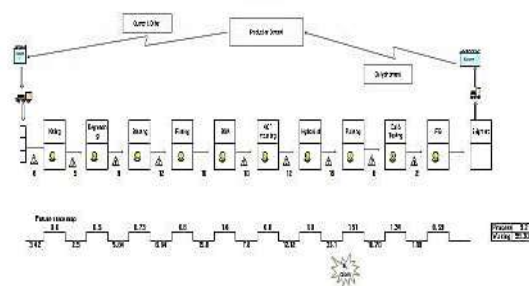


Fig. 13 Future state Map

In the Fig. 13 future state map is plotted to determine the approximate value of time which needs to be optimized along with clarity of improvisation.

$$\text{Process cycle efficiency} = VA \times \frac{100}{\text{Lead time}}$$

$$\text{Process cycle efficiency} = 550.7 \times \frac{100}{6208.8}$$

$$\text{PCE} = 8.87\%$$

9. Fixture Concept Generation

The safety of the operator is the major consideration in industry. Based on the unsafe considerations encountered in the assembly line during storing and assembling of the body, there is a need to develop an assembly fixture.

Number of concepts were generated for the safety fixture which are shown in Figs 14 – 18. The advantages and the disadvantages of those fixtures are discussed with assembly team by sharing the merits and demerits each concept and it is fine-tuned.

a. CONCEPT 1

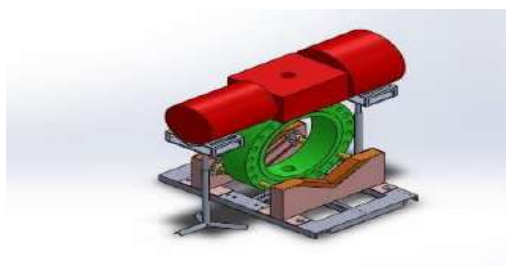


Fig. 14 Concept 1

ADVANTAGE

1. Designed using existing set up.
2. Able to move valve using manual pallet truck.
3. Standardizing the fixture.

Disadvantage

1. Structural integrity might be compensated.
2. Separate support stand needed and also need to be handled each time.

b. Concept 2

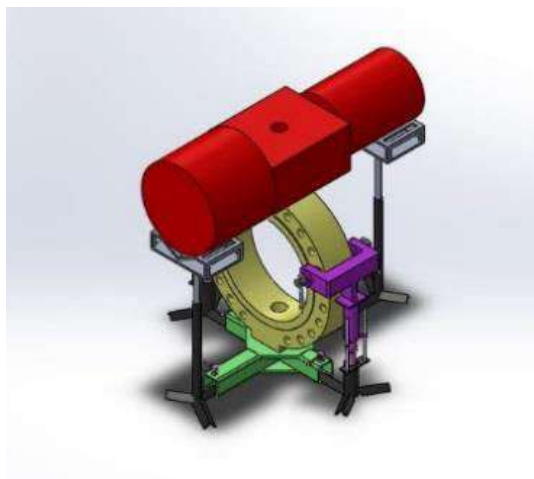


Fig. 15 Concept 2

ADVANTAGE

1. Highly flexible.
2. Number of lifts in crane can be minimized by modifying the design.
3. Pallet truck can be used to move the valve after redesign.

DISADVANTAGE

1. High number of special parts required.
2. Complicated design.
3. Costly.

c. CONCEPT 3

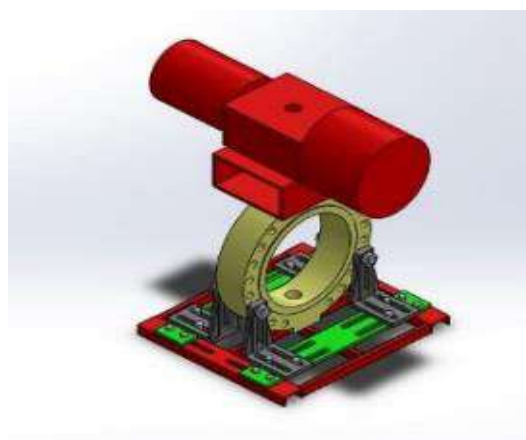


Fig. 16 Concept 3

ADVANTAGE

1. Easy to handle.
2. One operator is sufficient to handle the valve.

DISADVANTAGE

1. Number of bolt and nut that might compensate the structural integrity while loading
2. Separate support structure has to be designed.

d. Concept 4

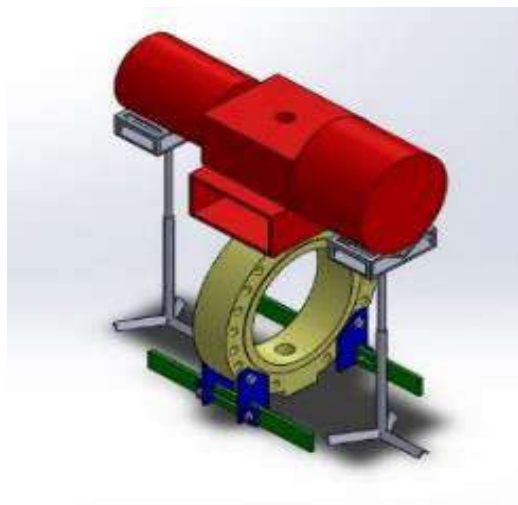


Fig. 17 Concept 4

ADVANTAGE

1. Most simple and cost-effective solution.
2. Easy to store.
3. Very less cost

DISADVANTAGE

1. Number of prototypes has to developed and the design has to be modified so that the flaws can be identified and redesigned

10. Concept Selection and Development

The generated concept is reviewed using the concept scoring table. The list of major requirements are listed in Table 1. The score for each concept is made.

Table 1 Concept selection

Criteria	weight	Concept 1	Concept 2	Concept 3	Concept 4
		weighted score	weighted score	weighted score	weighted score
Safety	25	4	22	5	8
Easy to Handling	20	18	18	6	12
Customer Preference	23	14	24	18	5
Cost	10	6	5	6	5
Easy of Manufacturing	7	5	4	5	2
Range	5	1	3	4	5
Close to existing Other fixtures	5	4	3	0	2
Quick change	5	1	1	1	2
Totals	100	53	80	45	41

The Table 1 shows the weightage score of each developed model. One concept is selected by using the concept selection process and that concept is irrelatively developed. The selected concept with highest score is 2.

11. Concept Development

Selected concept with 80 score is further developed and the concept is enhanced, Generation 2 of concept 2 is developed as screw rod type. After reviewing the concept, it is iterated again and refined.

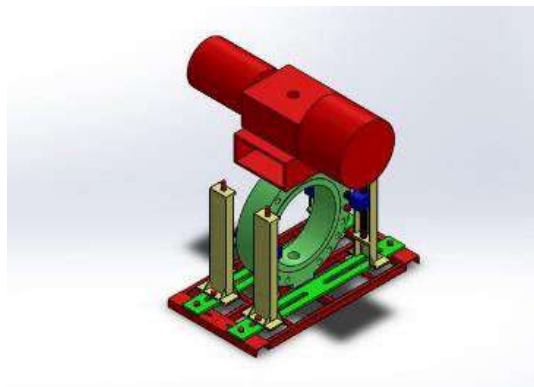


Fig. 18 Generation 2

After selecting the particular concept using concept selection process, it is involved for the cyclic development process and the negatives in that model are rectified and remodeled in the next generation, generation 2 model is shown in the Fig. 18.

12. Fixture Analysis

The fixture is analyzed for its maximum stress and the strain acting on the body so that the design can be validated. The self-weight and the actuator weight are given as the forces acting on it. The material properties of mild steel are used for analysis.

I. Stress analysis

The structure frame is first fixed at the bottom six legs and the self-weight of the valve is given along with the weight of the actuator and the combined weight of the actuator and the valve is given as 1500kg and it is measured for its maximum stress and the strain.

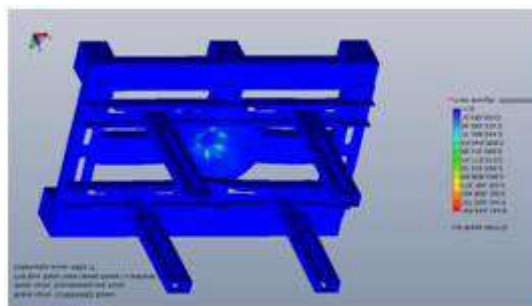


Fig. 19 Maximum Stress

The Fig. 19 describes about the maximum stress induced on the frame, and the interpreted through the figure is that the stress acting maximum on the six points where the valve rests in the frame. The value of the maximum stress is 149.5 MPa, whereas the yield stress of the material is 350 MPa, so the value of stress generated while loading the frame with the valve and actuator is much lesser than the yield stress of the material so that the material used and the frame is much safer.

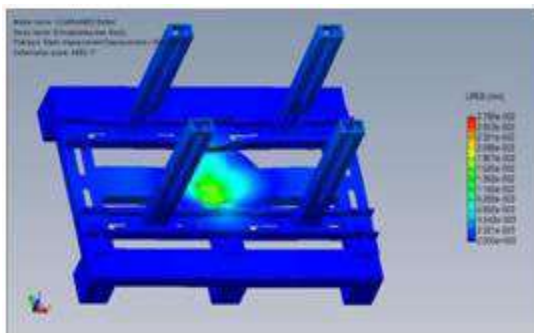


Fig. 20 Maximum strain

II. Strain Analysis

The Fig. 20 shows about the maximum strain on the fixture when it is loaded with the valve and the actuator. The interpretation from the figure is the maximum strain induced in the frame is 1.625×10^{-2} mm. The strain induced on the fixture is also very less. So, the design is safe.

13. Beta Prototype Of Fixture

Generation 3 of concept 2 is developed and the concept is finalized for the prototype, then the functional beta prototype of the generation 3 fixture was fabricated. The Fig. 21 shows the beta prototype of the fixture which is developed for assembling.



Fig.21 Generation 3 Beta-Prototype

14. CONCLUSIONS

1. The process cycle of the station before implementing the change is 8.6% and after implementing the changes in the line is 8.87%, 0.27% of process cycle efficiency of the production line is improved.
2. Fixture is designed and the prototype is developed for making the assembly line safer and engage the operator with operations with confidence to work in the assembly line.

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Throughput Time Reduction Through Production Layout Optimization in a Garment Industry

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ABSTRACT

The garment manufacturing industries in India is an important sector to the country's economic development. The small and medium scale garment manufacturing industries follows the traditional batch production system which leads to higher work-in process (WIP) inventory and longer throughput time. These are considered as non-value added activities from the customer point of view. Lean manufacturing (LM) concentrates on eliminating the non-value added activities by a systematic approach through continuous improvement. This paper discusses the redesign of a production layout using VIP-PLANOPT software and manual cell formation inside the sewing section to reduce the WIP inventory, throughput time, material movement distance and space consumption which are considered as the non-value added activities where the customers are not willing to pay. Before and after implementation models are simulated using manufacturing system simulation software (ARENA) and the results were analyzed.

Keywords: Lean manufacturing, throughput time, WIP, layout optimization, VIP-PLANOPT, manual cell formation, ARENA.

INTRODUCTION

LM is a systematic approach to identify and eliminate wastes through continuous improvement by flowing the product at the pull of the customer in pursuit of perfection [1]. The concept of LM was proposed by a Japanese automotive company, Toyota, during 1950's which was famously known as Toyota Production System (TPS). The first goal of TPS was to improve productivity as well as to decrease the cost by eliminating waste or non-value added activities [2]. The lean concept helps companies achieve more with less human effort, time and cost.

The garment (textile and fashion) industry is a major contributor to several national economies, including both small- and large-scale processes globally. With concern to the employment as well as production, the textile sector is one of the prime industries in the world [3]. Garment sector is a sector where comparatively modern technologies could be implemented even in poor countries at moderately low investment costs [4].

Based on the volume-variety of products or parts produced as shown in Figure 1, the production layout can be selected [5].

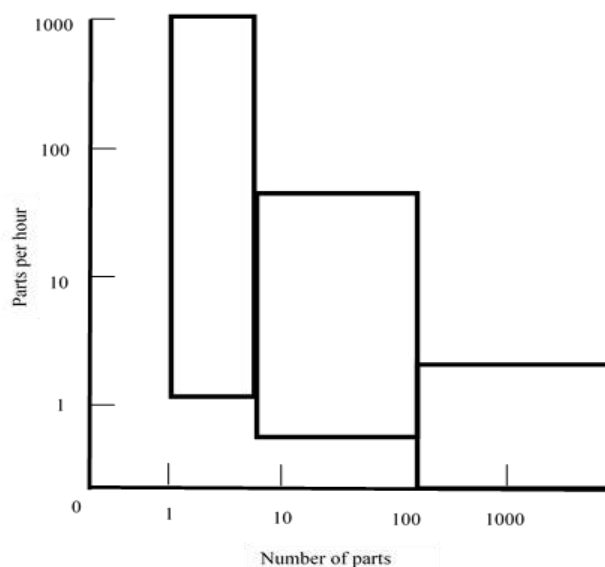


Figure 1. Volume versus variety

And the main characteristics of process and cellular layout types is tabulated and shown in Table 1,

Table 1. Characteristics of layout types

Characteristic	Process	Cellular
Throughput time	High	Low
Work in process	High	Low
Unit production cost	High	Low

This research attempts to redesign a production layout to achieve mixed one-piece flow and batch production in order to minimize the WIP inventory, throughput time and material movement distance which are considered as non-value adding activities. This layout redesign may help the garment industries of small and medium sectors to improve the production process with less cost and improved quality.

LITERATURE REVIEW

B.Sudarshan et al. [6], in their research said, by transforming to lean based cellular layout from progressive bundling system layout has reduced WIP to 70%-80% and by reducing the various non-value added activities the production lead time has reduced from 2 days to 20 minutes.

By using simulation techniques in the garment industry, *Mominul Islam* et al. [7], selected the best optimized layout with balanced line from the different scenarios and by which the efficiency is increased from 46.2% to 50.9% and also there is a reduction in the non-productive time.

For optimizing the production lines in garment factories, *Guoqiang Pan* [8] with SIMIO simulation platform showed a comparative analysis of how the efficiency of four different cell production modes is affected and then concluded that in order to obtain higher total output, some key indicators including the number of operators, operation modes and the number of buffers should be reasonably set for the particular apparel production line.

Praveen Saraswat et al. [9], identified the higher WIP and lead time in a bearing manufacturing industry using current state VSM, has suggested some lean principles and techniques and drawn the future state VSM where the lead time is reduced from 7.3 days to 3.8 days and also the WIP is reduced at each work stations.

Vajram Ramesh [10], proposed a practical approach on one-piece lean line layout in a pump industry using the simulation techniques and the wooden prototypes were created for validation. Many trials are carried out to optimize the design in the shop floor for the full scale production.

Mohammed Said Obeidat et al. [11], identified five types of wastes including defects, inventory, over production, transportation and waiting time in a production line of sewing industry through current state VSM and by applying the lean techniques which include line balancing layout redesign and quality at the source achieved a reduction of 96% in production wastes and 43% in lead time.

Introducing cellular manufacturing in an operating sewing section by changing the layout of the plant and forming sub cells, *Arun Senthil Kumar* et al. [12], in his research attempts to improve the efficiency of garments industry with reduced cost and time.

A simulation study was conducted on the sewing section which includes 14 main processes using ARENA software. From the simulation results, *Liong* et al. [13], concluded that some improvements are needed in order to increase the production and to achieve a more balanced resource utilization.

Isanur Shaikh et al. [14], proposed a U-shaped cellular layout in a ready-made garment industry which increases the line efficiency by 11% and total output per day from 1190 to 2378. Also the author offers some recommendations for successful implementation of cellular manufacturing system in the sewing floor.

A work study was conducted to minimize SMV by having better synchronization with man, machine, material and methods to achieve higher efficiency. *Mohammad Abdul Jalil* et al. [15], also provides a clear concept of determining line balance, machine requirements and man power allocations.

METHODOLOGY

The methodology for production layout optimization to reduce the non-value added activities in a garment industry is as follows,

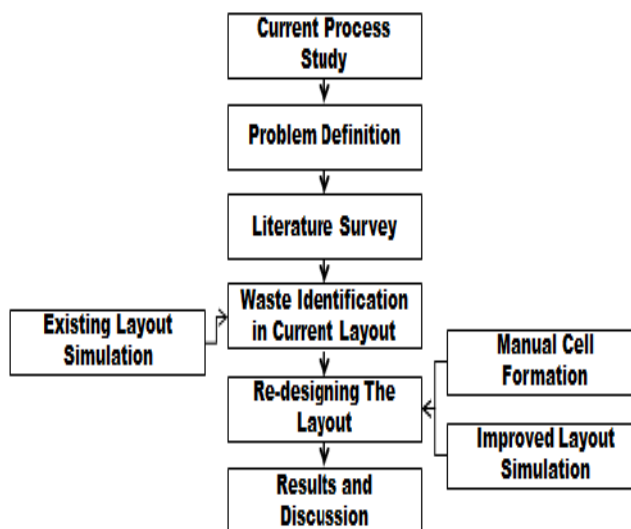


Figure 2. Methodology

Existing Layout - Drawbacks

Due to following of traditional batch production system there is higher WIP inventories as shown in Figure 3, which leads to longer throughput time.



Figure 3. Work-in process inventory

The existing layout of the sewing section is drawn using VIP-PLANOPT as shown in Figure 4. It follows a process layout where similar machines are grouped together.

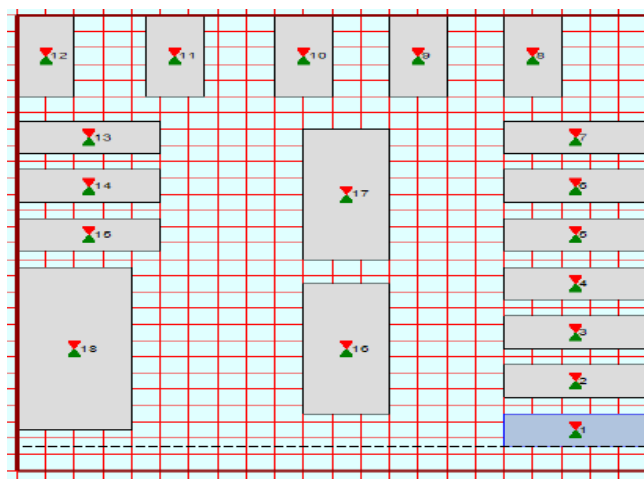


Figure 4. Existing layout of sewing section

Table 2. Machines/equipment dimensions

Description	Dimensions(in cm)	Quantity
Ironing table	150*120	1
Power supply box for ironing	65*40	1
Flat lock machine	123*63	4
Over lock machine	120*60	4
Lock stitch machine	120*53	7
Table (s)	240*75	2
Table (l)	245*123	2

Table 2, shows the dimensions and the quantity of machines and equipment used inside the industry.

Types of T-Shirt

There are three main types of T-shirt styles produced in the industry and their operations are shown in Figure 5 (a), (b), they are,

- Crew neck
- V-neck
- Polo

Crew and V-neck T-shirts each follow same operations whereas polo T-shirt a little different operations.



Figure 5. (a) Crew neck T-shirt



Figure 5. (b) Polo T-shirt

Outline Process Chart

The outline process chart of the different types of T-shirt operations in the sewing section are shown in Figure. 6 (a), (b).

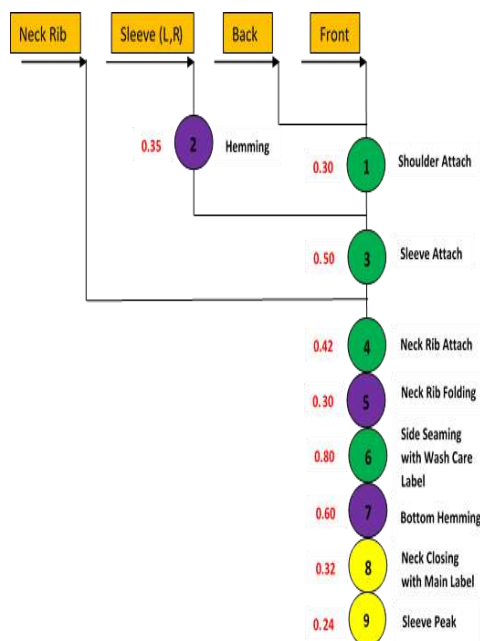


Figure 6. (a) Outline process chart for crew and V-neck T-shirt

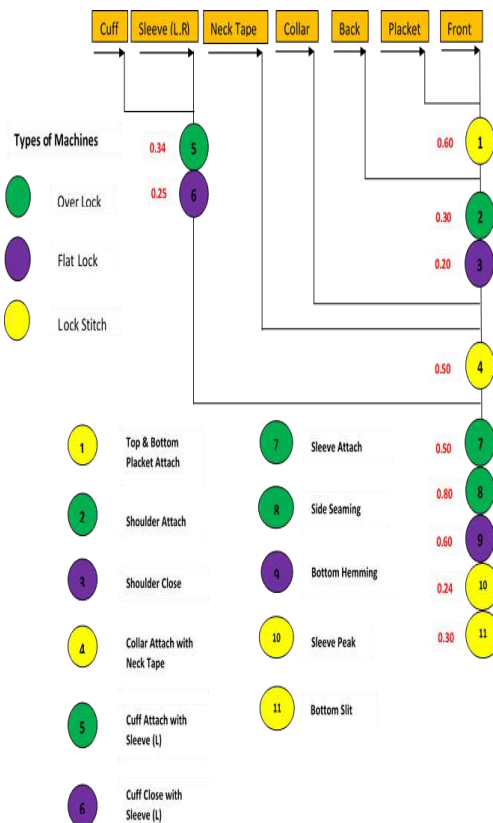


Figure 6. (b) Outline process chart for polo T-shirt

In sequence = 2 | 16.67%
 By passing = 3 | 25%
 Back tracking = 7 | 58.3%

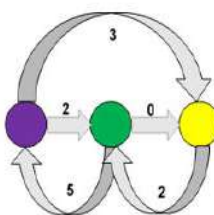


Figure 7. Types of part movement-Existing layout

Figure 7, shows the different types of part movements and the back tracking of the parts was 58.3%.

Table 3. Existing layout summary

Description	Existing	
	Crew & V-Neck	Polo
Work-in process (Sewing)	372	420
Material movement distance	100.65m	171.80m
Throughput time (Sewing)	5.65 hrs.	9.35 hrs.
Production rate per hour (Sewing)	35	22
Back tracking (Sewing)	58.3%	
Space consumption	280m ²	

Redesigning the Production Layout

The improved layout is shown in Figure. 10 where the process layout is changed to cellular layout and the sub cells were formed and the trimming, checking, ironing and packing tables were shifted to the sewing section area to minimize the material movement distance. This optimized layout combines both continuous and discontinuous flow of materials to reduce the WIP, throughput time.

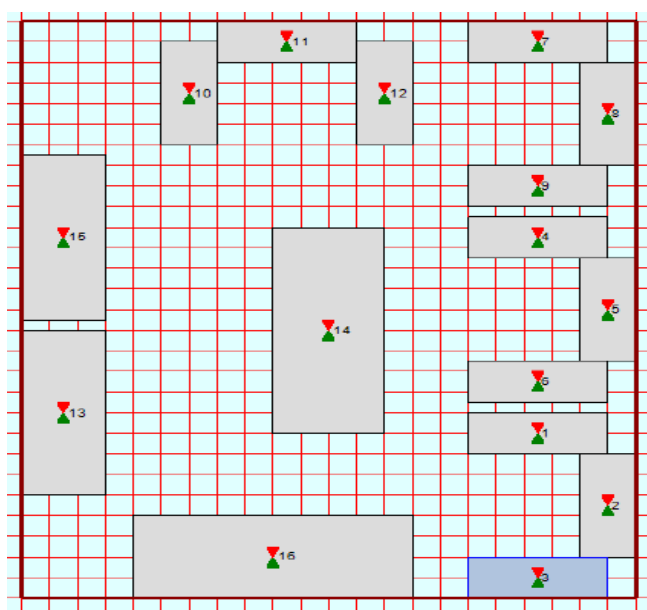


Figure 10. Optimized layout

Improved Operation Sequence

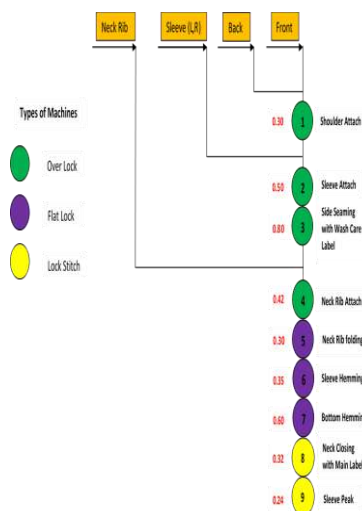


Figure 11. (a) Improved Outline process chart for crew and V-neck T-shirt

The existing operation sequence consists of large operator idle time so the operation sequence is changed as shown in Figure. 11 (a), (b), based on the precedence relationship and process time to reduce the idle time of the operator and to follow the best sequence of operations.

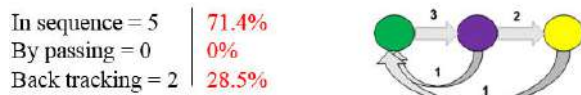


Figure 12. Types of part Movement-Improved layout

The back tracking of parts also reduced to 28.5% as shown in Figure. 12,

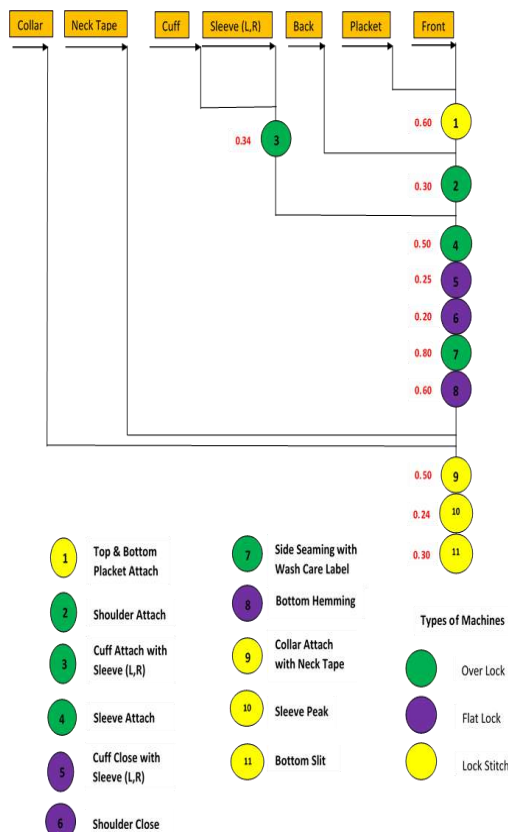


Figure 11. (b) Improved Outline process chart for polo T-shirt

Reduced Material Movement Distance

From the Figure 13, it shows the material flow from the starting to end of the process and there are no any unwanted material movements in between each process.

The optimized layout reduces the material movement distance of crew and V-neck T-shirt to 28.55m and polo T-shirt to 37.35m.

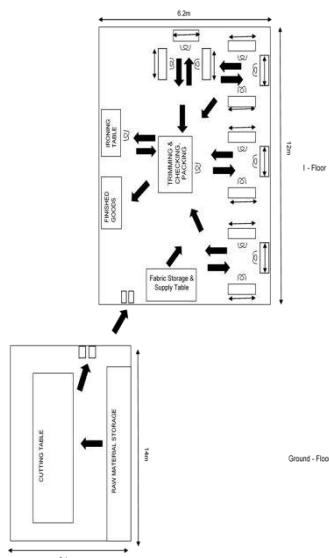


Figure 13. Improved layout material flow

Improved Model Simulation

The improved model is simulated using ARENA as shown in Figure 14, and the summary of results have been shown in Table.4.

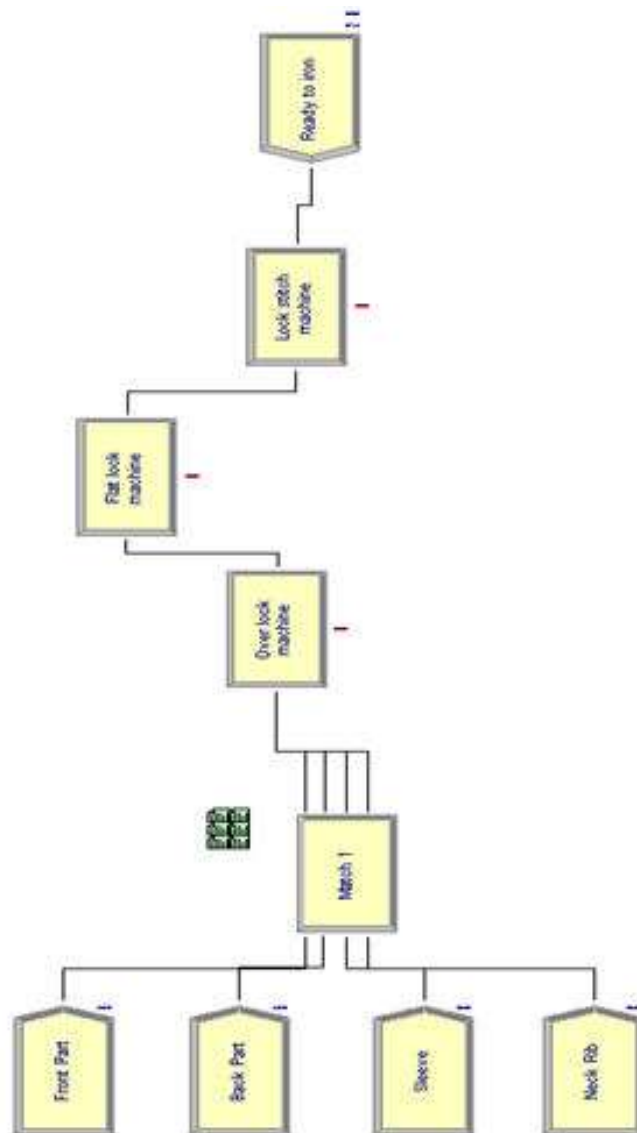


Figure 14. Improved model simulation

Table 4. Improved layout summary

Description	Improved	
	Crew & V-Neck	Polo
Work-in process (Sewing)	21	33
Material movement distance	28.55m	37.35m
Throughput time (Sewing)	6 min	9.2 min
Production rate per hour (Sewing)	43	31
Back tracking (Sewing)	28.5%	
Space consumption	206m ²	

RESULTS AND DISCUSSION

The comparison of summary of results before and after redesigning the layout is shown in the Figure. 15.

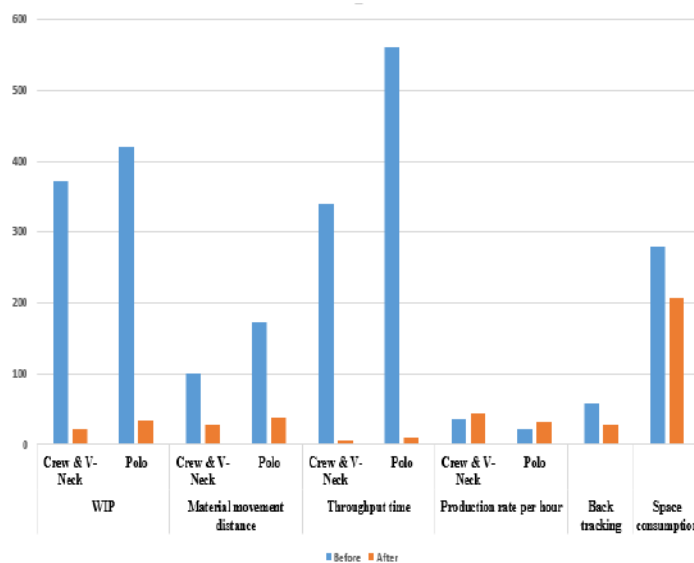


Figure 15. Before and after layout optimization comparison

CONCLUSION

By mixing one-piece flow and batch production through redesigning the layout there may be a dramatic reduction in WIP and throughput time which in turn increases the production rate with effective use of man power and other resources. The layout optimization also helps in reducing the material movement distance and space consumption.

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Reliability Data Analysis of Through Hole Light Emitting Diode

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ABSTRACT

In today's world, everyone prefers Light Emitting Diodes (LEDs) over other lamps and bulbs for lighting purposes because of its small size, low power consumption and robust nature. Through hole LEDs are one of the most commonly used LEDs for indication purposes. The reliability of a system is directly proportional to the reliability of the individual components used in that system. Thus, the reliability of the through hole LEDs are important when considering the reliability of the systems/ devices / applications where they are used. In this study, Quantitative reliability analysis has been used to find the life characteristics (TTF, MTTF, MTBF, etc.) of the product/ system using accelerated methods. Also, the life of the through hole LEDs, has been evaluated using ANSYS. The FEA analysis has been conducted as per the designed Accelerated life test (ALT) plan.

Keywords – Reliability, Accelerated Life Testing (ALT), Light Emitting Diodes (LED), Fatigue life

1.INTRODUCTION

LED is an acronym for Light Emitting Diodes. These are basically semiconductor devices that emit light due to the Electroluminescence effect. The effect enables, especially a semiconductor, to emit light in response to an electric current or electric field. Basically, LED is not symmetric, in the case of polarity, which indicates that it allows the flow of current in only one direction. There are two terminals in these types of LEDs. They are Positive terminal and Negative terminal. The positive terminal is the anode and the negative terminal is the cathode. Anode will have higher terminus than the cathode in LEDs for the easy identification because of its non-symmetric property. Anode should be connected in the higher potential than the cathode, as the current flows from anode to cathode. The usage of leads in the components and placing it on the holes in the PCB and soldering it to the pads on the opposite side is called the Through-hole technology. The orthographic view of the LED along with its parts is shown in the fig.1

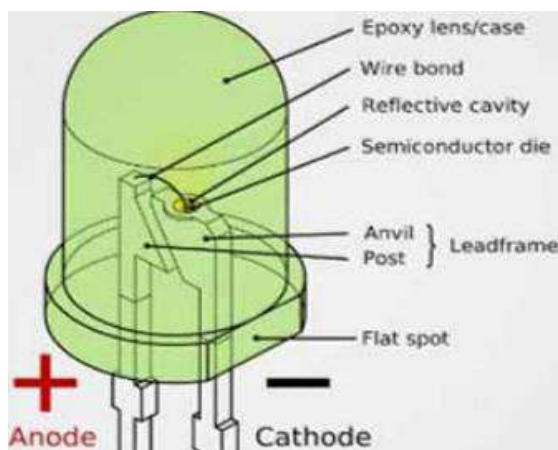


Fig.1 Orthographic view of LED

The main objectives of this work are to generate the failure data of the through hole LEDs with respect to time by testing under accelerated conditions, to fit a suitable distribution for the TTF (Time to Failure) data and evaluate the parameters of the distribution, to calculate the life of the through hole LEDs under accelerated conditions using the parameters of the distribution and to calculate the life of the through hole LEDs under normal conditions by extrapolating the results from the accelerated conditions using accelerated models.

The accelerated life testing of products to evaluate their life has been studied by a number of researchers over the few decades. Kalaiselvan et al [1] evaluated the life of nano ceramic capacitor by generating the time taken to failure at accelerated condition and non-parametric method is used to convert the data obtained in accelerated condition into normal working condition. The life of the nano ceramic capacitors is found to be 68934.22 hours which corresponds to 7.86 years. Wen Hua Chen et al [2] found solutions for some problems that ALT faces, such as the verification of the statistical model, limitation of sample size, solutions of resource limits, optimization of the test arrangement, and management of product complexity. Lorenzo Trevisanello et al [3] conducted experiments on different families of light-emitting diodes from various manufacturers that were

subjected to different stress conditions, with high temperature storage without bias and high dc current test. Chan et al [4] conducted the Accelerated life tests of high-power white light emitting diodes under an unbiased highly accelerated temperature and humidity test (HAST) and a normal aging test. The conditions in the unbiased HAST were 110°C - 85% RH, 130°C - 85% RH without bias. Travis Ashburn et al [5] discussed Time-to-Failure predictions at working conditions for the widely used class of ceramic capacitors and median time-to-failure projected was well in excess of several hundred years for medical implantable application conditions at a particular voltage and temperature. Zaharia et al [6] has conducted various experiments and determined the mean number of cycles to failure of the specimens in accelerated testing conditions and using the appropriate acceleration models predicted the mean and median time to failure under normal working conditions.

II. PROPOSED METHODOLOGY

The methodology used in this work is shown in the Fig.2. First, the literature survey about the through hole LEDs has been undergone and the problem has been formulated along with the main objectives. The main objective is to find the life of the through hole LEDs under the normal conditions. The Accelerated Life Testing (ALT) method is adopted in this work to find the life of the diode. To perform an ALT, a design for accelerated life testing has been developed. The time to failure (TTF) data that is generated in the ALT is used for further analysis of the data. Subsequently, the TTF is plotted in the graph to obtain a distribution that is best fit for the obtained data. The parameters of the selected distribution are evaluated to determine the life of the LEDs under the accelerated conditions. By applying suitable acceleration model, the life of the LEDs under the normal stress conditions is determined.

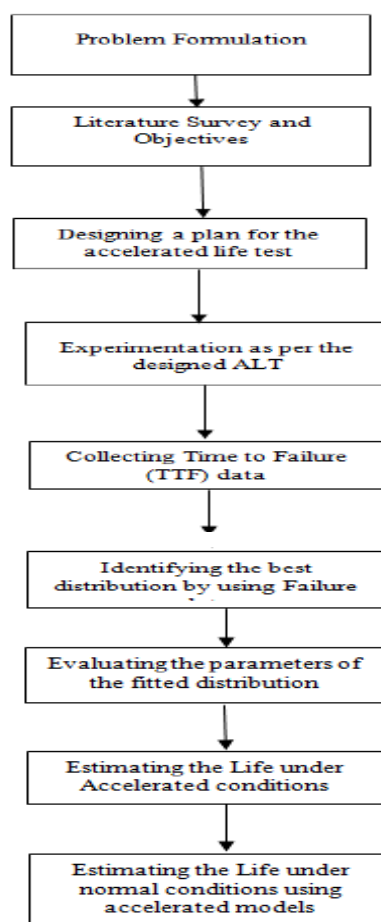


Fig.2 Proposed Methodology

III. EXPERIMENTAL DETAILS

A. Design of the ALT

The design of the ALT actually includes the type of stress, stress levels, operating range for the stress levels, etc as follows.

- The Component on which ALT was performed is the through hole LEDs of vertical lamp type and of size 5mm.

- The stress was given in the form of the accelerated temperature inside the Environmental/Climatic chamber.
- The rated current of the through hole LEDs are 20mA, the rated temperature is -40°C to +85°C and the forward voltage is 2.2V (this range differs with respect to manufacturers).
- The LEDs were tested under the accelerated temperature of 125°C and the sample size that will be used for this test is 50.
- The LED was considered as a failed one, only when it stops to glow, under the accelerated conditions, with respect to the circuit connections.

B. Experimental Setup

The experimental setup consists of a perfboard, LEDs selected for the test, resistors, a battery source and the jumping wires. The Test was conducted by using environmental chamber. First the positive terminal of the battery source was connected to the cathode of the breadboard and the negative terminal was connected to the anode. Then, the LEDs were connected in parallel by providing resistors to resist to the allowable current. All the LEDs were soldered for the convenience of connecting it to the battery source easily instead of using the jumping wires.

C. Resistance Calculation

The resistance level varies with each application which can be calculated using Ohm's law. $RESISTANCE = (Supply\ Voltage - voltage\ drop) / Required\ current$. The basic forward voltage (voltage drop) of the LED ranges from 1.8 – 3.3 (varies with respect to the manufacturers and colors). This is the formula when each LED is provided with a separate resistor. When a single resistor is used for multiple LEDs, then the obtained resistance value should be divided by the total number of LEDs. Here, it has been calculated for every individual LED.

iv. Numerical Analysis

A. Modeling of the LED

The model of the through hole LED has been developed using CREO parametric 3.0. It is shown in the Fig 3.

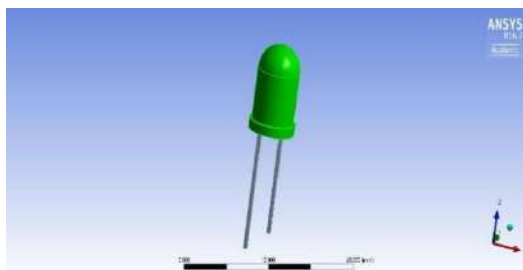


Fig.3 Modeling of the LED

B. Mesh Model of The Led

The Mesh model of the LED has been created by using ANSYS 16.2. It is shown in the Fig 4.



Fig.4 Mesh model

C. Material Properties

The materials used for this model are Polycarbonate and mild steel with tin plating. Polycarbonate is used for the plastic part that covers the inner parts of the LED and mild steel is used for the conducting pins that are used to transfer the electricity. The material properties are given in the table 1.

Table 1. Material properties

Properties	Polycarbonate	MildSteel
Young's	2.4GPa	200GPa

Modulus		
Tensile Strength	55 – 75 MPa	414 - 560 MPa
Compressive strength	80 MPa	140 – 160 MPa
Poisson's ratio	0.31	0.29
Density	1.22 g/cm ³	8 g/cm ³
Thermal Conductivity	0.22 W/mK	16 W/mK
Specific heat capacity	1.3 KJ/kgK	0.5 KJ/kgK

D. Thermal Loading Conditions

Since the accelerated temperature should be 125°C, the temperature is set at 125°C and the complete model has been given the thermal load as shown in the Fig.5.

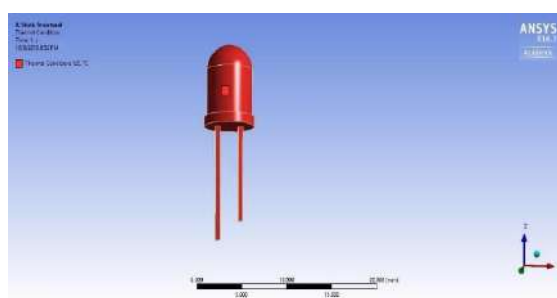


Fig.5 Thermal loading conditions

E. Fixed Support

The fixed support has been given to the complete model to ensure the static position of the LED and also to resolve solver pivot warnings as shown in the Fig.6.

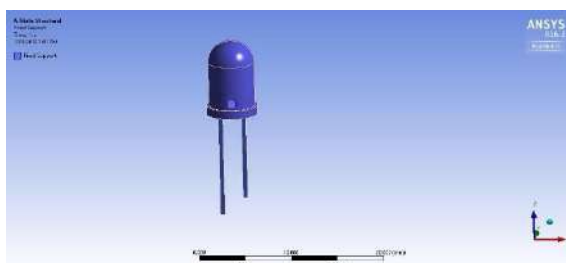


Fig.6 Fixed support

F. Fatigue Life

From the analysis, it can be seen that the fatigue life of the through hole LED under the accelerated conditions is 1702 hours that is shown in the Fig.7.

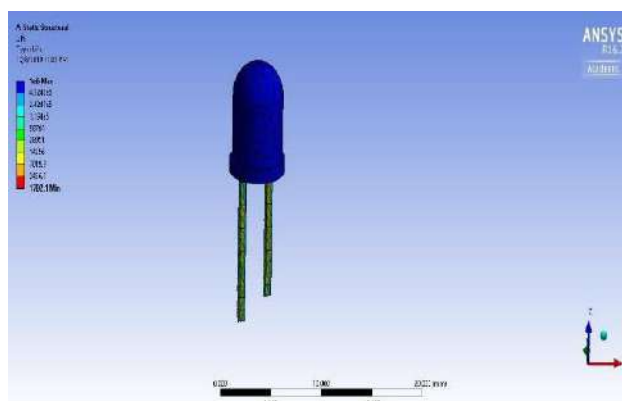


Fig.7 Fatigue life

V. Experimental Setup

In the Initial design, the setup consists of a breadboard, resistors, LEDs and jumping wires. The LEDs are connected in parallel to get the failure data for every individual sample. Resistors are connected before each LED to limit the current supply and to allow the required current into the LED. The jumping wires are used to connect the battery source. The ALT test conditions have been set at a temperature of 125°C, and the breadboard starts to malfunction above 50°C. Therefore, the breadboard should be replaced by another PCB board which can withstand 125°C. Since the breadboard cannot withstand the accelerated temperature, a perfboard (Dot PCB) has been chosen to do the perform the test. The LEDs are connected in parallel with resistor, as per the Initial design. The red colored wire acts as cathode and yellow colored terminal acts as anode. The LEDs and the resistors have been joined and soldered into the perfboard. Initially 9V battery has been given as a power source. Thus, the resistance has been calculated as 200 ohms. For the safety purpose, the 1000-ohm resistors are selected and used in the circuit. 9V battery is not enough to glow all the LEDs at the same time. Therefore, 25V battery has been used, as anything above 25V will require more than 1000-ohm of resistance. But, 25V battery is still not required to glow all the LEDs. The circuit has been refined to do the ALT as shown in the Fig.8. The Environmental chamber temperature range to do the ALT is between -85°C to + 200°C. Since the experiment hadn't been conducted, the complete experimental setup with the Environmental chamber is not possible. Only the circuit has been presented here in the Fig.8.

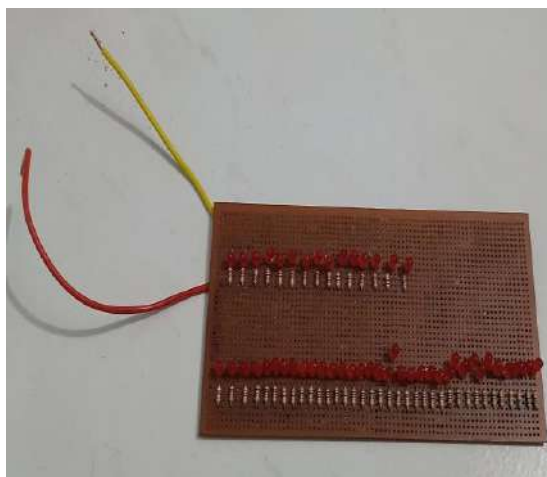


Fig.8 Experimental setup

VI. Distribution and parameter evaluation for the sample experimental data

A. Fitting the Distribution

The sample data that have been selected represents the Time to Failure for each LED. From the Fig.9, it can be understood that the provided data best fits the Weibull three parameter distributions.



Fig.9 Distribution

B. Failure Rate and Pdf

Failure rate is the frequency at which a component or system fails with respect to time. PDF is used to specify the random variable falling within a particular range of values. The graph that represents the Failure rate vs Time is shown in the Fig.10 and the PDF is shown in the Fig.11.

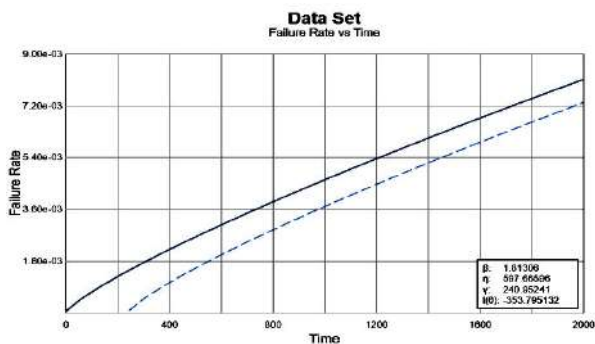


Fig.10 Failure rate Vs Time

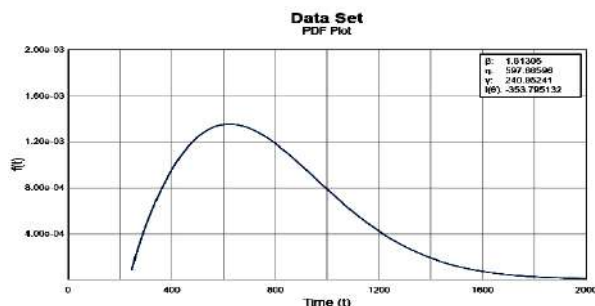


Fig.11 Probability Density Function (PDF)

It is understood from Fig.10 that the failure rate increases with respect to time. The shape corresponds to the standard shape of the failure rate for $\beta = 1.5 - 2$.

The PDF for the data set shows a right skewness, from which it could be interpreted that some diodes' life exceeds far beyond the normal life of the diodes.

C. Probability, Reliability and Unreliability

Reliability is the probability of a product or component or system to perform its intended function within a specific period of time. Unreliability refers to the opposite of reliability. Unreliability = 1 - reliability. The probability, reliability and unreliability with respect to time is shown in the fig.12,13 and 14 respectively. The unit of the time in this case is considered in the hours (hrs).

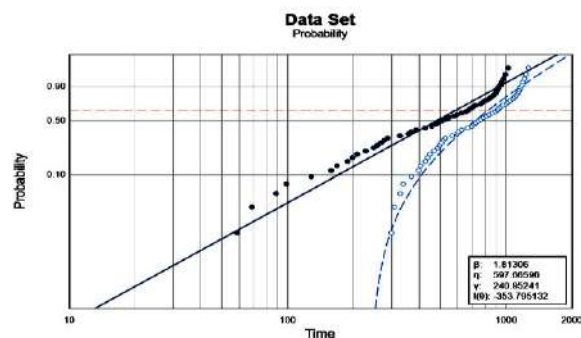


Fig.12 Probability Vs Time

The probability of failure of the diodes for a specific duration of time is determined for any specific amount of time using Fig.12.

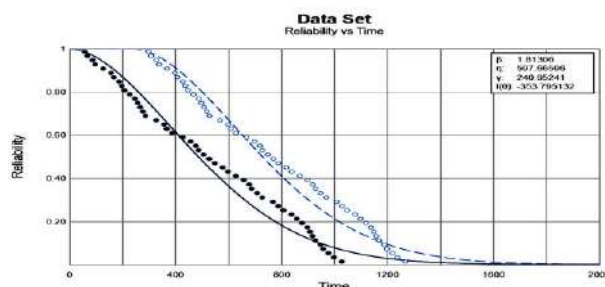


Fig.13 Reliability Vs Time

The reliability Vs time graph in Fig. 13 provides the reliability of the diode for any specific instance of time. Obviously, the reliability of the diode decreases with increase in time.

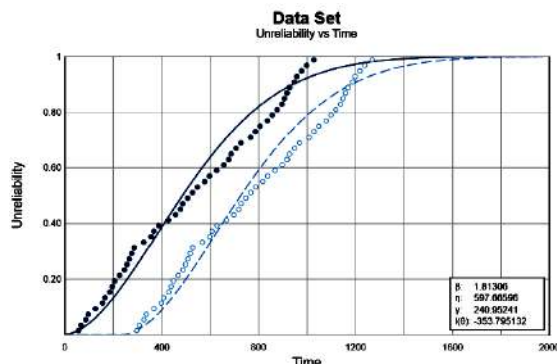


Fig.14 Unreliability Vs Time

The unreliability, which is the inverse of reliability, is determined using figure 14, for any specific time. As per its customary behavior, the unreliability values, shown in figure 14, increases as the time increases. The “T” is given by:

$$T = \gamma + \eta \cdot \Gamma \left(1 + \frac{1}{\beta} \right)$$

Where β – shape parameter

η – scale parameter

γ – Location parameter

T- Mean Time to Failure (MTTF) under accelerated conditions

From the graph, it can be seen that:

$$\beta = 1.81306$$

$$\gamma = 240.95241$$

$$\eta = 597.66596$$

$$T = 773 \text{ hours}$$

A.F is given by:

$$A.F = \frac{t_1}{t_2} = \exp \left[\left(\frac{E_a}{K} \right) \left(\frac{1}{T_1} - \frac{1}{T_2} \right) \right]$$

Where A.F – Acceleration Factor

T_1 - Normal temperature = 358K

T_2 - Accelerated temperature = 408K

E_a - Activation Energy = 0.8 eV

K- Boltzmann constant = $8.62 \times 10^{-5} \text{ eV/K}$

t_1 – MTTF under normal conditions

t_2 – MTTF under accelerated conditions

Using acceleration models, the MTTF under normal conditions corresponds to 2.11 years.

VII.CONCLUSION

Accelerated Life Test plays an important role in the quantitative test due to the advantage of time compression. Basically, only the quantitative analysis and reliability prediction models are usually used while performing the Accelerated Life Tests (ALT) to find the life of the product. But in this study, not only quantitative analysis of the through hole LEDs is used, but also the numerical analysis has been performed. The numerical analysis has been done according to the design of the accelerated life test plan that has been discussed in the chapter 5, by providing the appropriate material properties. From numerical analysis, it has been found out that the fatigue

life of through hole LEDs under the accelerated conditions is 1702 hours. This approximately corresponds to the Mean Time to Failure (MTTF) that has been found out by performing the accelerated life testing and using the appropriate acceleration models. It has been understood that, though lognormal distribution fits the sample data, the three parameter weibull distribution has been found to be the best fit to the data. The life of the diode under the normal conditions with the sample data after using acceleration models is 2.11 years. The failure rate of the diode increases with respected to time for the determined ' β ' = 1.81, and its shape resembles to standard failure rate plot for ' β ' = 1.5 to 2. The Weibull pdf is positively skewed (has a right tail), depending on the slope of the distribution, and corresponds to the shape of the standard PDF plot of weibull distribution for $\beta < 2.5$.

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Development of Augmented Reality Based Book for Education

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ABSTRACT

The rapid development and easy access to latest technologies lead the way for the implementation of Augmented Reality in various fields. In education, Augmented Reality paved the way for quick, easier understanding and visualization of the concept. With easy access to smartphones to the students and the teachers, basic concepts of science can be easily presented using Augmented reality. The aim of this work is to develop a marker-based Augmented Reality book that follows the curriculum of the school education. Interactive AR environment is created that contains the basic concept of physics. AR based mobile application is developed with the color theory for texturing the models and perfect lighting of the scenes to engage students in learning. This mobile application will run on android platform and easily accessible to the students.

Keywords— Augmented reality, virtual reality, image tracking, marker-based system, texturing.

INTRODUCTION

Augmented reality is an enhanced version of virtual reality, it's an overlay of the virtual object in the real-world environment [1]. With accelerating, pace in the development of new technology led a way to the implementation of Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR) in various fields. As mobile hardware and software have become more advanced in recent years AR starting digital trends to take off in many industries. AR technology is implemented in many fields for visualization, communication and entertainment. Advancements in technologies have changed the educational field from projector to interactive whiteboards. AR will change the method of teaching and learning process. AR helps in remembering the information, easily acquire and process the information through the ways of visualization, communication and entertainment. There is no age limit for the AR application. It can be used from preschool to college and even at industries / organizations [2]. AR does not require any high-end devices, easy to use and easily accessible when compared to virtual and mixed reality.

Every year a new interactive tool is made available for teachers to led the students to participate in the development process [3]. With the use of AR, the students can learn through interactive games and creative tasks [4]. With the introduction of interactive game models like collective game-based design and a sequential-mission gaming design led to an increase in learning effectiveness, cognitive load and flow experience of the students [5]. The student with learning disabilities gets distracted easily but AR tends to catch the interest of such students with attractive models and texture [6]. AR can be used by students with learning disabilities and hearing disabilities to improve their visualization in the concepts [7]. Interactive text books for assisting students with learning disabilities gives evidence for the effectiveness of design and textures used in the Augmented Reality application [8]. AR with wearable glasses supports the communication and feedback loop between the instructor and a Deaf or Hard of Hearing (DHH) learner [9]. AR with sound enabled system can be used to train the student in vocabulary, language and communication skills [10].

There are various types of AR used in the field of education based on the method of implantation like the usage of image recognition, object recognition, real-time tracking and ground plane detection. AR technology-enabled learning process will be more active, effective, attractive, motivating, and meaningful for a student [11]. The AR picture book is used for exercise and also improves the hands-on ability and imagination of the children [12]. Introducing Augmented Reality in the book brings back students to the traditional reading book. AR with the use of a head-mounted display and with an empty book can bring tactile sensation. In addition to that, it also reduces the discomfort from the superimposed page by using curvature correction [13].

AR learning makes use of marker, marker-less and projection-based AR systems. Marker-less AR system does not require markers but for a better experience, it is required that the surface has a texture for computer vision to recognize it [14]. The Augmented Reality application focus on the design aspect of the 3D model and the interactive part of the AR learning system [15]. The design aspect of the model and the application will increase the number of usage and usage time [16]. As the design tools become easier to use and more affordable, teachers can craft specially designed interactive software in a reasonable amount of time [17]. AR is an emerging technology, subsequently equal to e-learning and m-learning. AR has been evolving to make learning

interesting and effective in real-time [18]. The purpose of this work is to develop an interactive AR application to help students in understanding and visualization the concepts of physics. From the published literature, it is found that AR based mobile application will motivate the students and also help to visualize the basic concepts. Therefore, in this work an AR based application is developed for android platform.

DESIGN AND DEVELOPMENT OF APPLICATION

Blender 3D is an open source software used for developing 3D models with texturing and shading. It is used for the creation of low polygon models and animation. The models are saved in the *.obj and *.fbx formats which can be imported into the application development platform. The *.obj format contains only information on the geometry of the 3D model and *.fbx format contains every piece of information about the 3D model.

Figure 1 represents a low polygon model made using Blender. If models are made with a low polygon structure then number of vertices can be reduced. Since there are fewer vertices the size of the model is also reduced. Texturing of the model gives the high-frequency detailing and color information. Figure 2 represents the low polygon model with texture developed using blender 3D software.

Unity is an application development platform used for building android applications. Unity is the well-suited platform for VR, AR, and MR applications. Unity is used for making immersive and interactive applications for all kinds of mobile platforms.

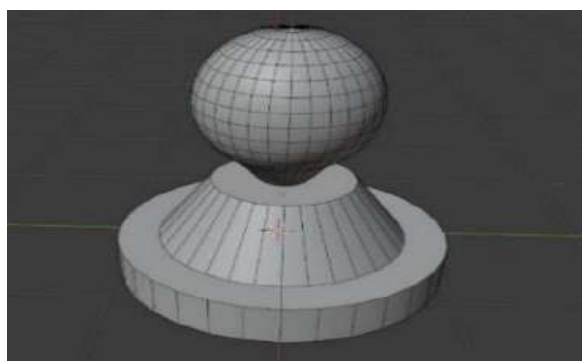


Fig. 1. Low polygon model 1



Fig. 2. Low polygon model with texture

Figure 3 shows the three dimensional model of electric circuit developed using blender 3D software. Vuforia is AR software development kit used along with Unity for AR application development. Vuforia facilitates for the multiple image tracking and object recognition. Vuforia is used for the reduction in the delay of the image tracking process.

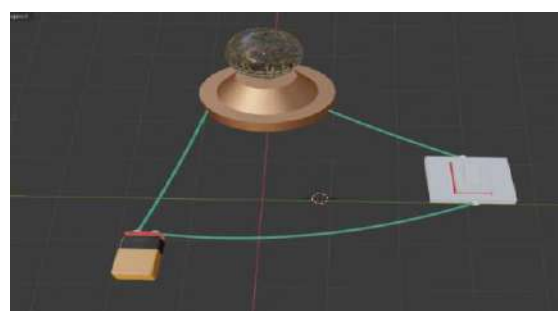


Fig. 3. 3D Model of open and closed circuit

The Marker-based AR is the recognized-based AR where the virtual object is placed in the place of the 2D or 3D objects. Lighting play important role in achieving practical or aesthetic effects. Images in the book act as the markers for the application. Vuforia also supports light estimation. with light estimation, the application can adapt to the real-world environment.

Lighting play important role in achieving real-world texture or aesthetic effects. Figure 4 represents the tracking of image and presenting the virtual object in the real-world environment. Hardware used for running the application is mobile phones and tablets with the android version above android 8.0.

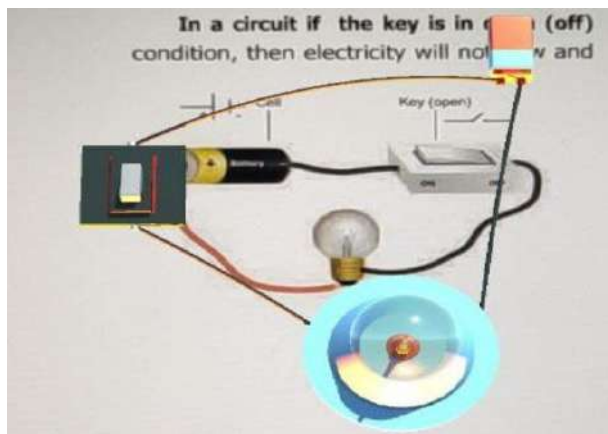


Fig. 4 Image tracking using Vuforia

Figure 5 shows the virtual objects in the AR application. User can interact with these virtual objects by changing the size and orientation of the object.

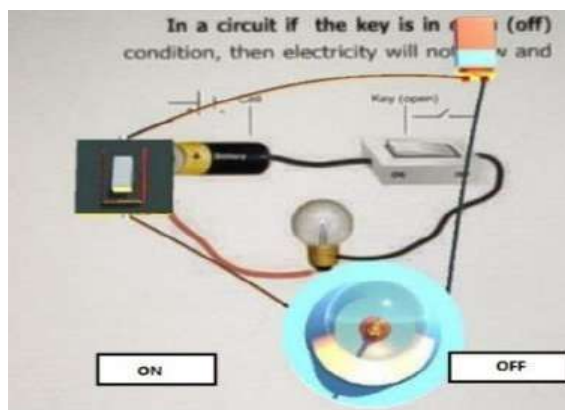


Fig. 5. Application developed with interactions

RESULT AND DISCUSSIONS

In this work, an interactive AR education application is developed for android platform using Blender 3D software, Unity game engine and Vuforia AR software development kit. Image tracking is the process of recognizing the images or video frames captured by the camera. The smartphone and tablets are used to capture the image and interact with the virtual objects. Figure 6 shows the tracking of images for representing different types of magnets. In the AR application students will be able interact with the virtual objects by changing the size and orientation of the models with touch-based interaction.

Figure 7 represents the virtual objects of magnets that can be used for explaining the magnetic attraction and repulsion in AR application. In this environment, the user can interact with the objects by fixing magnet and moving the other magnet for learning the magnetic attraction and repulsion concepts.

Figure 8 shows the image tracking for explaining the length measurement. User can move the scale and compare the length of the virtual object with the scale. This AR application will work in the android platform so students can use mobile phone or tables to track the image and interact with the virtual object without any additional hardware attachment. This AR application will motivate the students to learn the fundamentals of physics. Further, this AR application will also improve the visualization capability of the students and better understanding of the subjects.

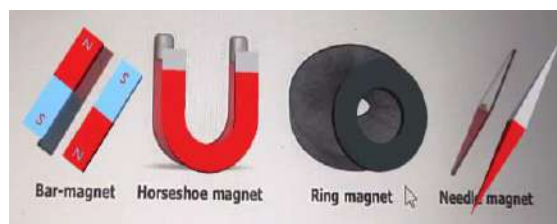


Fig. 6 Image tracking for displaying types of magnet

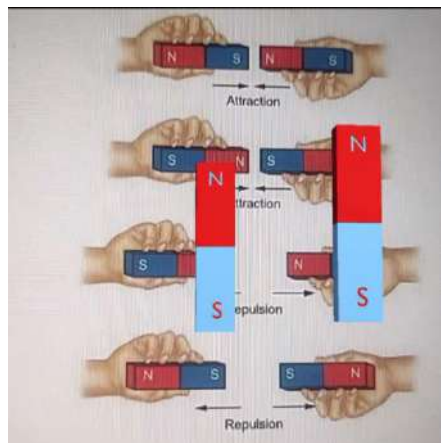


Fig. 7. Image tracking for explaining magnetic attraction and repulsion

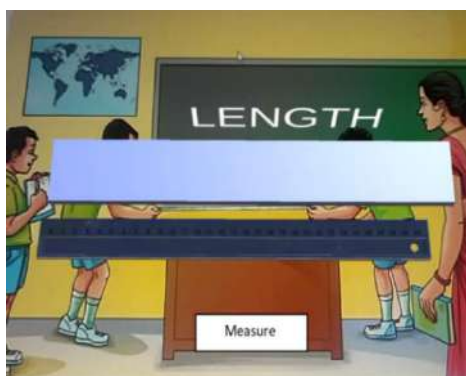


Fig.8 Image tracking for explaining length measurement

CONCLUSIONS

This paper presents implementation of AR in the book for school students. AR based application is new to the student's introduction of AR in learning will create fun and excitement to the students. Further, students will be motivated and it will improve the visualization of the concept. In future, every student and teacher will be using AR as an effective method for teaching and learning. AR does not require any additional gadgets and high-end devices like virtual reality. The AR based application can be implemented in mobile phones and made available to the schools and educational institutions. This work can be extended further by studying the usability and educational value of the application at school levels.

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Geometry Optimization of Walk-in Type Solartunnel Drier Using CFD

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ABSTRACT

Natural solar drying of clothes has been in practice from long time and the demerit of such process is that it is non-uniform and inefficient in nature leading to quality defects and as such process is energy inefficient as well. Solar dryer using artificial means is more energy efficient process in which drying becomes highly controlled leading to easy drying of the product. Thus a solar tunnel drier is designed and developed to increase the efficiency of the drying. The dry air temperature, air flow rate, relative humidity inside the tunnel dryer is optimized by adjusting air velocity using divergent nozzle connected to the nozzle. The air flow is analysed using ANSYS Fluent. Being a green technology, this attempt helps to save the costly petroleum fuel namely diesel use in the boilers as at present and also reduce the carbon emission considerably.

Keywords: Mathematical model; CFD analysis; laundry clothes.

INTRODUCTION

The solar energy is a clean renewable energy resource and it's available at the rate of 350 -1000 W/m² in India. It is one of the most promising renewable energy sources in the world. Hence, solar energy is used for drying purpose instead of non-renewable resources. Drying is a simple process of excess water removal from the product or material in order to maintain standard/desired moisture content. The moisture content can be removed in two ways – vaporization and evaporation. The evaporation process is the most efficient way to remove moisture content from the substance[1-4]. In this study, the drying of clothes is focused. This process requires complete removal of moisture content from clothes. Since evaporation process is used, the main factors affecting the process are the fluid free stream velocity as well as the temperature and relative humidity. The free stream velocity is obtained from the experimental data and is averaged to the region. The free stream velocity is between 1.5 to 5 m/s in India during winter seasons and 5 – 10 m/s during summer seasons. The solar tunnel drier should be designed for winter season (worst case scenario). This will also help in better performance during summer seasons. The artificial drier is mostly based on non-renewable energy because of its reliability during the winter as well rainy seasons. But the cost of energy consumption is high than using the renewable resources though development and investment are less. The fluid flow through the solar tunnel has to be analysed for effective energy usage [5-9]. This helps in making the solar tunnel drier feasible and cost effective in the long run.

METHODOLOGY

The methodology for the study is discussed. The input data for the analysis is obtained from the experimental analysis. The data obtained is given as the input for the analysis.

A. Experimental Details

The experiment data is measured using anemometer with an in-built thermometer.

The velocity data for the input condition of the solar tunnel is gathered using anemometer. The temperature is also measured. The flow data is averaged to 5 m/s and given as input to the numerical simulation.

B. Numerical Details

The governing equations for the analysis are mentioned below,

Continuity Equation

$$\frac{\partial \rho}{\partial t} + \frac{\partial(\rho u_i)}{\partial x_i} = 0, \quad (1)$$

Momentum Equation

$$\frac{\partial(\rho u_i)}{\partial t} + \frac{\partial(\rho u_i u_j)}{\partial x_j} = \frac{\partial(\sigma_{ji})}{\partial x_j} + \rho g_i, \quad (2)$$

The governing equations are solved using Ansys Fluent software.

Geometry of Solar Tunnel: The geometry of the solar tunnel is analysed and iterated to optimize the shape of the solar tunnel. The divergent angle and the throat section thickness is taken as variables for optimizing the shape and get better performance of the fluid flow. The geometry of the solar tunnel is shown in Fig. 1.

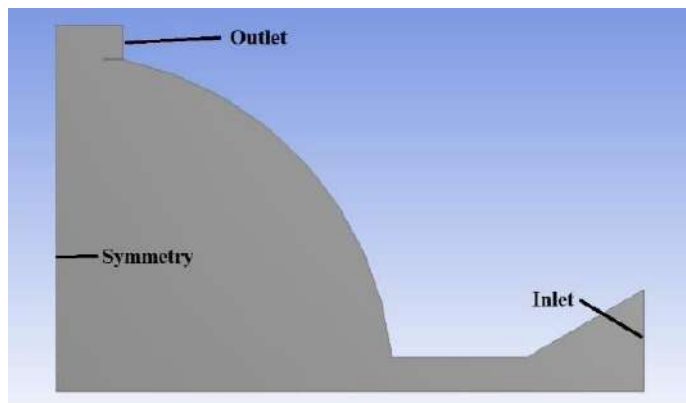


Figure 1: Geometry of Solar Tunnel

Meshing of Solar Tunnel: The geometry is meshed using CFD mesh solver with uniform size function with triangular elements. The walls of the tunnel are meshed using structured mesh. The meshed geometry is shown in Fig. 2. The structured mesh at the walls of the solar tunnel is obtained by using the inflation command.

Min Size: 4 mm
Max Size: 20 mm
Nodes: 15658
Elements: 23302
Aspect Ratio: 5.36

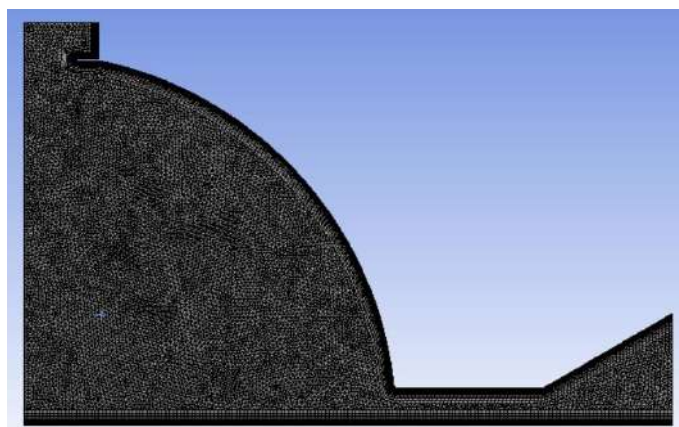


Figure 2: Meshed Geometry of Solar Tunnel

Parameters considered for optimization of Solar Tunnel: The velocity of the free stream flow fluctuates; hence the fluid flow velocity is taken as output variable for optimization. The throat height is considered for the optimization of the tunnel. The throat height is varied from 160 – 240 mm. The divergent angle is also considered for optimization. The divergent angle is varied from 20 – 50 degree. Thus optimal performance range is found out for each parameter and analysed further. This helps in increasing the resolution of the result.

Analysis settings for Solar Tunnel: The analysis settings in Fluent for the solar tunnel are mentioned below

Sl. No	Description	Model
1.	Viscous Model	Detached Eddy Simulation (withSST)
2.	Inlet Condition	Velocity inlet (1.5 – 5.5 m/s)
3.	Outlet Condition	Outflow condition
4.	Pressure Velocity Coupling	SIMPLE Scheme
5.	Solver	Pressure Based, Transient analysis

RESULTS AND DISCUSSION

First, the angle of the divergent nozzle is varied from 20 – 50 degree. The angle is stepped in 10°. Then the velocity is plotted against the angle. The graph of maximum velocity for different angle is shown in Fig. 3. The data points where velocity is calculated, is shown in Fig. 4. The white dots in the geometry indicate the data points.

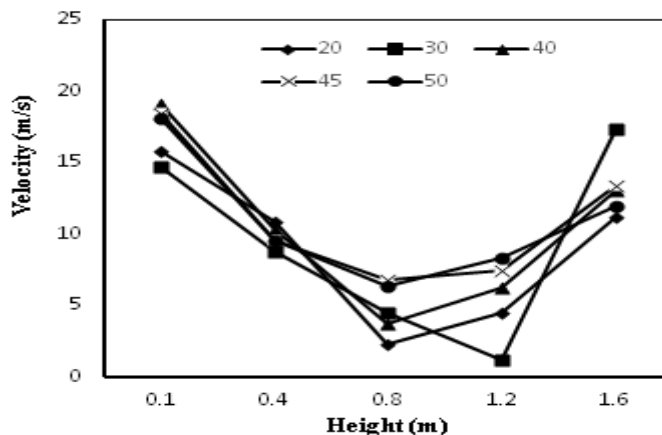


Figure 3: Velocity data for different divergent angle

From the Fig. 3, it can be seen that the velocity profile of the solar tunnel is efficient at angle 40 – 50°. Hence divergence angle at 45° is also analysed to see the performance. From the Fig. 3, it can be seen that the velocity profile creates extreme vortices and abnormal velocity distribution and hence cannot be used. While increase in divergent angle from 50 degree showed decrease in the velocity profile of solar tunnel. This is due to the pressure drop at the inlet condition.

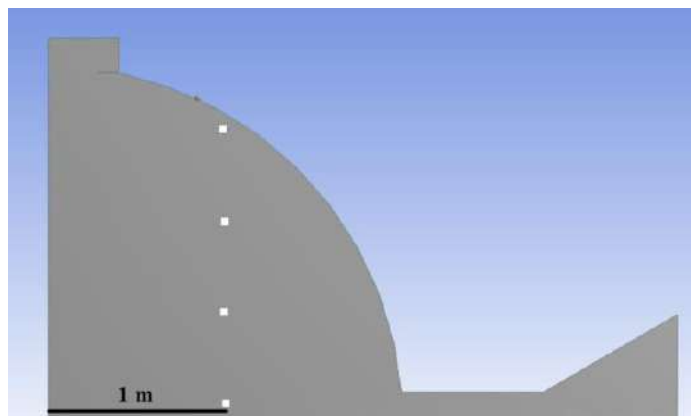


Figure 4: Data Points for gathering velocity profile details

The velocity profile of the solar tunnel for the divergent angle of 45° shows the optimum performance. The velocity profile is shown in Fig. 5.

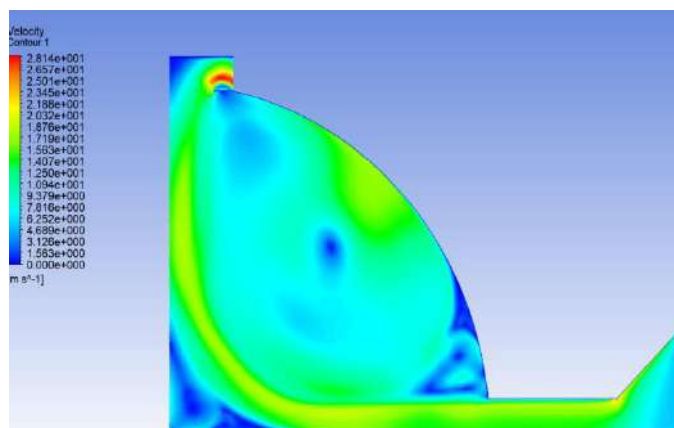


Figure 5: The Velocity profile of Solar Tunnel at divergent angle = 45°

Next the throat opening height is optimized by varying from 160 – 240 mm, the length is stepped by 20 mm. Then the velocity is plotted against the throat height. The graph of velocity for different throat height is shown in Fig. 6. The data point where velocity is calculated is same as before.

From the Fig. 6, it can be seen that the velocity profile of the solar tunnel is efficient at throat height of 200 – 220°. Hence throat height of 210 mm is analysed but showed less efficient. The velocity profile of the solar tunnel for the throat height of 200 mm shows the optimum performance with stable velocity profile than the other values in the parameters. The velocity profile of the solar tunnel at throat height of 200 mm is shown in Fig. 7.

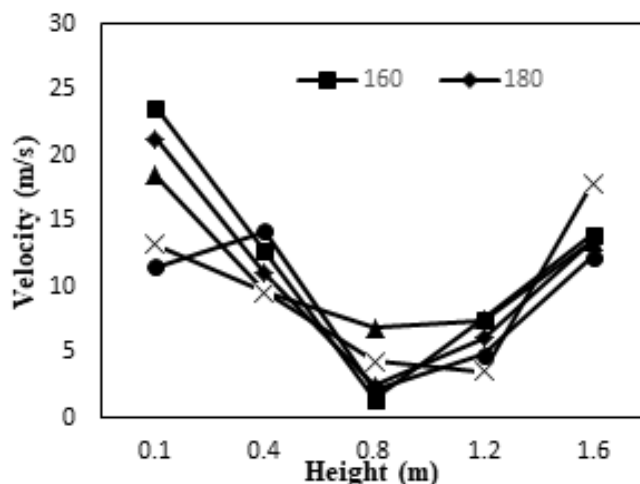


Figure 6: Velocity data for different throat height

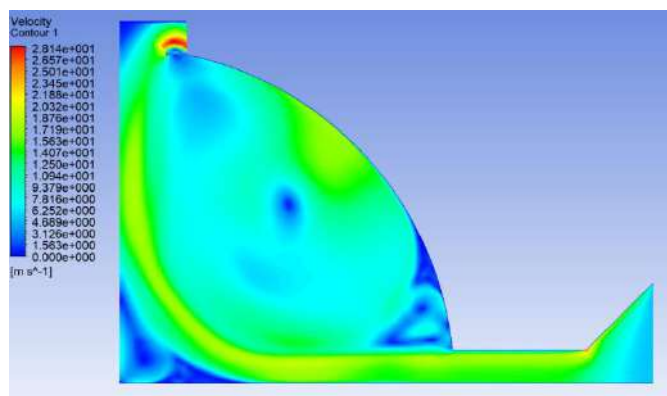


Figure 7: The Velocity profile of Solar Tunnel at throat height = 200 mm

Next the throat opening height and divergence angle is kept constant, and the velocity profile is varied from 1.5 – 5.5 m/s. The velocity profile for the solar tunnel at 1.5, 3.5, 5.5 m/s is shown in Fig. 8.a-c

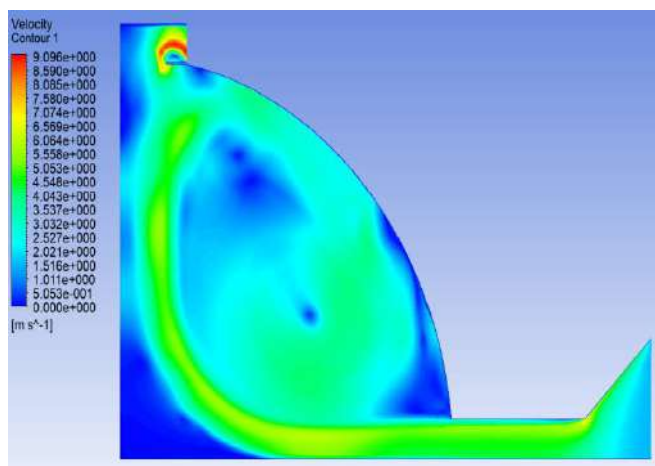


Figure 8.a: The Velocity profile of Solar Tunnel at velocity inlet 1.5 m/s

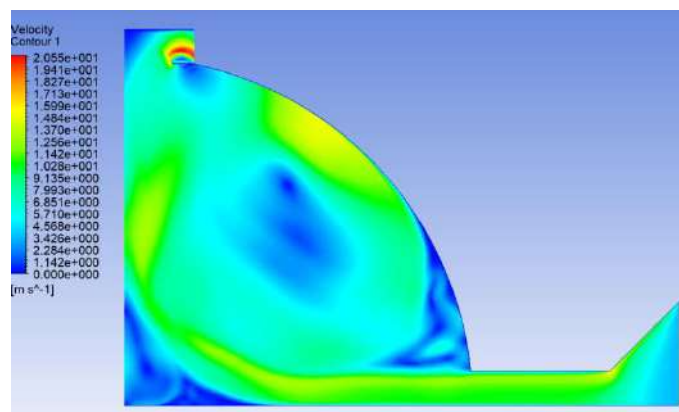


Figure 8.b: The Velocity profile of Solar Tunnel at velocity inlet 3.5 m/s

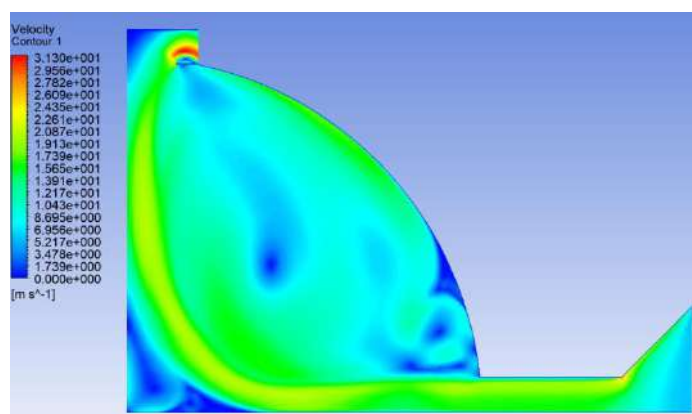


Figure 8.c: The Velocity profile of Solar Tunnel at velocity inlet 5.5 m/s.

CONCLUSIONS

The 2D geometry of the solar tunnel is used to analyse using the numerical simulation. This helps in reducing the solver processing time and easy to optimize the geometry shape. The divergent angle and throat height, are the two parameters considered for optimizing the tunnel. The divergent angle at an angle of 45° is found to be efficient thus the velocity profile of the solar tunnel is optimized. Thus, the increase or decrease in the angle will only reduce the performance. Then throat height in the tunnel is to be optimized, and the design is finalised. The throat height at 200 mm is found to be efficient. The solar tunnel geometry is optimised and the velocity profile of the solar tunnel for various velocity magnitudes is found.

The magnitude of velocity at inlet of solar tunnel is varied from 1.5 – 5.5 m/s. The velocity profile in the tunnel showed vortex formation which helps in drying of clothes. Thus the vortex formation can be further studied to allow the dryness to be uniform in the material (clothes in this study).

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Computational Investigations on HVAC DUCT System: A Case Study

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ABSTRACT

Globalization has increased the purchasing power of the consumer. Humans have started to strive for solace in all means - thermal comfort being one. Besides, highly conditioned environment is to be met at Hospitals. The aim of this paper is to give an understanding about the standard practices for designing an HVAC system and using CFD as a tool to improve the efficiency of the system by reducing energy intake and thereby energy cost. The duct elbow is parameterized to avoid the formation of turbulence and hence the pressure loss. Comparison of the numerical solutions shows a reduction of 20% in pressure loss by replacing a 6 inch elbow by an 8 inch elbow with baffle. The scope of this research lies in optimization of duct line throughout its length for improving the energy efficiency of existing systems.

Keywords: HVAC, CFD, Pressure Loss, Baffles, Optimization

I. INTRODUCTION

A HVAC system includes daily utilities like air conditioner at homes to the large systems used in industrial complexes, hospitals and apartment blocks. A good HVAC system aims to provide thermal control and indoor comfort. It must be properly designed using the conservation laws and fluid physics. In most of the existing HVAC systems design errors leads to improper flow rates at outlets. Sharma et al. [1] discusses problems such as frictional loss, uneven cooling in the building, increased installation cost, increased noise level and power consumption due to improper ducting [2]. Tengfang T. Xu et al. [3] did a field study on the performance of five thermal distributed systems in four large commercial buildings and provides solutions for duct sealing and insulation. The heart of the problem lies in variable pressure drops that happen in fittings and joints along ducts because of the space constraints in the building interiors. studied the energy loss related to the air leakage by using power law model with the duct diameter parameterized and reduced 50% loss in pressure [4-8].

CFD is a useful tool in fast optimization and virtual experimentation for analysing these flows. ANSYS 15.0 Version is used for the study and Fluent solver for performing the numerical analysis. The need for a complete HVAC design and energy conservation recommendations for a client is dealt with this case. The outcome of the research is to design retro-fit elbows for existing duct lines.

II. FIELD STUDY

The design of an HVAC system begins with reading of the CAD and P&I Diagrams of the site and the structures.

Description of the Building:

The hospital consists of four floors and each floor consists of patient rooms, a reception, an operation theatre, culture room, and pharmacy and walk area. The theatre and the culture room have to be maintained highly clean for medical practices. Heat load calculations were performed for each floor separately (area-wise) with consideration to standards of ASHRAE. The total tonnage of refrigeration was estimated to be 42 TR. The design of ducting and routing is performed via sketching using Auto-CAD 2014 after consultation with the client.

III. Parametric Analysis on duct fillet and baffle placement using CFD

Geometry: The study is performed for a 2D surface sketch (flow domain) as per the dimensions. 2D analysis is justified because of the symmetry of flow through the duct. The elbows in the duct line along the entire run are parameterized as an input variable (fillet radius). **Meshing:** Global Settings: Fluent (CFD Compatible) an unstructured mesh is generated. The mesh element size was subjected to the grid - independence test and the convergence holds for an element size of 1 inch. The number of elements were set to 8, 81,250.



Fig.1: CAD diagram of the facility

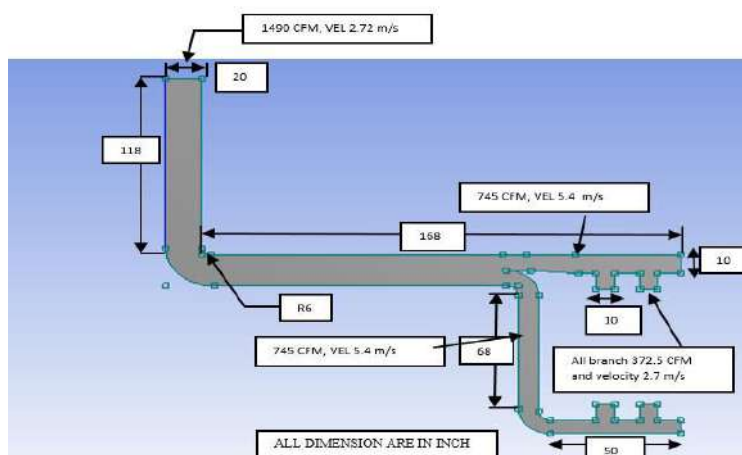


Fig.2: Geometry - Designed using ANSYS 2015.0 Design Modeller with appropriate flow rates and sizing

Solver Physics: The model is set to Pressure based solver being an in-compressible flow with density changes less than 5% (or) $Ma < 0.3$. The velocity formulation is set to absolute because the flow domain is non-rotating and numerical diffusion is reduced. A steady state simulation is used because the loss in pressure is calculated after flow becomes resolute. The turbulence around the duct fillet can be captured by $k - \epsilon$ model effectively because of its robust nature. Realizable model is preferred for boundary layers under strong adverse pressure gradients, separation and re circulation. It solves five equations simultaneously defined by the following (1) to (5) to a convergence of 0.001:

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \cdot u) = 0 \quad (1)$$

$$\frac{\partial(\rho u)}{\partial t} + \frac{\partial(\rho u^2)}{\partial x} + \frac{\partial(\rho uv)}{\partial y} + \frac{\partial(\rho uw)}{\partial z} = -\frac{\partial P}{\partial x} + \frac{1}{Re} \left[\frac{\partial \tau_{xx}}{\partial x} + \frac{\partial \tau_{xy}}{\partial y} + \frac{\partial \tau_{xz}}{\partial z} \right] \quad (2)$$

$$\frac{\partial(\rho v)}{\partial t} + \frac{\partial(\rho uv)}{\partial x} + \frac{\partial(\rho v^2)}{\partial y} + \frac{\partial(\rho vw)}{\partial z} = -\frac{\partial P}{\partial y} + \frac{1}{Re} \left[\frac{\partial \tau_{xy}}{\partial x} + \frac{\partial \tau_{yy}}{\partial y} + \frac{\partial \tau_{yz}}{\partial z} \right] \quad (3)$$

$$\frac{\partial(\rho k)}{\partial t} + \frac{\partial(\rho k u_i)}{\partial x_i} = \frac{\partial}{\partial x_j} \left[\frac{\mu_t}{\sigma_k} \cdot \frac{\partial k}{\partial x_j} \right] + 2\mu_t E_{ij} E_{ij} - \rho \epsilon \quad (4)$$

$$\frac{\partial(\rho \epsilon)}{\partial t} + \frac{\partial(\rho \epsilon u_i)}{\partial x_i} = \frac{\partial}{\partial x_j} \left[\frac{\mu_t}{\sigma_k} \cdot \frac{\partial \epsilon}{\partial x_j} \right] + C_{1\epsilon} \frac{\epsilon}{k} 2\mu_t E_{ij} E_{ij} - C_{2\epsilon} \frac{\rho \epsilon^2}{k} \quad (5)$$

The velocity inlet for duct are given as a parametric input ranging from 7.5 m/s to 9.5 m/s with step of 1 m/s. The significance lies in the obtaining required flow speed at the outlet as per the room needs (cfm). The outlet is specified as pressure outlet with operating conditions of 101325 Pa. Semi - Implicit method for Pressure Linked

Equations are used in solving the pressure - velocity dependence equations. Simulation is run in first order upwind for first level convergence and is updated with second convergence for accurate results. The model is initialized at inlet and is solved for convergence to 3000 iterations.

IV. RESULTS AND DISCUSSIONS

Figure 3. Shows the base model (6 inch radius elbow) using the velocity 8.5 m/s. Eddy formation leads to a pressure loss of 13 Pa. This affects flow rates and energy cost seriously. So, it's important to work on design modifications for improved system. In Figure 4, a) the vortex created is reduced and pressure loss equivalent to 10.81 Pa in elbow is observed. In Figure 4.(b), The pressure loss increases by 0.27 Pa/ turn, but the turbulence in the flow is reduced in the presence of the baffle.

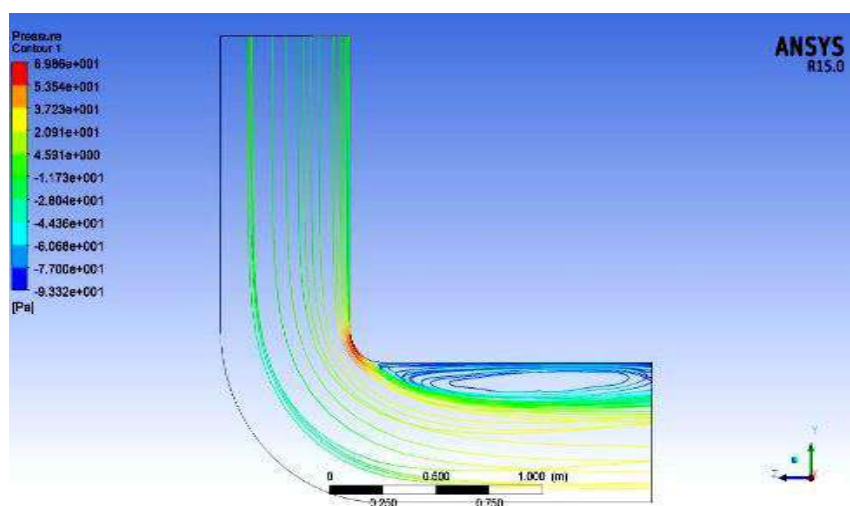


Fig.3: Flow Patterns observed for 6” radius elbow with velocity 8.5 m/s

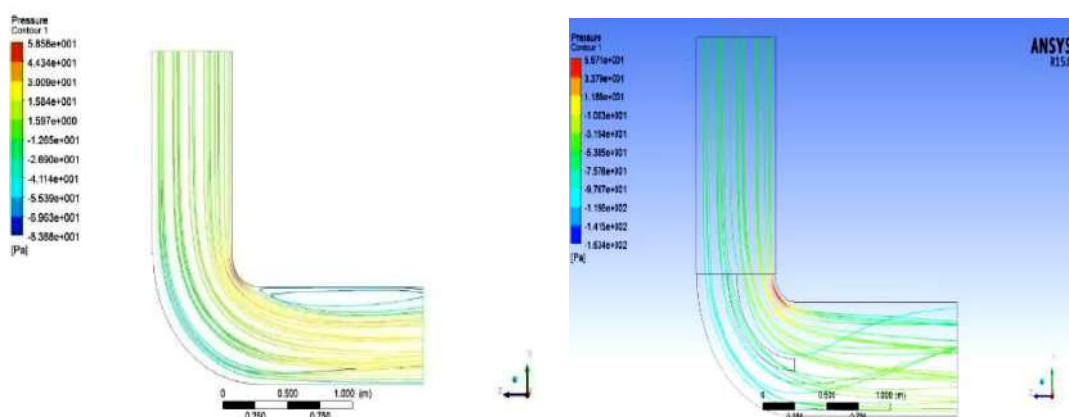


Fig.4: Flow Patterns observed for 8” radius elbow with velocity 8.5 m/s

[a) Without baffle; b) With baffle]

The vorticity transport equation is given for this in-compressible flow regime by:

$$\frac{D\omega}{Dt} = (\omega \cdot \nabla)u + \nu \nabla^2 \omega \tag{6}$$

By using an 8” single baffle setup with flow speed of 8.5 m/s, the pressure loss is reduced by 36% throughout the duct length from primary value. The presence of baffle aids in reducing fluid layer mis-run.

V. CONCLUSIONS

CFD as a design optimization tool aids in fast virtual experimentation. Duct fittings (elbows) are essentially modeled using ANSYS 15.0 DM and the results of the analysis are in good fit with the approach. Future works deals with real time experimentation and retrofitting of ducts in the client facility.

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Design Proposal of Automatic Waste Segregator Foran Organization

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ABSTRACT

India faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal. Current systems in India cannot cope with the volumes of waste generated by an increasing urban population, which impacts on the environment and public health. Waste segregation at source and use of specialized waste processing facilities to separate recyclable materials has a key role in managing our wastes. In this work, a miniature version of urban waste segregation unit for an organization waste was designed. This designed segregator is of size (4 x 4 x 3m), which incorporates parallel plate capacitor and near infrared sensor for sorting green waste and plastic waste respectively. A cost volume analysis was mainly done to optimize the operating time and cost of the segregator by incorporating capital expenditure with depreciated asset value and operating expenditure and amount of waste generated per day in an organization (PSG college of Technology). The main goal is not to dump a gram of waste to the garbage dumping sites. Also segregated wastes of green waste can be used as raw material for Bio-Methanation unit, papers and plastics for recycling and non-recyclable plastics can be heat treated to make it back to oil. Further reuse of wastes can also be used as fuel for power plants in generating of electric power.

Keywords: Waste segregation; Waste Management; Municipal solid wastes; Cost volume analysis; Recycling.

I. INTRODUCTION

With increasing urban population, India's Solid Waste Management (SWM) system cannot cope up with the volumes of waste generated every day. It faces major environmental challenges associated with waste generation and inadequate waste collection, transport, treatment and disposal [1]. Unprocessed disposal of wastes in a landfill causes serious health impacts for people, animals and environment around it.

Waste segregation at source and use of specialized waste processing facilities to separate recyclable materials has a key role. Disposal of residual waste after extraction of material resources needs engineered landfill sites and/or investment in waste-to-energy facilities. The potential for energy generation from landfill via methane extraction or thermal treatment is a major achievement and resource.

The Ministry of Environment, Forest and Climate change (MoEF) issued Municipal Solid Waste (MSW) management and handling rules (2000) to ensure proper waste management [2] from Urban Local Bodies (ULBs). That the municipal authorities are responsible for collection, storage, segregation, transportation, processing and disposal of MSW. Current scenario with respect to waste management in most Indian cities are only collection, transportation and disposal of MSW on a landfill.

II. PROBLEM FORMULATION

A. Problem Identification

Currently urban mining and e-mining are vogue in developed countries. But in India, huge amount of waste material resources are left decaying without being reused or recycled on waste landfill sites. Moreover the resourceful waste gets mixed with other wastes, converting it not suitable for reuse or recycle. This is because of the lack of knowledge in sorting at the waste generated source itself. Due to the human's habit of littering, all types of wastes gets accumulated in one place which are burnt or left forever at the dumping sites to further pollute the environment.

Moreover plastics get mixed with green wastes and releases harmful toxic gases when exposed to sun light. After a long period of time, green wastes generates methane gas under anaerobic conditions, which is highly inflammable and also a major contributor to global warming [3]. At times, due to this the landfill sites catch fire. In such scenario, different types of wastes get burnt and releases tiny toxic particles into the air which creates respiratory problems and also heavy smog which reduces vision of sight.

It is estimated that approximately 200km² was occupied by wastes in India at 1997 [4], and it is expected to increase to 800km² by 2020 and to 1400km² by 2050. Hence a large area of resourceful land is also wasted for

dumping waste. Due to dumping on a resourceful land, its ground water, surface water, soil fertility and air quality also gets affected.

So it is necessary to process the waste from source by segregation and converting it as a raw material (resource) for various sectors.

Initially to make this work on a small scale, a design proposal for an urban waste segregation machine for an organization is to be done. And the organization Considered for this design proposal is PSG college of Technology, Coimbatore. On an average PSG College of Technology generates 11,400 litres of waste per day. So a machine segregating this much volume of waste for certain hours per day is to be designed.

III. LITERATURE REVIEW

Kumar et al [1], the article delivers the details waste management scenario in India and effects and health impacts from contamination wastes at land sites. Also it describes about various waste to energy methods.

From Ministry of Environment, Forest and Climate change [2], the procedure for collecting and processing municipal solid wastes from urban local bodies were described by the government of India.

From Sridevi et al [3], this paper about a review of integrated solid waste management and it has more details about generation methane gas from waste landfill sites which causes fire and explosion.

From Singhal S and Pandey S [4] their paper on status and direction of solid waste management in India is about amount of land area required for dumping waste and their research on future land area requirement.

The elaborate knowledge about capacitive sensor was given by Vishal V and Sayantan Gangopadhyay [5], on their paper "Capacitive sensors: The future of Waste Segregation". They have illustrated the dimensions of parallel plate capacitors and their distance between them.

Ernie Beker [6], on his paper about NIR Technology used for automatic sorting of recyclable plastics of various types. Here he clearly discusses working of NIR sensors.

From Income tax department of India [7], depreciation rates for the components of segregator machinery were acquired for the fiscal year 2018-2019.

From Tamil Nadu Electricity Regulatory Commission [8], electricity usage tariff was acquired for using it in calculation electricity charges under operating cost.

IV. DESIGN

The Automatic waste segregator was designed to process a waste capacity of 180 litres per minute. The whole machinery consists of a bag opener, trommel, collection trays, conveyors, magnetic separators, eddy current separators, parallel plate capacitors, near infrared sensors, proximity sensors, pneumatic push rods, pneumatic caster wheels and enclosures. This automatic waste segregator is of size 4 x 4 x 3m as shown in the fig.1.

A. BAG OPENER

Normally wastes are collected in the garbage cover and dumped in to the large bins. So it is necessary to have a bag opener as shown in fig. 2(a). It consists of two shafts with cutters as shown in fig. 2(b) that rotates in opposite direction which is driven by a motor. The cutter shears the plastic bag and simultaneously crushes bigger waste particles to small.

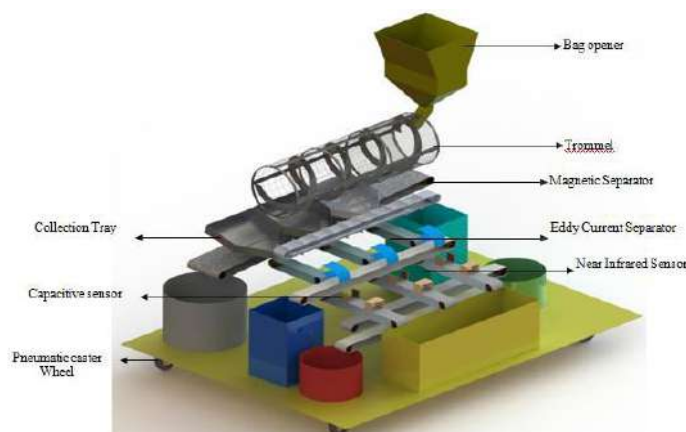


Fig. 1. Components of automatic waste segregator.

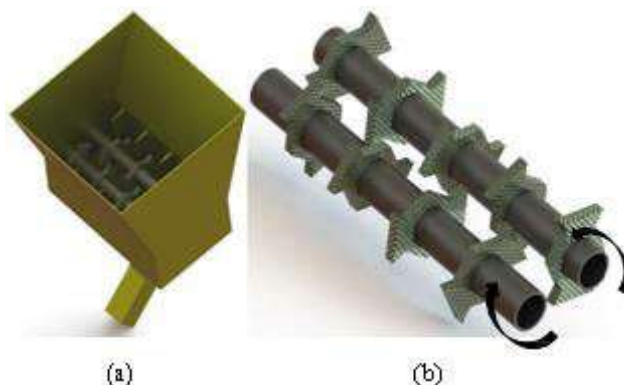


Fig. 2. (a) Bag opener (b) shafts with cutter.

B. TROMMEL

The crushed wastes from the bag opener falls into the trommel as shown in fig. 3, which is rotating size screening device. It screens the crushed wastes with the help of wire mesh of size 2 x 2 cm, 5 x 5 cm and 8 x 8 cm into three categories. A vane was provided inside the trommel to propagate the waste forward whilst the trommel rotates in anti-clockwise direction.

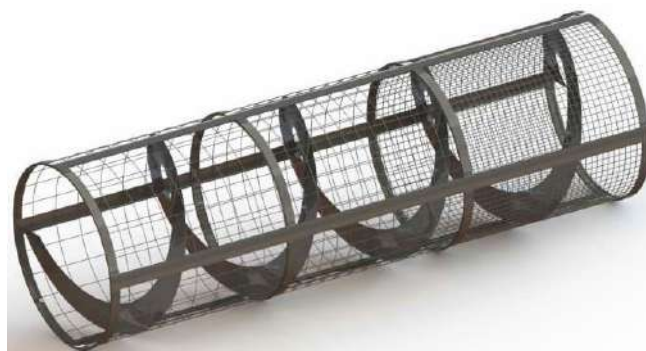


Fig.3. Trommel

C. Collection trays

Collection trays with perforated holes as shown in fig. 4, placed under the trommel. It receives the screened wastes and sends the wastes to the conveyor in small stream for easy detection of type of waste under the sensors. The perforated hole on the surface of the collection tray is to drain the liquids from the wastes.

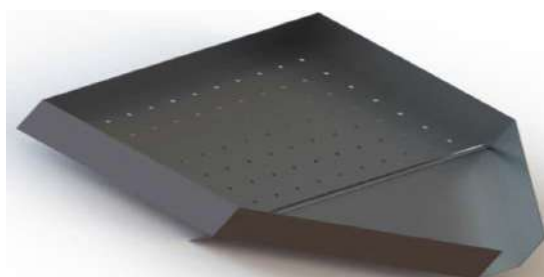


Fig. 4. Collection tray.

D. Magnetic Separator

Initially the streamed waste from collection tray is checked for metals and the metal are removed by using magnetic separator as shown in the fig. 5. Here only ferrous metals are segregated. As it possess magnetic properties.



Fig. 5. Magnetic separator.

E. Eddy Current Separator

After removal ferrous metals from the wastes, then the waste is moved to eddy current separator at the end of the conveyor as shown in fig. 6. Here the magnetic drum placed inside the conveyor drum, which induces eddy current on the moving non-ferrous metal such as aluminium, tin cans, etc. Thus creating a repulsive magnetic force on the non-ferrous metals. Hence it throws away non-ferrous metal as shown in fig. 7, to next conveyor located perpendicular to it.

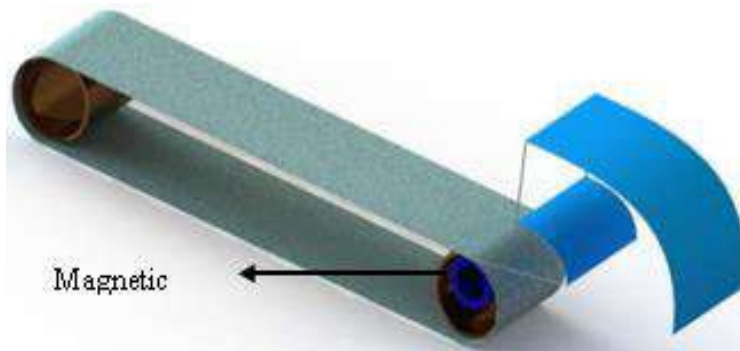


Fig.6 Eddy current separator

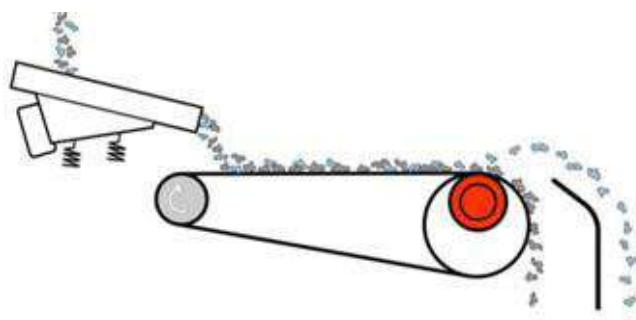


Fig. 7. Illustration of Eddy Current Separation of non-ferrous metals.

F. Parallel Plate Capacitors – Capacitive Sensor

Capacitive sensors are employed here as shown in fig. 9 to detect wet waste (green / biodegradable waste) from dry waste (plastics, paper, etc.). Capacitive sensor [5] is a technology based on capacitive coupling that accounts the capacitance produced by the material introduced within its field region as input as shown in fig. 8.

A basic capacitive sensor is any metal or conductor and that detects any material that is conductive or has a dielectric constant different from air. The channel count is different for different materials.

The high densities of electric fields between the two plates allow high sensitivity. To analyze materials, the capacitance between the plate's changes accordingly based on the difference of dielectric constant from material to material and provides a unique count value as output.

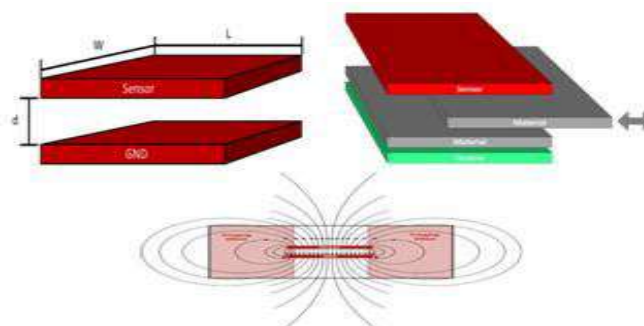


Fig. 8. Parallel plate capacitors [5].

G. Near Infra-Red (NIR) Sensor

Here a Near Infra-Red camera type sensor as shown in fig.9 is used to detect the plastic wastes. The basic principle behind NIR technology [6] is measuring the reflectivity of an object within a wavelength range of 1.100 to 2.100 nm. In this wavelength range, materials such as plastics, paper, and textiles have their own specific characteristics.

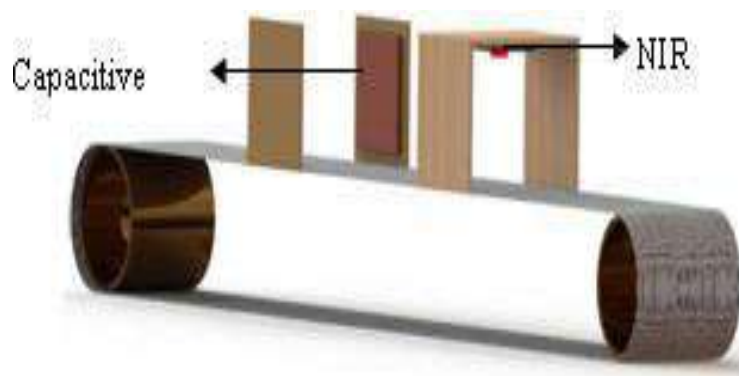


Fig. 9. Capacitive sensor and NIR sensor on the conveyor

This range of wavelengths is not visible to the human eye. This is also the reason that optical sorting system is used with the help of NIR camera.

V. Flow of Waste

This flow chart describes how the waste from garbage bag gets opened, crushed, screened and finally segregated with the help of sensors is shown in fig. 10.

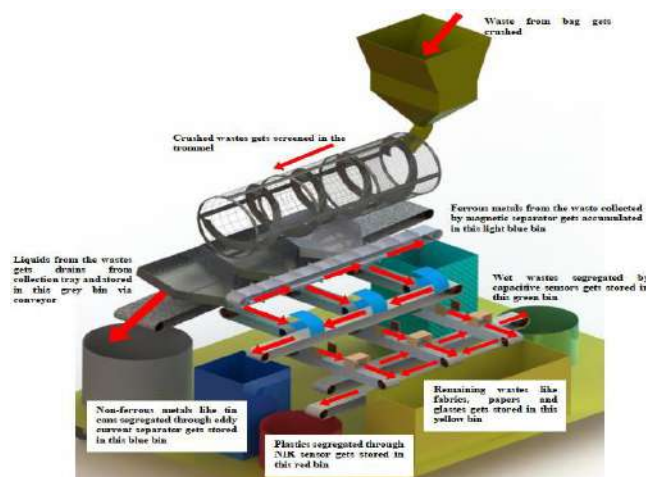


Fig. 10. Flow of wastes in the segregator.

Vi. Cost Volume Analysis

A. Volume of Waste

The organization considered in this work was PSG College of Technology, Coimbatore. The institution has 80m³ (approx.) size of dump yard nearby hostel premises as shown in fig. 11.

On a weekly basis, the waste dumped in this dump yard is collected by Coimbatore corporation waste management, and this collected waste is dumped nearby waste landfill site at vellalore, Coimbatore Dt. On an average, per day the daily waste generated by PSG College is 11.4m³ i.e., 11,400 liters.



Fig. 11. Site view of PSG College dump yard.

B. Capital Expense (Capex)

The cost required to set up this segregator machinery was Rs.6,03,900/-. Costs of each component were obtained as reference from E-Commerce site www.indiamart.com.

C. DEPRECIATION

Depreciation allows only a portion of capital cost of the asset for making a balance sheet of an organization. This depreciation method depicts the cost of an asset in an operating year rather than its full life time. In other words, the capital asset depreciates every year.

In this work straight line method was used, as it allocates even rate of depreciation amount in its useful life of the asset.

$$\text{Annual depreciation expense} = \frac{(\text{Asset cost} - \text{Residual value})}{\text{Useful life of the asset}}$$

Residual value and useful life of the asset were given in "Depreciation rates as per income tax department of India for the fiscal year 2018-2019" [7], which is of 15% of asset cost and 15 years respectively. Though 15 years of life were set by income tax department of India, on accounting evolution of technology and machinery is susceptible to unfavourable climatic conditions, so its useful life is taken as 5 years. For parallel plate capacitors and proximity sensors, it was assumed that it depreciates 100% annually because of wet wastes may deteriorates its life.

Annual depreciation expense of all the components is Rs.1,09,718/-.

D. Operating Expense (Opex)

Operating expenditure of this machinery includes electricity charges, labour wages and maintenance cost.

- a) Electricity charges: Tamil Nadu Electricity Regulatory Commission (TNERC) by latest regulations dated 11/08/2017 [8], for Govt. aided educational institutions the electricity usage tariff is Rs.6.35/unit. Power consumption by the motors (rotating drives) present in the machine components is 25.2kW.

Assumption: Designed trommel processes 180 litres of waste per minute. For the scenario of wastes dumped from the hostels and institute of management blocks is 11,400 litres. So approximately it takes 3 hours to segregate the waste.

So by considering above assumption, operation hour of the waste segregator machine is 3 hours / day. Electricity cost per day is Rs.480.06. And per year Excluding Sundays i.e., for 312 days is Rs.1,49,800/- (approx.)

- b) Labour wages: (Assumption) Three labours are required, one for dumping the wastes on to the hopper and others for assisting the earlier and collecting the segregated waste and packing it for transport. For three hour work, their work charges can be Rs.150 each. (excluding Sundays). Total Monthly Charges: Rs.11,700/- so yearly its Rs.1,40,400/-
- c) Maintenance cost: (Assumption) 10% of the capital cost was considered as yearly maintenance cost of the whole machinery. Annual Maintenance cost: Rs.60,000(approx..)

E. Cost per Unit

CAPEX is considered as fixed cost, since it has to last at least one year; hence depreciation expense per year is to be considered. OPEX is considered as Variable cost and its projected to one year. So OPEX cost is Rs.3,50,200/- for processing 41,61,000 liters of waste.

Total cost per year = Annual depreciation expense of all

Components + OPEX

$$= 1,09,718 + 3,50,200 = 4,59,918/-$$

$$\text{Total cost/litre} = \frac{(\text{Total Cost per year})}{\text{Total amount of waste processed in a year}}$$

$$= 0.1105$$

Cost per litre of segregating waste is Rs. 0.11 Paise.

Cost of segregating per day waste is Rs. 1,260(Approx.)

VII. CONCLUSION

From problem definition, it states that the whole lot of wastes of different type in India gets mixed and dumped in resourceful land. Hence resourceful energy from waste is getting deteriorated simply of no use rather than creating harmful impact on health of environment and humans. To address this issue people should possess knowledge about waste and to have a habit of sorting the waste while dumping in the trash bins.

The afore mentioned habit lacks in India, so as a miniature version of processing municipal solid wastes from urban local bodies, an automatic waste segregator was designed for an organisation (PSG College of Technology), which is an initial step of waste management i.e., segregating the waste of different types before contaminating each other wholly.

In this work, a whole machinery of segregation was designed by incorporation various components like bag opener, screening trommel, metal separators, wet waste separation using capacitive sensors and plastic, paper separation using Near Infrared (NIR) camera.

Later these segregated wet wastes can be used as raw material for bio-Methanation plant in producing methane (natural) gas. Uncontaminated plastic wastes can be recycled or it can be converted back to oil by pyrolysis process. Obtained paper and glass can also be recycled.

Moreover contaminated wastes can be used as fuel for thermal power plants because these wastes have high calorific values and emits only one percent toxic gases. A fact is that replacing one tonne of fuel for 3 tonnes of waste is happening in Sweden power plants. If above process is achievable, need of land for dumping waste can be avoided and renewable energy production peaks.

Scope for Future Work

- Capacitive sensors and NIR sensors are older technology. Hence this work can be improved by discovering or innovating newer sorting technologies.
- Proof of concept prototype of above mentioned technologies can be made and tested.
- If the prototype is a success, then a fully developed segregator can be made to function.
- This work can be explored to other organization types and can be redesigned to its requirements.
- Operational flow of segregation of plastic, paper, glass from single sensor can be implemented.

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Influence of Central Composite and Box-Behnken Designs on Response Optimization in Plastic Injection Moulding

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ABSTRACT

In this work, response surface methodology (RSM) was used to develop statistical models of plastic injection moulding (PIM) process for a high-volume plastic component produced in an industry. In this process, temperature in the heating zone, nozzle temperature, injection speed, holding time, back pressure and cooling time were considered as the influential factors. Cycle time and power consumption were considered as the response variables. Experiments were designed using Central Composite (CCD) and Box Behnken designs (BBD) and cycle time and power consumption were considered as response variables. Statistical models relating the responses with the explanatory variables were developed and validated using multiple regression. The process parameter combination that minimizes cycle time and power consumption were determined using single and multi-objective optimization approaches. It was found that CCD when combined with Multi-Objective Optimization (MOO) using GA resulted in 47.7% reduction in cycle time and 43.3% saving in Power Consumption.

Keywords: Plastic injection moulding, Response surface methodology (RSM), CCD, BBD, Multi-objective Optimization (MOO).

1.0 INTRODUCTION

Plastic Injection Moulding process is generally used for manufacturing plastic components and is known for its high quality and repeatability. Intricate designs and contours can be manufactured in short span of time. Cycle time is an important factor influencing its productivity. Power consumption is also considered important as the process is power-intensive and industries strive for power savings on a continual basis. The parameters influencing cycle time and power consumption are the temperature maintained in the heating chamber, injection speed, holding time, back pressure and cooling time. Injection speed is normally maintained on higher side of range for thick walled components and on lower side for thin walled components. Holding time is the duration for which the injected liquid plastic is kept in the mould cavity for proper solidification. This parameter decides the dimensional accuracy of the component being manufactured. Back pressure is the opposing pressure exerted by the material when it is injected into the mould. Cooling time is the time for which the mould has to be kept closed after injection, so that complete solidification of the component takes place after the cavity is filled. Cooling time depends on the thickness of the plastic component [1]. The process parameters are in general component-specific and are normally set based on its geometry, raw material and intricacy.

Statistical design of experiments refers to the process of planning the experiment, so that an appropriate set of data are collected and analysed using statistical methods. Statistical analysis of the experimental data is necessary to draw meaningful conclusions from the data. Response surface methodology is a powerful statistical tool to develop input–output relationships [2]. Response surface methodology is a collection of statistical and mathematical methods which are very much useful in modelling, analyzing and optimizing process parameters [1]. Minitab v17 software can be used for creating and analyzing response surface designs [7]. The Design of experiments (DoE) approach has been used in several industrial applications particularly in optimizing manufacturing processes parameters or designing mechanical components [3-6]. Evolutionary optimization techniques such as genetic algorithm (GA) and simulated annealing (SA) etc. can be used for optimizing the process parameters when dealing with highly nonlinear, multidimensional and ill-behaved complex optimization problems [8-9]. The performance of these techniques was compared for many different applications and conditions by several researchers [10-12].

2.0 PROBLEM DEFINITION

The component, shown in Figure 1, was suggested by the industry as a candidate for study and a need was expressed for optimizing its cycle time and power consumption. The machine used for manufacturing the component is shown in Figure 2. The concern expressed by the industry was that the item was consuming probably more time than it should have been because of the setting of process parameters on a trial and error basis resulting in an increased consumption of resources. The process parameter settings adopted currently by the industry is shown in Table 1.



Fig. 1 Plastic stopper



Fig. 2 ENGEL 35T machine

Temperature at HZ 1 (°C)	Nozzle temperature at HZ 4 (°C)	Injection speed (mm/sec.)	Holding time (secs.)	Back pressure (MPa)	Cooling time (secs.)
155	196	52	4	37	20

With the process parameters held at this setting, the total cycle time for a component was reported to be 38 seconds and the power consumption around 0.03 KWh per component. It is the objective of this work to evolve a suitable scientific methodology for minimizing the cycle time and power consumption during the manufacture of this component. In this work, an attempt was made to design experiments using two commonly used RSM designs, the central composite design (CCD) and the Box Behnken design (BBD), to conduct the experiments followed an analysis and comparison of the influence of these designs on their ability to minimize the cycle time and power consumption when coupled with a suitable optimization procedure. All the experimental work reported in this paper was carried out in a plastic injection moulding industry in Coimbatore, India.

3.0 METHODOLOGY

In this work, the following things have been attempted: (i) Experiments were conducted as per the designs stipulated by CCD and BBD and statistical models were developed for cycle time and power consumption in both the cases (ii) Multi-objective Optimization of the statistical models obtained through CCD and BBD routes was carried out using Genetic Algorithms (iii) Single objective optimization was carried out for cycle time and power consumption in both the cases using genetic algorithm and simulated annealing procedures. These optimization procedures were executed using optimization tool box of MATLAB [7] (iv) The optimum set of process parameters and the improvement in responses obtained through the routes (ii) and (iii) were compared. The methodology adopted in this work is shown in Figure 3.

3.1 Factors, Levels And Experimental Arrays

The variables influencing cycle time and power consumption and their operating ranges were identified in consultation with the industry and on the basis of a detailed survey of literature on plastic injection moulding [1, 14-23]. The various factors considered and their levels are shown in Table 2.

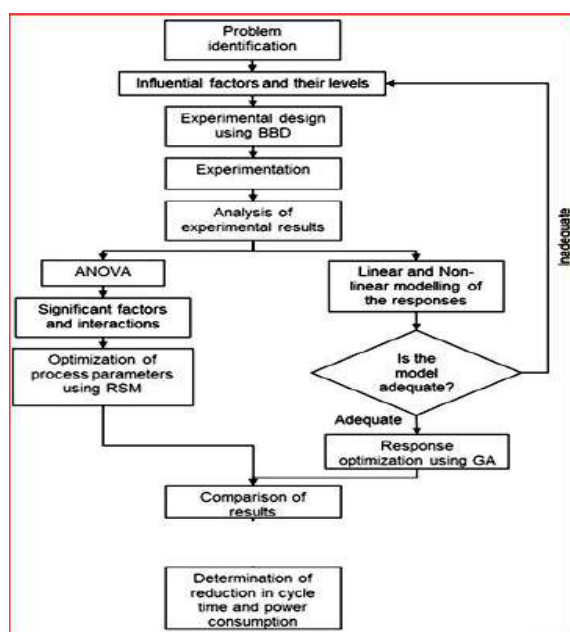


Figure 3 Methodology adopted

Table 2 Process parameters and their operating levels

S.No.	Parameter Description			Levels		
	Factors	unit	Notation	Low (-1)	Middle (0)	High (+1)
1	Temperature at HZ 1	°C	A	140	150	160
2	Nozzle temperature at HZ 4	°C	B	190	200	210
3	Injection speed	mm/sec.	C	50	70	90
4	Holding time	secs.	D	2	3	4
5	Back pressure	MPa	E	35	37.5	40
6	Cooling time	secs.	F	12	16	20

4.0 EXPERIMENTATION

4.1 Experimentation Using Ccd

Experimental array obtained using central composite design is shown in Table 3 and the responses (cycle time and power consumption) were recorded for every trial. The principle of blocking was utilized in this study due to practical difficulties in completing all the 86 trials with 3 repetitions per trial, at a stretch. Hence the experiments conducted in a day were accommodated in a block as indicated in the first column of Table 3. The CCD array consisted of five blocks. Each trial was repeated thrice to facilitate estimation of experimental error and the average of the response was used for analysis. The experimental results are presented in Appendix 2. The alpha value was selected so as to maintain a constant variance in prediction accuracy from the central design point.

Table 3 CCD Experimental Array

Block	Run	A:Temperature at HZ 1	B:Nozzle temperature at HZ 4	C:Injection speed	D:Holding time	E:Back pressure	F:Cooling time	Cycle time (in secs.)	Energy consumption (in KWh)
		(in °C)	(in °C)	(in mm/sec.)	(in secs.)	(in MPa)	(in secs.)		
B1	1	150	200	70	3	37.5	16		
B1	2	150	200	126.56	3	37.5	16		
B1	3	160	210	90	2	35	12		
B1	4	140	210	50	2	35	20		
B1	5	150	228.28	70	3	37.5	16		
B1	6	150	200	70	3	37.5	27.31		
B1	7	178.28	200	70	3	37.5	16		
B1	8	150	200	70	3	37.5	16		
B1	9	140	210	50	2	40	12		
B1	10	140	190	50	4	35	12		
B1	11	150	200	70	3	44.57	16		
B1	12	140	190	50	2	40	12		
B1	13	160	210	50	4	35	12		
B1	14	150	200	70	3	37.5	16		
B1	15	140	190	90	2	35	12		
B1	16	140	190	90	4	40	20		
B1	17	150	200	70	5.83	37.5	16		
B1	18	160	190	50	2	35	20		
B2	19	140	210	50	4	40	12		
B2	20	160	210	90	4	35	20		
B2	21	160	190	90	2	40	12		
B2	22	140	190	50	2	40	20		
B2	23	140	190	90	4	35	20		
B2	24	160	190	50	4	40	20		
B2	25	140	210	90	2	35	12		

B2	26	160	190	90	4	35	12		
B2	27	160	190	50	4	35	12		
B2	28	140	210	90	2	35	20		
B2	29	160	210	50	2	35	12		
B2	30	160	210	50	2	40	20		
B2	31	140	210	50	4	35	20		
B2	32	160	210	90	4	40	12		
B2	33	150	200	70	3	37.5	16		
B2	34	140	190	50	2	35	12		
B2	35	140	210	90	4	40	12		
B2	36	160	210	50	4	40	20		
B3	37	140	190	90	2	35	20		
B3	38	160	190	50	2	40	12		
B3	39	140	190	50	4	35	20		
B3	40	160	210	50	2	35	20		
B3	41	140	190	90	2	40	12		
B3	42	140	190	50	4	40	12		
B3	43	160	190	90	4	40	20		
B3	44	140	210	90	4	40	20		
B3	45	160	210	90	4	35	12		
B3	46	160	190	90	4	35	20		
B3	47	160	210	90	2	40	12		
B3	48	150	200	70	3	37.5	16		
B3	49	140	210	50	4	35	12		
B3	50	160	190	50	2	40	20		
B3	51	160	190	90	2	35	12		
B3	52	140	210	90	2	40	20		
B3	53	160	210	50	4	40	12		
B3	54	160	210	50	4	35	20		
B4	55	160	190	90	2	40	20		
B4	56	140	190	50	4	40	20		
B4	57	140	210	50	2	40	20		
B4	58	150	200	70	3	37.5	16		
B4	59	160	210	90	2	40	20		
B4	60	140	190	90	4	35	12		
B4	61	160	190	50	2	35	12		
B4	62	140	190	50	2	35	20		
B4	63	140	210	90	2	40	12		
B4	64	150	200	70	3	37.5	16		
B4	65	140	210	50	2	35	12		
B4	66	160	190	90	2	35	20		
B4	67	160	190	50	4	40	12		
B4	68	140	190	90	4	40	12		
B4	69	140	210	90	4	35	20		
B4	70	150	200	70	3	30.43	16		
B4	71	121.76	200	70	3	37.5	16		
B4	72	150	200	70	3	37.5	16		
B5	73	150	200	70	3	37.5	16		
B5	74	140	190	90	2	40	20		
B5	75	150	171.76	70	3	37.5	16		
B5	76	160	210	90	4	40	20		
B5	77	140	210	90	4	35	12		
B5	78	160	190	50	4	35	20		
B5	79	150	200	70	3	37.5	16		
B5	80	140	210	50	4	40	20		
B5	81	150	200	70	3	37.5	4.69		
B5	82	150	200	70	0.17	37.5	16		
B5	83	150	200	13.43	3	37.5	16		
B5	84	160	190	90	4	40	12		
B5	85	160	210	50	2	40	12		

B5	86	160	210	90	2	35	20		
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4.2 Experimentation using BBD

Experiments were also conducted as per the Box Behnken Design array shown in Table 4. Accordingly, the experiments conducted in a day were accommodated in a block, indicated in the first column of Table 4. The complete BBD array consists of five blocks. Each trial was repeated thrice to facilitate error estimation and the average of the response was used for analysis. The results of various trials are presented in Appendix 3.

Table 4 BBD Experimental Array

Block	Run	A: Temperature at HZ 1	B: Nozzle temperature at HZ 4	C: Injection speed	D: Holding time	E: Back pressure	F: Cooling time	Cycle time	Energy consumption
		(in °C)	(in °C)	(in mm/sec.)	(in secs.)	(in MPa)	(in secs.)	(in secs.)	(in KWh)
B1	1	150	200	70	3	37.5	16		
B1	2	150	210	90	3	35	16		
B1	3	150	190	90	3	40	16		
B1	4	160	210	70	4	37.5	16		
B1	5	150	190	70	3	35	20		
B1	6	160	200	50	3	37.5	20		
B1	7	150	200	50	4	37.5	12		
B1	8	150	200	70	3	37.5	16		
B1	9	160	200	90	3	37.5	12		
B1	10	140	210	70	2	37.5	16		
B1	11	150	200	50	2	37.5	12		
B2	12	160	200	90	3	37.5	20		
B2	13	140	190	70	4	37.5	16		
B2	14	160	200	70	4	40	16		
B2	15	150	200	90	2	37.5	12		
B2	16	140	200	70	2	40	16		
B2	17	150	200	70	3	37.5	16		
B2	18	150	190	70	3	35	12		
B2	19	150	200	70	3	37.5	16		
B2	20	140	210	70	4	37.5	16		
B2	21	160	200	50	3	37.5	12		
B2	22	150	200	50	2	37.5	20		
B3	23	140	200	90	3	37.5	20		
B3	24	150	190	50	3	40	16		
B3	25	150	200	90	4	37.5	12		
B3	26	150	200	70	3	37.5	16		
B3	27	160	200	70	2	40	16		
B3	28	150	200	50	4	37.5	20		
B3	29	140	200	50	3	37.5	12		
B3	30	160	200	70	2	35	16		
B3	31	150	210	70	3	40	20		
B3	32	150	210	70	3	40	12		
B3	33	150	210	50	3	35	16		
B4	34	150	190	90	3	35	16		
B4	35	150	210	70	3	35	12		
B4	36	150	200	70	3	37.5	16		
B4	37	140	200	70	4	40	16		
B4	38	140	190	70	2	37.5	16		
B4	39	160	190	70	4	37.5	16		
B4	40	150	210	70	3	35	20		
B4	41	150	200	90	2	37.5	20		
B4	42	140	200	70	4	35	16		
B4	43	150	210	90	3	40	16		
B4	44	140	200	50	3	37.5	20		
B5	45	160	200	70	4	35	16		
B5	46	150	200	90	4	37.5	20		

B5	47	150	210	50	3	40	16		
B5	48	150	190	70	3	40	20		
B5	49	140	200	70	2	35	16		
B5	50	160	190	70	2	37.5	16		
B5	51	160	210	70	2	37.5	16		
B5	52	150	190	50	3	35	16		
B5	53	140	200	90	3	37.5	12		
B5	54	150	190	70	3	40	12		

The process parameters for every trial were set in the control panel of ENGEL 35T Machine. The cycle time of the component was measured using the stopwatch and the power consumption was measured using an energy meter attached to the machine.

5.0 STATISTICAL MODELING

5.1 Response – Cycle Time

5.1.1 Model development for CCD and BBD:

Statistical models relating the responses with the corresponding explanatory variables were obtained using **multiple regression**. The results of regression analysis are shown in Table 5. For cycle time, the best fit model was found to be **linear** since it has the maximum p-value of 0.3979 and maximum adjusted R² value of 0.9527. *This indicates that the second-order effects i.e., interaction effects are not statistically significant.*

Table 5 Fit summary for cycle time (CCD)

Source	Sequential p-value	Lack of fit p-value	Adjusted R ²	Predicted R ²	
Linear	< 0.0001	0.3979	0.9527	0.9421	Suggested
Quadratic	0.4056	0.3888	0.9524	0.9117	
Cubic	0.8353	0.2846	0.9437	-0.5018	Aliased

The linear models obtained for cycle time (CT) using CCD and BBD designs are given by Equations 1 and 2.

$$CT_{CCD} = -94.72463 + 0.376719A + 0.217901B - 0.095036C + 0.846118D + 0.377174E + 1.00856F \quad (1)$$

$$CT_{BBD} = 5.88684 + 0.02804A + 0.093399B - 0.085408C + 0.176019D + 0.143919E + 0.736528F \quad (2)$$

Regression analysis provides information on what happens to the response when input parameters are changed. It will not however reveal the physics of the process.

5.1.2 Analysis of Variance for Ccd:

Analysis of Variance (ANOVA) partitions the total variation in the data into accountable sources and determines the factors that are statistically significant in influencing the response. The results of ANOVA for CCD cycle time performed at 95% level of confidence are shown in Table 6.

Table 6 Results of ANOVA for CCD - cycle time

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	3224.28	6	537.38	272.95	< 0.0001	significant
A-Temperature at HZ 1	1130.52	1	1130.52	574.23	< 0.0001	significant
B-Nozzle temperature at HZ 4	376.22	1	376.22	191.09	< 0.0001	significant
C-Injection speed	287.79	1	287.79	146.18	< 0.0001	significant
D-Holding time	57.03	1	57.03	28.97	< 0.0001	significant
E-Back pressure	70.61	1	70.61	35.87	< 0.0001	significant
F-Cooling time	1292.56	1	1292.56	656.54	< 0.0001	significant
Residual	147.66	75	1.97			
Lack of fit	140.32	70	2.00	1.37	0.3979	not significant
Pure error	7.33	5	1.47			
Total	3379.92	85				

The calculated F-value of 272.95 implies the model is significant which means that there is only a 0.05% chance that an F-value this large could occur due to noise. P-value of a factor less than 0.0500 indicates that the

factor is statistically significant. From ANOVA, it is found that *all the factors are statistically significant in influencing the cycle time.*

5.1.3 Analysis of Variance for BBD:

The results of ANOVA for BBD cycle time performed at 95% level of confidence are shown in Table 7.

Table 7 Results of ANOVA for BBD - cycle time

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	299.89	6	49.98	12.12	< 0.0001	significant
A-Temperature at HZ 1	1.78	1	1.78	0.4324	0.5143	
B-Nozzle temperature at HZ 4	20.10	1	20.10	4.88	0.0326	significant
C-Injection speed	67.76	1	67.76	16.44	0.0002	significant
D-Holding time	0.7373	1	0.7373	0.1789	0.6745	
E-Back pressure	2.98	1	2.98	0.7239	0.3996	
F-Cooling time	203.25	1	203.25	49.30	< 0.0001	significant
Residual	177.26	43	4.12			
Lack of Fit	175.20	41	4.27	4.15	0.2131	not significant
Pure Error	2.06	2	1.03			
Total	482.53	53				

The calculated F-value of 12.12 implies the model is significant and there is only a 0.05% chance that an F-value this large could occur due to noise. P-values less than 0.0500 indicate model terms are statistically significant. From ANOVA, it is found that the *Nozzle temperature, Injection speed and Cooling time are statistically significant in influencing cycle time.*

5.1.4 Contour Plots and their significance

Matrices containing contour plots for every combination of parameters against the response, for CCD and BBD are shown in Figures 4 and 5. It is clearly seen that, in both cases, the *relationship between the response and any combination of parameters is linear.* Some basic insights into the relationship between various factors and their influence on the response can be obtained by a careful examination of the contour plots. Contour plots also provides an experimenter with useful information on the region of operation, for a particular combination of variables when the other factors held a constant, for optimizing the response.

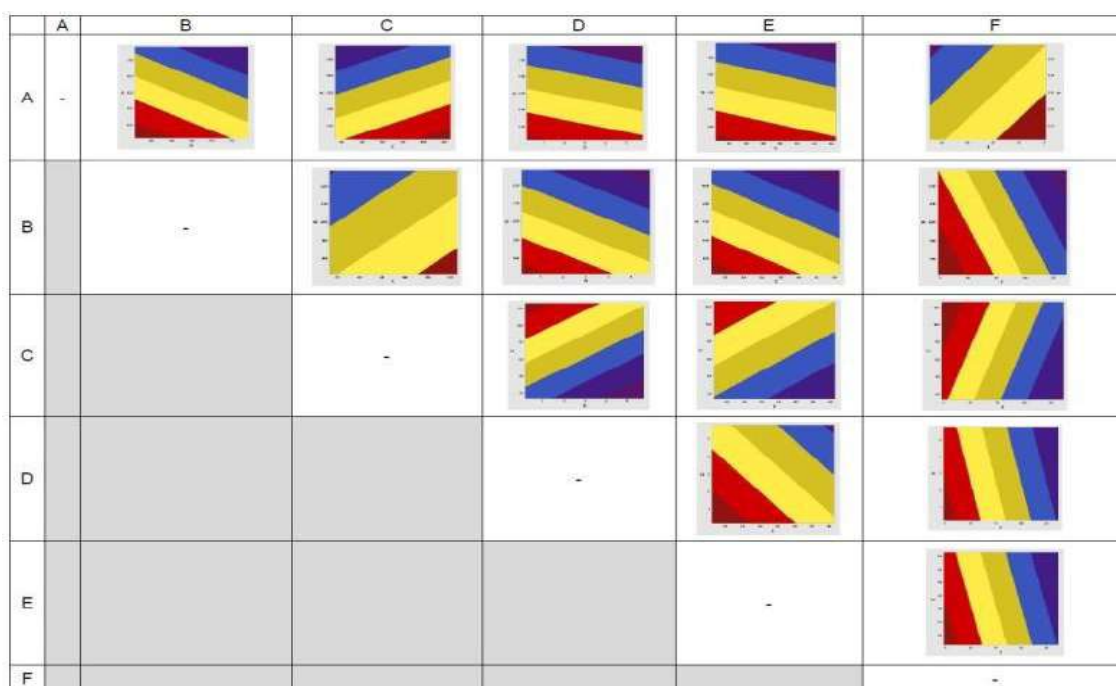


Fig. 4 Matrix of contour plots for various parameter combinations for CCD

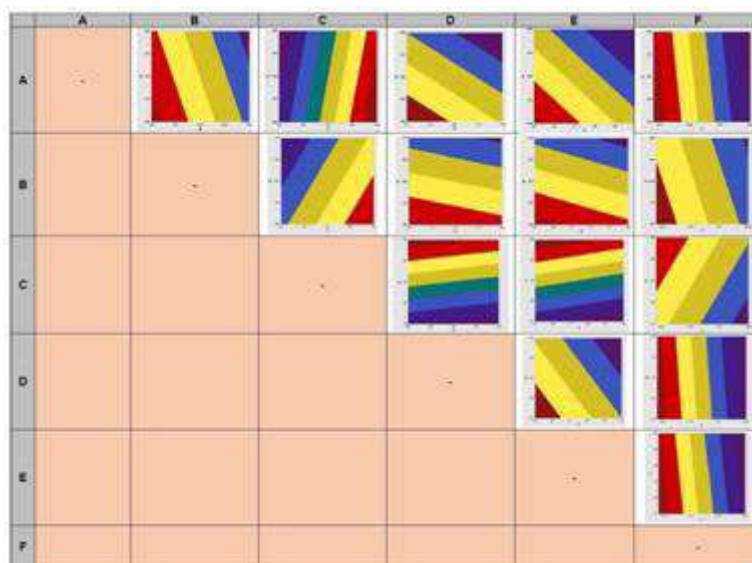


Fig. 5 Matrix of contour plots for various parameter combinations for BBD

From the contour plot for the combination A, B against Cycle Time, it is easily realized that minimum cycle time is realized when temperatures at the heating zones 1 and 4 are minimum (in the range). This is because the time taken for the raw materials to reach the set temperature is a direct function of its numerical value. Thus when A and B are minimum, the cycle time is also a minimum provided the other factors are held constant.

In the case of cycle time vs A and C, with the other factors held constant, it can be seen that minimum cycle time is realized when A is minimum and C is maximum. This is because when the injection speed is maximum, the cavity is filled fast and the corresponding time taken is a minimum. A should necessarily be a minimum as explained earlier. Similarly, holding time (D) and cooling time (F) are components of cycle time. Therefore, arguing on similar lines, parameters D and F held at their lower bounds will yield minimal cycle time. However, from the plot, it is evident that holding time has very negligible effect on the cycle time.

The back pressure is the opposing pressure maintained at the end of the screw which in turn is communicated to the ingate of the mould to prevent any leakage. In this case, it is easily seen that the cycle time is directly proportional to the set value of back pressure (E).

Thus for achieving minimal cycle time, parameters A, B, D, E, F have to be maintained at their minimum values and while C has to maintained at its maximum value.

5.2 Response – Power Consumption

5.2.1 Model Development For CCD And BBD:

For power consumption, results of regression analysis are shown in Table 8 for CCD. For power consumption, the best fit model was found to be **quadratic** since it has the maximum p-value of 0.7433 and maximum R^2 value of 0.9225. *Quadratic model implies the existence of interaction effects among all or some of the parameters considered.*

Table 8 Fit summary for power consumption

Source	Sequential p-value	Lack of fit p-value	Adjusted R^2	Predicted R^2	
Linear	< 0.0001	0.3570	0.8526	0.8189	
Quadratic	0.0030	0.7433	0.9225	0.8582	Suggested
Cubic	0.5324	0.7320	0.9212	-0.9282	Aliased

The non-linear models obtained for power consumption (PC) using CCD and BBD designs are given by Equations 3 and 4.

$$\begin{aligned}
 PC_{CCD} = & 0.337837 - 0.002003A - 0.001247B + 0.001154C - 0.012284D - 0.003163E - 0.009092F + 0.00000249251AB - \\
 & 0.00000394488AC + 0.000035AD + 0.000019AE + 0.000036AF - \\
 & 0.00000163601BC + 0.000028BD + 0.00001BE + 0.000011BF - 0.000017CD - 0.00000658097CE - \\
 & 0.00000723811CF + 0.000024DE + 0.000122DF + 0.000027EF + 0.00000265927A^2 + 0.00000140927B^2 + 0.0000005 \\
 & 08568C^2 + 0.000141D^2 - 0.000017E^2 + 0.000056F^2 \quad (3)
 \end{aligned}$$

$$PC_{BDD} = 2.2183885731673 - 0.0086446358786005A - 0.0058401013502731B - 0.0029103977790823C - 0.037623066084103D - 0.029562899971761E - 0.034140296471898F + 0.000027499999999997AB - 9.9638748051419E-07AC - 0.0001637529397913AD + 0.000099999999999996AE - 0.000001268062597427AF - 4.9999999999999991E-06BC + 0.00022499999999995BD + 8.7900518989449E-06BE + 0.000079737564873684BF + 0.000072463874805146CD + 0.000080000000000002CE + 0.0000390625CF + 0.00020000000000004DE + 0.00029981937402573DF + 0.00044395025949473EF$$

(4)

5.2.2 Analysis Of Variance For CCD:

The results of ANOVA for CCD power consumption performed at 95% level of confidence are shown in Table 9.

Table 9 ANOVA for power consumption - CCD

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	0.0042	27	0.0002	36.70	< 0.0001	significant
A-Temperature at HZ 1	0.0012	1	0.0012	290.80	< 0.0001	significant
B-Nozzle temperature at HZ 4	0.0004	1	0.0004	94.58	< 0.0001	significant
C-Injection speed	0.0004	1	0.0004	85.79	< 0.0001	significant
D-Holding time	0.0001	1	0.0001	24.81	< 0.0001	significant
E-Back pressure	0.0001	1	0.0001	24.14	< 0.0001	significant
F-Cooling time	0.0016	1	0.0016	379.95	< 0.0001	significant
AB	3.925E-06	1	3.925E-06	0.9209	0.3415	
AC	0.0000	1	0.0000	9.33	0.0035	significant
AD	7.756E-06	1	7.756E-06	1.82	0.1830	
AE	0.0000	1	0.0000	3.27	0.0762	
AF	0.0001	1	0.0001	30.14	< 0.0001	significant
BC	6.813E-06	1	6.813E-06	1.60	0.2116	
BD	5.134E-06	1	5.134E-06	1.20	0.2773	
BE	4.243E-06	1	4.243E-06	0.9955	0.3229	
BF	0.0000	1	0.0000	2.97	0.0905	
CD	7.229E-06	1	7.229E-06	1.70	0.1983	
CE	6.890E-06	1	6.890E-06	1.62	0.2090	
CF	0.0000	1	0.0000	5.01	0.0294	significant
DE	2.270E-07	1	2.270E-07	0.0533	0.8184	
DF	0.0000	1	0.0000	3.52	0.0661	
EF	4.779E-06	1	4.779E-06	1.12	0.2944	
A ²	7.799E-06	1	7.799E-06	1.83	0.1818	
B ²	2.190E-06	1	2.190E-06	0.5139	0.4766	
C ²	4.564E-06	1	4.564E-06	1.07	0.3054	
D ²	2.190E-06	1	2.190E-06	0.5139	0.4766	
E ²	1.312E-06	1	1.312E-06	0.3078	0.5813	
F ²	0.0001	1	0.0001	20.54	< 0.0001	significant
Residual	0.0002	54	4.262E-06			
Lack of fit	0.0002	49	4.126E-06	0.7368	0.7433	not significant
Pure error	0.0000	5	5.600E-06			
Total	0.0045	85				

The calculated F-value of 36.70 implies the model is significant which means that there is only a 0.05% chance that an F-value this large could occur due to noise. P-value of a factor less than 0.0500 indicates that the factor is statistically significant. From ANOVA, it is found that *all the parameters (A to F) and interactions namely AC, AF, CF, F² are statistically significant in influencing the power consumption.*

5.2.3 Analysis of Variance for BBD:

The results of ANOVA for BBD power consumption performed at 95% level of confidence are shown in Table 10.

Table 10 ANOVA for power consumption - BBD

Source	Sum of Squares	df	Mean Square	F-value	p-value	
Model	0.0027	21	0.0001	5.83	< 0.0001	significant
A-Temperature at HZ 1	1.307E-06	1	1.307E-06	0.0596	0.8089	
B-Nozzle temperature at HZ 4	0.0001	1	0.0001	4.86	0.0358	significant
C-Injection speed	0.0004	1	0.0004	20.00	0.0001	significant
D-Holding time	8.011E-07	1	8.011E-07	0.0365	0.8498	
E-Back pressure	0.0000	1	0.0000	1.63	0.2126	
F-Cooling time	0.0013	1	0.0013	61.53	< 0.0001	significant
AB	0.0001	1	0.0001	2.76	0.1079	
AC	3.089E-07	1	3.089E-07	0.0141	0.9064	
AD	0.0000	1	0.0000	1.86	0.1832	
AE	0.0001	1	0.0001	2.28	0.1423	
AF	2.001E-08	1	2.001E-08	0.0009	0.9761	
BC	8.000E-06	1	8.000E-06	0.3647	0.5508	
BD	0.0000	1	0.0000	1.85	0.1851	
BE	7.631E-07	1	7.631E-07	0.0348	0.8534	
BF	0.0001	1	0.0001	3.62	0.0674	
CD	0.0000	1	0.0000	0.7447	0.3955	
CE	0.0001	1	0.0001	5.83	0.0225	significant
CF	0.0002	1	0.0002	7.12	0.0125	significant
DE	2.000E-06	1	2.000E-06	0.0912	0.7649	
DF	0.0000	1	0.0000	0.5099	0.4811	
EF	0.0002	1	0.0002	7.01	0.0131	significant
Residual	0.0006	28	0.0000			
Lack of Fit	0.0006	26	0.0000	3.70	0.2345	not significant
Pure Error	0.0000	2	6.250E-06			
Total	0.0033	53				

The F-value of 5.83 obtained in the model implies that it is significant. There is only a 0.01% chance that an F-value this large could occur due to noise. P-values less than 0.0500 indicate model terms are significant. In this case *B, C, F, CE, CF, EF are statistically significant in influencing the power consumption.*

5.2.4 Contour Plots and their significance

Contour plots were obtained using Minitab software for visualizing the function landscape for every combination of parameters, in the region of interest. Matrices containing the contour plots for every combination of parameters against the response, in the region of interest, for CCD and BBD are shown in Figures 6 and 7. It is clearly seen that the *relationship between the response and any combination of parameters is non-linear.*

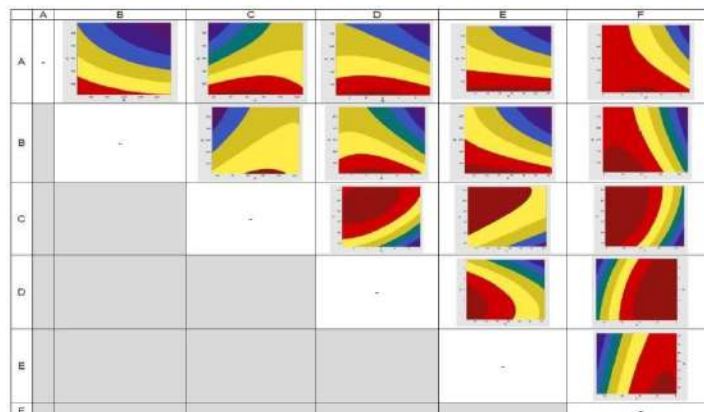


Fig. 6 Matrix of contour plots for various parameter combinations

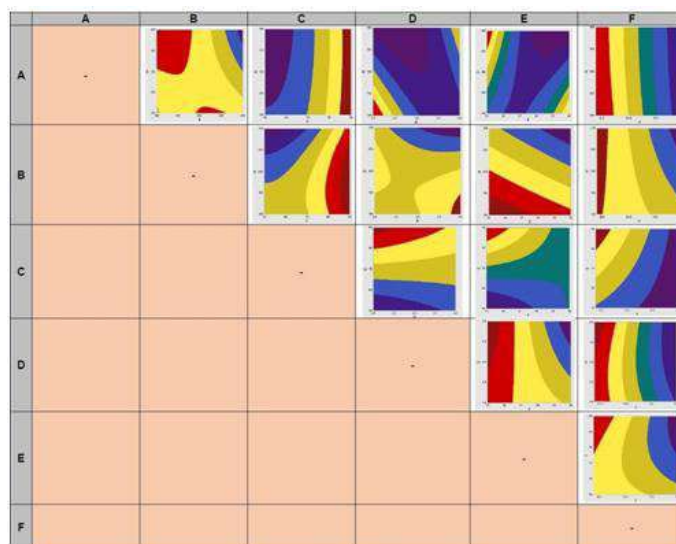


Fig. 7 Matrix of contour plots for various parameter combinations

In all the plots, the region corresponding to dark red colour indicates minimal power consumption. In general, power consumption increases with an increase in cycle time since the machine is run for a longer period of time. However when the injection speed is increased, the time taken to fill the mould is reduced. This implies that the machine will run only for a short duration thereby reducing the the power consumption,. Specifically, for the combination C, E vs power consumption, back pressure needs to be maintained at its minimum value and injection speed maintained at its maximum value for minimizing the power consumed.

6.0 RESPONSE OPTIMIZATION

6.1 Genetic Algorithms (GA)

6.1.1 Optimization with one objective at a time using GA

Using GA, optimum parameter values were obtained through constrained minimization of the regression equations separately for both CCD and BBD. Toolbox solver from MATLAB R2018a was used to execute the GA procedure. The limits of parameters were set as A = 140 - 160°C, B = 190 – 210°C, C = 50 - 90mm/sec. and D = 2 - 4 secs., E = 35 - 40 MPa and F = 12 - 20 secs. For cycle time and power consumption, optimum solution was obtained after 97 and 55 iterations for CCD and 135 and 83 iterations for BBD designs.

6.1.2 Multi-objective Optimization using GA

Multi-objective optimization enables the determination of a process parameter combination that simultaneously optimizes two or more responses. In this work, statistical models for CT and PC obtained through respective approaches, CCD and BBD, were fed to the toolbox solver to obtain a parameter combination that simultaneously minimizes cycle time and power consumption. 70 different sets of solutions were obtained as shown in Appendix 4 and 5 for CCD and BBD respectively. Out of the 70 solution sets, solution number 1 yields the minimum cycle time in CCD and the solution number 2 yields the minimum cycle time in BBD.

6.2 Simulated Annealing (SA)

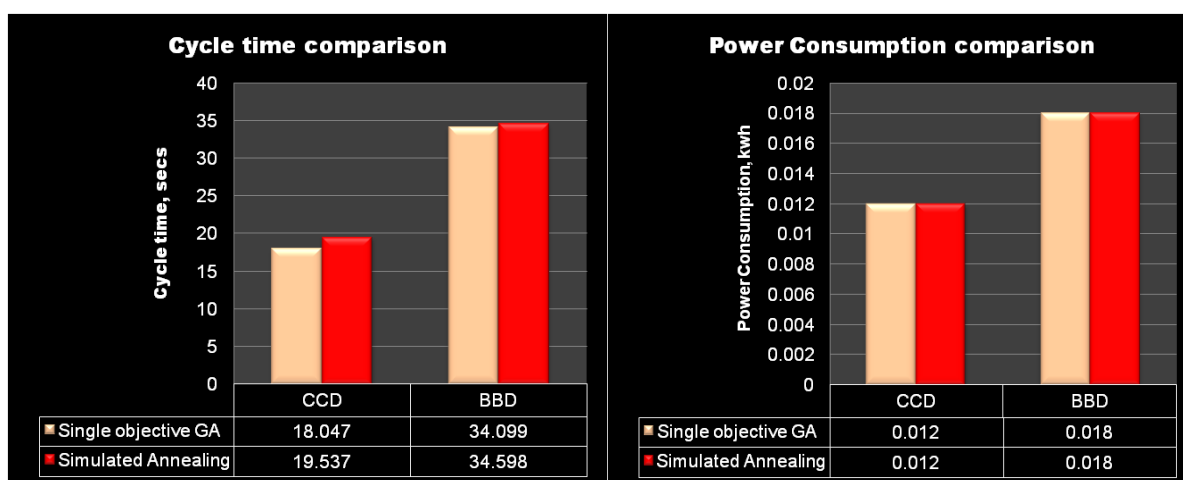
Simulated annealing procedure was executed on the objective functions given by Equations 1 to 4. MATLAB Toolbox solver was used to execute the problem. The limits of the parameters were set as discussed in section 5.1.1. The current values of the process parameters given in Table 1 were used as the starting point (initial seed point). For cycle time and power consumption, the solver took 4915 and 4398 iterations in CCD and 7462 and 5828 iterations in BBD respectively to yield the optimum solutions.

6.3 Comparison of results

The optimal process parameter and response values obtained from solver for CCD and BBD designs using various optimization approaches are shown in Table 11 as a nested to permit easy comparison. It is evident that CCD gives much better results compared to BBD. Graphical comparisons are also presented in Figures 8 (a) to (d) to permit better visual comparisons. The reason is that CCD utilizes information from a greater number of design points such as factorial, axial (star) and center points to generate the response function whereas BBD uses lesser number of points. Further, BBD cannot test the responses at extreme conditions within their ranges [15, 24]. Hence, Box Behnken design is dominated by the design nature of the Central composite design.

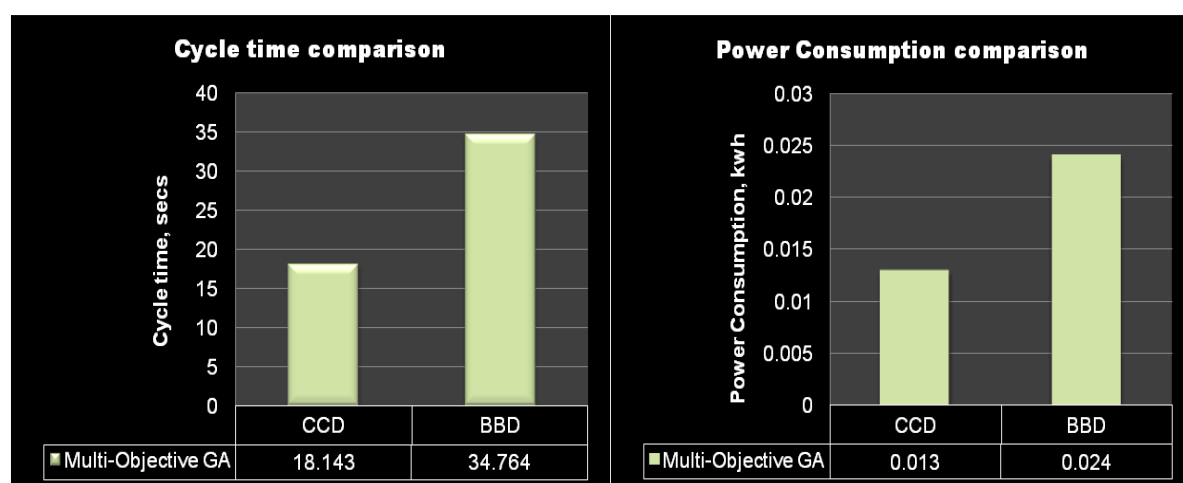
Table 11 Comparison of optimum parameter combinations and response values using various optimization approaches

Exp. Design	Optimization using		Optimum parameter settings						Response	
	Method	Response	A	B	C	D	E	F	Cycle time	Power consumption
CCD	Single-obj. GA	CT	160.000	190.002	89.999	4.000	35.003	12.001	18.047	-
		PC	140.000	190.000	89.998	4.000	40.000	12.000	-	0.012
	Multi-Objective GA		140.044	190.000	89.999	2.054	35.003	12.010	18.143	0.013
	Simulated Annealing	CT	140.439	193.016	86.023	2.166	35.057	12.312	19.537	-
		PC	140.003	190.002	89.430	4.000	39.998	12.001	-	0.012
BBD	Single-obj. GA	CT	140.000	190.001	90.000	2.000	35.000	12.000	34.099	-
		PC	160.000	190.002	89.999	4.000	35.003	12.001	-	0.018
	Multi-Objective GA		154.775	190.000	89.753	3.293	35.000	12.003	34.764	0.024
	Simulated Annealing	CT	145.196	190.040	89.928	2.056	36.161	12.225	34.598	-
		PC	141.193	209.866	84.796	2.175	39.464	12.007	-	0.018



(a)

(b)



(c)

(d)

Figure 8 Graphical comparisons of response values

7.0 CONCLUSIONS

Application of experimental design procedure coupled with optimization was illustrated for a plastic injection moulding process. Two commonly used RSM designs, the central composite design (CCD) and the Box Behnken design (BBD), were used to develop the experimental arrays. Statistical process models for cycle time and power consumption were developed. The process parameter combination that minimizes cycle time and power consumption were determined using single and multi-objective optimization approaches. The following are the conclusions made out of this study.

1. Cycle time is a linear function of all the factors, in both CCD and BBD models.
2. Power consumption is a *non-linear function of process parameters, interactions and second degree terms* in CCD and a *non-linear function of process parameters and interactions* in BBD. Table 12 summarizes the findings of multiple regression and ANOVA.

Table 12 Regression and ANOVA Summary

Response	Model	Terms in Regression Model			ANOVA	
		First order	Interactions	Second Order	Statistically Significant	
					Factors	Interactions
Cycle Time	CCD	A,B,C,D,E,F	NIL	NIL	A,B,C,D,E,F	NIL
	BBD	A,B,C,D,E,F	NIL	NIL	B,C,F	NIL
Power Consumption	CCD	A,B,C,D,E,F	all possible interactions	second degree terms of all factors	A,B,C,D,E,F	AC, AF, CF, F ²
	BBD	A,B,C,D,E,F	all possible interactions	NIL	B, C, F	CE, CF, EF

3. CCD gives better values of the response than BBD since, in general, the amount of data required for building a response surface depends on the amount of knowledge about the objective function. CCD considers a greater number of points (factorial, axial (star) and center points) in the design space than BBD for building the response surface. It is concluded that CCD is a better option for optimization using response surface methodology.
4. With a single objective to be optimized, both GA and SA procedures give the same optimum value for power consumption although GA gives better values for cycle time.
5. In the case of multi-objective optimization using GA, CCD outperforms BBD for both cycle time and power consumption. The phenomenal reduction in cycle time and power consumption obtained using combined RSM and MOO approaches are presented in Table 13.

Table 13 Response improvement over existing value

Response	Existing value	Value obtained through CCD+MOO	Value obtained through BBD+MOO
Cycle time, secs	38	18.143	34.764
Power Consumption, kwh	0.03	0.013	0.024

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APPENDIX 1

Nomenclature

- A Temperature at HZ (Heating zone) 1 (°C)
 B Nozzle temperature at HZ (Heating zone) 4 (°C)
 C Injection speed (mm/sec.)
 D Holding time (secs.)
 E Back pressure (MPa)
 F Cooling time (secs.)
 R₁ Cycle time (secs.)
 R₂ Power consumption (KWh)
 CT_{CCD} Cycle time regression equation (Central composite design)
 PC_{CCD} Power consumption regression equation (Central composite design)
 CT_{BBD} Cycle time regression equation (Box Behnken design)
 PC_{BBD} Power consumption regression equation (Box Behnken design)

Appendix 2 Experimental Results for CCD

Block	Run	A (in °C)	B (in °C)	C (in mm/sec.)	D (in secs.)	E (in MPa)	F (in secs.)	Cycle time				Energy consumption (in KWh)
								Obs. 1	Obs. 2	Obs. 3	Avg.	
								(in secs.)	(in secs.)	(in secs.)	(in secs.)	
B1	1	150	200	70	3	37.5	16	33.05	33.06	32.98	33.03	0.014
B1	2	150	200	126.57	3	37.5	16	25.21	25.26	25.22	25.23	0.014
B1	3	160	210	90	2	35	12	29.55	29.51	29.50	29.52	0.036
B1	4	140	210	50	2	35	20	32.65	32.68	32.47	32.6	0.015
B1	5	150	228.28	70	3	37.5	16	38.68	36.62	40.59	38.63	0.015
B1	6	150	200	70	3	37.5	27.31	44.32	44.29	44.42	44.34	0.027
B1	7	178.28	200	70	3	37.5	16	40.85	40.89	40.90	40.88	0.028
B1	8	150	200	70	3	37.5	16	31.06	31.08	31.01	31.05	0.032
B1	9	140	210	50	2	40	12	26.77	26.74	26.71	26.74	0.029
B1	10	140	190	50	4	35	12	22.29	22.25	22.15	22.23	0.033
B1	11	150	200	70	3	44.57	16	33.35	33.32	33.41	33.36	0.021
B1	12	140	190	50	2	40	12	24.27	24.33	24.27	24.29	0.015
B1	13	160	210	50	4	35	12	34.21	34.26	34.19	34.22	0.014
B1	14	150	200	70	3	37.5	16	31.06	31.08	30.98	31.04	0.021
B1	15	140	190	90	2	35	12	16.22	16.15	16.17	16.18	0.022
B1	16	140	190	90	4	40	20	28.06	28.08	27.95	28.03	0.037
B1	17	150	200	70	5.83	37.5	16	35.82	35.81	35.89	35.84	0.015
B1	18	160	190	50	2	35	20	37.94	37.99	37.92	37.95	0.023
B2	19	140	210	50	4	40	12	30.77	30.78	30.73	30.76	0.015
B2	20	160	210	90	4	35	20	37.88	37.84	37.95	37.89	0.014
B2	21	160	190	90	2	40	12	28.35	28.32	28.41	28.36	0.015
B2	22	140	190	50	2	40	20	30.26	30.24	30.16	30.22	0.015
B2	23	140	190	90	4	35	20	28.62	28.62	28.62	28.62	0.017
B2	24	160	190	50	4	40	20	42.24	42.21	42.30	42.25	0.031
B2	25	140	210	90	2	35	12	28.61	28.66	28.53	28.6	0.017
B2	26	160	190	90	4	35	12	26.12	26.19	26.32	26.21	0.016
B2	27	160	190	50	4	35	12	29.91	30.01	29.93	29.95	0.02
B2	28	140	210	90	2	35	20	28.85	28.74	28.78	28.79	0.024
B2	29	160	210	50	2	35	12	33.75	33.73	33.86	33.78	0.029
B2	30	160	210	50	2	40	20	42.15	42.14	42.16	42.15	0.018
B2	31	140	210	50	4	35	20	34.69	34.65	34.49	34.61	0.017
B2	32	160	210	90	4	40	12	31.96	32.08	31.99	32.01	0.02
B2	33	150	200	70	3	37.5	16	33.09	33.04	32.99	33.04	0.02

B2	34	140	190	50	2	35	12	22.39	22.34	22.32	22.35	0.019
B2	35	140	210	90	4	40	12	27.05	27.02	27.17	27.08	0.016
B3	36	160	210	50	4	40	20	44.12	44.19	44.17	44.16	0.025
B3	37	140	190	90	2	35	20	26.39	26.44	26.40	26.41	0.03
B3	38	160	190	50	2	40	12	30.51	30.58	30.47	30.52	0.041
B3	39	140	190	50	4	35	20	32.29	32.35	32.32	32.32	0.024
B3	40	160	210	50	2	35	20	40.19	40.16	40.16	40.17	0.03
B3	41	140	190	90	2	40	12	17.89	18.05	17.94	17.96	0.015
B3	42	140	190	50	4	40	12	24.25	24.28	24.19	24.24	0.014
B3	43	160	190	90	4	40	20	36.15	36.12	36.27	36.18	0.025
B3	44	140	210	90	4	40	20	34.96	35.06	35.04	35.02	0.015
B3	45	160	210	90	4	35	12	31.77	31.76	31.81	31.78	0.026
B3	46	160	190	90	4	35	20	36.33	36.34	36.44	36.37	0.014
B3	47	160	210	90	2	40	12	32.17	32.16	32.24	32.19	0.028
B3	48	150	200	70	3	37.5	16	33.05	33.09	33.10	33.08	0.028
B3	49	140	210	50	4	35	12	26.69	26.71	26.46	26.62	0.018
B3	50	160	190	50	2	40	20	40.29	40.31	40.24	40.28	0.019
B3	51	160	190	90	2	35	12	24.16	24.21	24.44	24.27	0.024
B3	52	140	210	90	2	40	20	31.08	31.04	31.12	31.08	0.027
B4	53	160	210	50	4	40	12	38.35	38.33	38.19	38.29	0.016
B4	54	160	210	50	4	35	20	43.91	43.95	44.05	43.97	0.016
B4	55	160	190	90	2	40	20	36.21	36.26	36.16	36.21	0.026
B4	56	140	190	50	4	40	20	32.19	32.32	32.18	32.23	0.021
B4	57	140	210	50	2	40	20	36.81	36.82	37.01	36.88	0.017
B4	58	150	200	70	3	37.5	16	33.08	33.09	33.01	33.06	0.039
B4	59	160	210	90	2	40	20	40.01	40.05	40.21	40.09	0.014
B4	60	140	190	90	4	35	12	19.24	19.22	19.20	19.22	0.017
B4	61	160	190	50	2	35	12	27.71	27.77	27.80	27.76	0.018
B4	62	140	190	50	2	35	20	30.16	30.18	30.11	30.15	0.023
B4	63	140	210	90	2	40	12	24.91	24.96	24.95	24.94	0.019
B4	64	150	200	70	3	37.5	16	31.02	31.09	31.07	31.06	0.014
B4	65	140	210	50	2	35	12	24.52	24.51	24.65	24.56	0.025
B4	66	160	190	90	2	35	20	34.11	34.08	34.17	34.12	0.023
B4	67	160	190	50	4	40	12	34.26	34.21	34.28	34.25	0.016
B4	68	140	190	90	4	40	12	19.93	19.95	19.85	19.91	0.03
B4	69	140	210	90	4	35	20	32.71	32.76	32.75	32.74	0.032
B5	70	150	200	70	3	30.43	16	29.77	29.71	29.89	29.79	0.026
B5	71	121.72	200	70	3	37.5	16	19.46	19.42	19.44	19.44	0.022
B5	72	150	200	70	3	37.5	16	33.02	33.09	33.04	33.05	0.03
B5	73	150	200	70	3	37.5	16	31.06	31.09	30.91	31.02	0.018
B5	74	140	190	90	2	40	20	27.92	27.96	27.88	27.92	0.016
B5	75	150	171.72	70	3	37.5	16	26.29	26.25	26.21	26.25	0.027
B5	76	160	210	90	4	40	20	42.01	42.03	42.02	42.02	0.014
B5	77	140	210	90	4	35	12	22.78	22.72	22.81	22.77	0.015
B5	78	160	190	50	4	35	20	38.12	38.15	38.12	38.13	0.018
B5	79	150	200	70	3	37.5	16	31.09	31.07	30.99	31.05	0.014
B5	80	140	210	50	4	40	20	36.78	36.71	36.88	36.79	0.022
B5	81	150	200	70	3	37.5	4.69	21.76	21.77	21.68	21.74	0.043
B5	82	150	200	70	0.17	37.5	16	30.19	30.15	30.20	30.18	0.014
B5	83	150	200	13.43	3	37.5	16	39.16	39.19	39.10	39.15	0.035
B5	84	160	190	90	4	40	12	28.16	28.19	28.19	28.18	0.016
B5	85	160	210	50	2	40	12	34.12	34.16	34.17	34.15	0.031
B5	86	160	210	90	2	35	20	35.79	35.71	35.81	35.77	0.019

Appendix 3 Experimental Results for BBD

Block	Run	A	B	C	D	E	F	Cycle time				Energy consumption (in KWh)
		(in °C)	(in °C)	(in mm/sec.)	(in secs.)	(in MPa)	(in secs.)	Obs. 1	Obs. 2	Obs. 3	Avg.	
		(in °C)	(in °C)	(in mm/sec.)	(in secs.)	(in MPa)	(in secs.)	(in secs.)	(in secs.)	(in secs.)	(in secs.)	

B1	1	150	200	70	3	37.5	16	39.85	39.96	39.95	39.92	0.040
B1	2	150	210	90	3	35	16	37.26	37.18	37.19	37.21	0.029
B1	3	150	190	90	3	40	16	41.95	41.92	41.92	41.93	0.045
B1	4	160	210	70	4	37.5	16	44.75	44.65	44.76	44.72	0.048
B1	5	150	190	70	3	35	20	39.92	39.96	39.97	39.95	0.040
B1	6	160	200	50	3	37.5	20	45.90	45.95	45.94	45.93	0.053
B1	7	150	200	50	4	37.5	12	39.80	39.85	39.78	39.81	0.039
B1	8	150	200	70	3	37.5	16	41.99	41.96	41.90	41.95	0.045
B1	9	160	200	90	3	37.5	12	33.82	33.86	33.87	33.85	0.025
B1	10	140	210	70	2	37.5	16	41.95	41.92	41.92	41.93	0.045
B1	11	150	200	50	2	37.5	12	41.95	41.89	41.89	41.91	0.045
B2	12	160	200	90	3	37.5	20	43.88	43.81	43.89	43.86	0.049
B2	13	140	190	70	4	37.5	16	39.96	39.89	39.94	39.93	0.040
B2	14	160	200	70	4	40	16	41.51	41.59	41.52	41.54	0.044
B2	15	150	200	90	2	37.5	12	34.35	34.28	34.27	34.30	0.026
B2	16	140	200	70	2	40	16	37.95	37.98	37.95	37.96	0.030
B2	17	150	200	70	3	37.5	16	41.95	41.92	41.92	41.93	0.045
B2	18	150	190	70	3	35	12	41.99	41.96	41.90	41.95	0.045
B2	19	150	200	70	3	37.5	16	41.95	41.89	41.89	41.91	0.045
B2	20	140	210	70	4	37.5	16	41.99	41.96	41.90	41.95	0.045
B2	21	160	200	50	3	37.5	12	39.97	39.91	39.97	39.95	0.040
B2	22	150	200	50	2	37.5	20	41.95	41.89	41.89	41.91	0.045
B3	23	140	200	90	3	37.5	20	42.25	42.19	42.19	42.21	0.046
B3	24	150	190	50	3	40	16	39.96	39.89	39.94	39.93	0.040
B3	25	150	200	90	4	37.5	12	36.34	36.36	36.26	36.32	0.027
B3	26	150	200	70	3	37.5	16	39.92	39.96	39.97	39.95	0.040
B3	27	160	200	70	2	40	16	41.56	41.55	41.51	41.54	0.044
B3	28	150	200	50	4	37.5	20	41.95	41.92	41.92	41.93	0.045
B3	29	140	200	50	3	37.5	12	38.82	38.85	38.76	38.81	0.036
B3	30	160	200	70	2	35	16	38.02	38.09	38.04	38.05	0.030
B3	31	150	210	70	3	40	20	45.69	45.73	45.71	45.71	0.053
B3	32	150	210	70	3	40	12	37.71	37.77	37.77	37.75	0.029
B3	33	150	210	50	3	35	16	41.15	41.16	41.08	41.13	0.044
B4	34	150	190	90	3	35	16	36.35	36.38	36.44	36.39	0.028
B4	35	150	210	70	3	35	12	39.12	39.19	39.17	39.16	0.036
B4	36	150	200	70	3	37.5	16	39.96	39.89	39.94	39.93	0.040
B4	37	140	200	70	4	40	16	41.92	41.99	42.03	41.98	0.045
B4	38	140	190	70	2	37.5	16	41.95	41.92	41.92	41.93	0.045
B4	39	160	190	70	4	37.5	16	37.09	37.02	37.13	37.08	0.028
B4	40	150	210	70	3	35	20	47.11	47.16	47.18	47.15	0.055
B4	41	150	200	90	2	37.5	20	40.33	40.28	40.26	40.29	0.043
B4	42	140	200	70	4	35	16	39.41	39.49	39.54	39.48	0.039
B4	43	150	210	90	3	40	16	40.05	40.03	39.98	40.02	0.041
B4	44	140	200	50	3	37.5	20	44.82	44.89	44.78	44.83	0.051
B5	45	160	200	70	4	35	16	40.02	40.08	40.17	40.09	0.041
B5	46	150	200	90	4	37.5	20	42.30	42.33	42.30	42.31	0.048
B5	47	150	210	50	3	40	16	41.98	42.08	42.09	42.05	0.046
B5	48	150	190	70	3	40	20	44.21	44.29	44.19	44.23	0.050
B5	49	140	200	70	2	35	16	39.56	39.55	39.45	39.52	0.039
B5	50	160	190	70	2	37.5	16	40.36	40.31	40.38	40.35	0.043
B5	51	160	210	70	2	37.5	16	42.77	42.72	42.67	42.72	0.050
B5	52	150	190	50	3	35	16	41.92	41.98	41.95	41.95	0.045
B5	53	140	200	90	3	37.5	12	32.26	32.21	32.25	32.24	0.024
B5	54	150	190	70	3	40	12	34.19	34.26	34.21	34.22	0.026

Appendix 4 Multi-Objective Optimization solution sets for CCD

Sol. No.	Temperature @ HZ 1 (°C)	Nozzle Temperature (HZ 4) (°C)	Injection Speed (mm/sec.)	Holding Time (secs.)	Back Pressure (MPa)	Cooling Time (Secs.)	Cycle Time (Secs.)	Energy consumption (KWh)
1	140.018	190.031	89.039	2.003	35.011	12.010	17.982	0.013

2	140.015	190.019	89.157	3.935	35.015	12.009	19.601	0.013
3	140.020	190.033	89.149	3.558	35.017	12.003	19.283	0.013
4	140.018	190.024	89.158	3.502	35.017	12.010	19.239	0.013
5	140.016	190.022	89.124	3.476	35.014	12.007	19.216	0.013
6	140.016	190.018	89.252	3.857	35.015	12.009	19.527	0.013
7	140.022	190.042	89.038	2.092	35.012	12.012	18.064	0.013
8	140.016	190.025	89.167	3.906	35.017	12.010	19.580	0.013
9	140.018	190.034	89.080	2.224	35.027	12.013	18.174	0.013
10	140.016	190.037	89.127	3.798	35.016	12.010	19.494	0.013
11	140.023	190.026	89.113	2.841	35.024	12.014	18.694	0.013
12	140.018	190.039	89.205	2.386	35.019	12.010	18.294	0.013
13	140.017	190.033	89.114	2.824	35.036	12.010	18.679	0.013
14	140.015	190.029	89.156	3.445	35.018	12.009	19.190	0.013
15	140.019	190.028	89.150	3.466	35.018	12.011	19.212	0.013
16	140.019	190.033	89.095	2.155	35.014	12.011	18.107	0.013
17	140.017	190.026	89.211	2.755	35.018	12.010	18.602	0.013
18	140.018	190.026	89.174	3.368	35.014	12.010	19.123	0.013
19	140.022	190.021	89.158	3.616	35.018	12.012	19.340	0.013
20	140.020	190.045	89.092	2.247	35.029	12.010	18.193	0.013
21	140.017	190.021	89.163	2.940	35.015	12.011	18.762	0.013
22	140.016	190.018	89.179	3.713	35.014	12.009	19.412	0.013
23	140.014	190.029	89.168	2.497	35.017	12.011	18.388	0.013
24	140.017	190.023	89.098	3.177	35.016	12.012	18.972	0.013
25	140.019	190.023	89.177	2.882	35.015	12.011	18.713	0.013
26	140.023	190.027	89.176	3.029	35.020	12.016	18.848	0.013
27	140.016	190.024	89.196	3.166	35.016	12.010	18.950	0.013
28	140.018	190.045	89.163	2.186	35.026	12.009	18.132	0.013
29	140.016	190.019	89.204	3.601	35.014	12.009	19.314	0.013
30	140.020	190.030	89.108	3.421	35.019	12.009	19.177	0.013
31	140.015	190.023	89.137	3.968	35.011	12.008	19.631	0.013
32	140.017	190.041	89.110	3.652	35.025	12.009	19.376	0.013
33	140.018	190.029	89.068	2.514	35.012	12.010	18.411	0.013
34	140.030	190.026	89.165	2.671	35.028	12.015	18.550	0.013
35	140.022	190.027	89.167	3.517	35.031	12.013	19.261	0.013
36	140.016	190.018	89.182	3.736	35.015	12.009	19.431	0.013
37	140.016	190.023	89.096	3.188	35.017	12.012	18.981	0.013
38	140.017	190.027	89.177	3.862	35.014	12.009	19.541	0.013
39	140.017	190.034	89.161	2.548	35.027	12.010	18.437	0.013
40	140.022	190.041	89.078	2.207	35.018	12.013	18.160	0.013
41	140.015	190.024	89.094	3.377	35.013	12.009	19.136	0.013
42	140.015	190.024	89.386	3.710	35.014	12.009	19.390	0.013
43	140.017	190.020	89.154	3.984	35.014	12.010	19.645	0.013
44	140.018	190.029	89.370	2.466	35.015	12.010	18.344	0.013
45	140.023	190.019	89.192	3.255	35.023	12.012	19.033	0.013
46	140.017	190.036	89.121	2.275	35.021	12.015	18.214	0.013
47	140.020	190.029	89.163	2.950	35.015	12.015	18.779	0.013
48	140.018	190.037	89.119	2.340	35.023	12.013	18.268	0.013
49	140.018	190.033	89.086	2.468	35.020	12.012	18.377	0.013
50	140.021	190.025	89.270	2.600	35.026	12.010	18.470	0.013
51	140.022	190.036	89.107	2.618	35.019	12.012	18.502	0.013
52	140.017	190.025	89.151	3.111	35.018	12.012	18.911	0.013
53	140.017	190.031	89.133	2.091	35.011	12.011	18.048	0.013
54	140.015	190.032	89.151	2.335	35.017	12.014	18.258	0.013
55	140.011	190.021	89.154	3.391	35.016	12.014	19.146	0.013

56	140.016	190.029	89.135	2.440	35.012	12.011	18.342	0.013
57	140.018	190.028	89.135	3.638	35.016	12.011	19.358	0.013
58	140.019	190.036	89.144	2.311	35.015	12.007	18.233	0.013
59	140.016	190.020	89.152	3.415	35.019	12.009	19.164	0.013
60	140.028	190.029	89.146	2.715	35.021	12.014	18.585	0.013
61	140.015	190.026	89.173	2.659	35.040	12.009	18.532	0.013
62	140.016	190.030	89.096	3.087	35.013	12.009	18.892	0.013
63	140.018	190.026	89.066	3.323	35.023	12.010	19.100	0.013
64	140.025	190.023	89.134	3.078	35.016	12.010	18.885	0.013
65	140.021	190.032	89.066	2.065	35.013	12.010	18.034	0.013
66	140.015	190.025	89.125	3.312	35.013	12.011	19.079	0.013
67	140.014	190.025	89.151	3.053	35.018	12.010	18.859	0.013
68	140.016	190.026	89.137	2.785	35.019	12.013	18.638	0.013
69	140.019	190.053	89.083	2.018	35.030	12.013	18.005	0.013
70	140.019	190.023	89.177	3.007	35.015	12.011	18.818	0.013

Appendix 5 Multi-Objective Optimization solution sets for BBD

Sol. No.	Temperature at HZ 1 (°C)	Nozzle temperature at HZ 4 (°C)	Injection speed (mm/sec.)	Holding time (secs.)	Back pressure (MPa)	Cooling time (secs.)	Cycle time (secs.)	Energy consumption (KWh)
1	156.807	190.032	89.995	3.451	35.006	12.005	34.834	0.022
2	153.636	190.082	89.980	2.166	35.047	12.010	34.534	0.028
3	159.974	190.138	89.991	3.998	35.023	12.027	35.048	0.018
4	158.608	190.021	89.977	3.825	35.011	12.011	34.956	0.020
5	154.638	190.030	89.991	2.745	35.015	12.005	34.650	0.026
6	154.121	190.052	89.993	2.365	35.016	12.005	34.571	0.027
7	156.804	190.021	89.995	3.425	35.007	12.005	34.829	0.022
8	154.194	190.036	89.989	2.402	35.015	12.007	34.580	0.027
9	159.852	190.060	89.987	3.987	35.023	12.012	35.025	0.018
10	154.557	190.051	89.988	2.309	35.013	12.007	34.575	0.027
11	159.355	190.025	89.985	3.396	35.013	12.009	34.899	0.021
12	158.663	190.068	89.990	3.884	35.035	12.007	34.971	0.020
13	158.260	190.047	89.988	3.736	35.013	12.008	34.930	0.020
14	155.296	190.016	89.991	2.988	35.024	12.006	34.712	0.025
15	155.408	190.018	89.991	2.745	35.026	12.008	34.674	0.025
16	155.067	190.037	89.990	2.984	35.018	12.007	34.706	0.025
17	154.462	190.044	89.989	2.434	35.034	12.009	34.597	0.027
18	157.415	190.026	89.986	3.678	35.008	12.005	34.892	0.021
19	159.105	190.022	89.987	3.630	35.014	12.006	34.931	0.020
20	159.486	190.049	89.979	3.950	35.024	12.010	35.006	0.019
21	158.525	190.031	89.996	3.746	35.013	12.009	34.937	0.020
22	154.464	190.035	89.988	2.403	35.010	12.007	34.586	0.027
23	154.565	190.038	89.984	2.256	35.028	12.008	34.567	0.027
24	155.378	190.046	89.988	3.104	35.014	12.008	34.738	0.024
25	154.390	190.036	89.989	2.866	35.016	12.007	34.667	0.025
26	156.782	190.032	89.992	3.213	35.009	12.005	34.792	0.023
27	153.632	190.087	89.976	2.175	35.052	12.012	34.539	0.028
28	157.516	190.019	89.992	3.357	35.013	12.006	34.838	0.022
29	156.883	190.038	89.994	3.239	35.013	12.008	34.802	0.023
30	155.469	190.024	89.989	3.191	35.024	12.003	34.751	0.024
31	157.283	190.050	89.990	3.645	35.008	12.006	34.884	0.021
32	158.904	190.039	89.988	3.889	35.013	12.010	34.976	0.019
33	158.199	190.046	89.989	3.454	35.013	12.008	34.879	0.021
34	154.809	190.043	89.993	2.657	35.008	12.007	34.641	0.026
35	154.885	190.036	89.989	2.983	35.017	12.007	34.701	0.025

36	157.803	190.005	89.985	3.683	35.022	12.005	34.903	0.021
37	158.581	190.077	89.986	3.591	35.010	12.010	34.918	0.021
38	154.366	190.036	89.980	2.490	35.024	12.007	34.602	0.027
39	154.947	190.043	89.992	2.710	35.022	12.010	34.658	0.026
40	154.743	190.035	89.992	2.494	35.008	12.006	34.609	0.026
41	156.763	190.032	89.990	3.182	35.009	12.006	34.787	0.023
42	156.882	190.027	89.980	2.993	35.024	12.005	34.758	0.024
43	157.087	190.032	89.977	3.459	35.014	12.007	34.847	0.022
44	157.349	190.037	89.988	2.864	35.015	12.006	34.749	0.024
45	157.127	190.049	89.992	3.161	35.016	12.005	34.795	0.023
46	158.752	190.031	89.978	3.834	35.036	12.006	34.962	0.020
47	155.846	190.045	89.988	2.795	35.014	12.008	34.697	0.025
48	154.998	190.045	89.991	2.734	35.015	12.008	34.662	0.025
49	155.596	190.030	89.990	3.315	35.029	12.006	34.780	0.023
50	159.609	190.032	89.978	3.962	35.025	12.018	35.016	0.019
51	159.977	190.081	89.985	3.992	35.027	12.019	35.037	0.018
52	154.333	190.051	89.996	2.590	35.028	12.008	34.620	0.026
53	155.720	190.023	89.996	3.271	35.011	12.000	34.768	0.023
54	156.778	190.047	89.999	3.330	35.009	12.010	34.816	0.023
55	154.710	190.039	89.979	2.474	35.008	12.007	34.607	0.026
56	155.383	190.041	89.988	2.847	35.013	12.006	34.691	0.025
57	156.249	190.028	89.986	2.890	35.021	12.006	34.722	0.024
58	156.363	190.052	89.973	2.629	35.016	12.008	34.684	0.025
59	159.068	190.044	89.980	3.875	35.016	12.011	34.980	0.019
60	155.314	190.025	89.990	2.548	35.026	12.005	34.635	0.026
61	156.241	190.037	89.979	3.377	35.029	12.007	34.812	0.023
62	153.780	190.091	89.991	2.169	35.023	12.023	34.545	0.028
63	159.592	190.082	89.988	3.810	35.025	12.010	34.987	0.019
64	155.664	190.032	89.991	3.021	35.011	12.006	34.727	0.024
65	155.499	190.040	89.988	3.129	35.014	12.008	34.745	0.024
66	154.992	190.037	89.985	2.557	35.024	12.008	34.632	0.026
67	159.277	190.047	89.987	3.931	35.015	12.010	34.995	0.019
68	158.089	190.046	89.990	3.723	35.000	12.008	34.921	0.020
69	154.163	190.044	89.991	2.232	35.003	12.019	34.556	0.027
70	154.889	190.051	89.994	2.083	35.006	12.011	34.545	0.028

Systematic Applications of Simple Statistical Tools Help Fix a Problem in a Foundry – A Case Study

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ABSTRACT

Foundry process control is a matter of constant attention to details. Details refer to the process signature or voice of the process. This paper demonstrates how simple quality control tools when applied in a systematic manner helps to monitor, identify and fix problems in a foundry. A jobbing foundry suffering from rejections on a perennial basis with a high cost of rejection was taken up for study. Historical data pertaining to rejections and selected quality characteristics were collected followed by a detailed statistical analysis that revealed a large variation in the process, lack of control and capability. The results were presented to the top management and their significance was explained. Root cause analysis demanded infrastructural improvement and workforce training for minimizing the variation. The suggestion was put forth to the management for the consideration and implementation.

Keywords: Quality Control, Process Capability, Defects.

INTRODUCTION

Foundry industry is very sensitive to rejections. In recent days, it is well appreciated by anyone connected with foundry that improvements even on an incremental basis are very important for an organization to sail in the direction of continual improvement. There are instances where customers ask for price reductions at the current quality level or price reduction with enhanced quality. Concurrently, an organization also needs to address its internal productivity and profit concerns. Attainment of these objectives very much demands improvements from the product and process side. The normally sought-after avenue in a foundry for realizing sustained improvements is rejections. Although the control of rejections is very much dependent on domain-specific knowledge, application of statistical principles helps bring about a rational thinking in the analysis and interpretation of process data which can be used as a basis for further action. Rejection is a very crucial and sensitive factor for it not only determines the quality and productivity but also the nature and health of work environment in a foundry. Further to the fact of tough working environment in a foundry, such rejections create a psychologically tiresome and harsh environment between functions or departments leading to heated exchanges and angry fights between personnel on the cause of rejections. Operating on a trial and error basis or on the basis of experience guided by empirical rules may not fetch the expected result always since many operating parameters in a foundry are random variables. On the other hand, systematic application of simple statistical tools and their analysis coupled with process knowledge can throw light on simple facts which if paid enough attention can bring in sustained improvements in process performance. This paper illustrates the power of statistical approach by way of indicating how a systematic application of a simple quality control tools can help identify a problem and narrow down its causes. The present paper discusses on the data collection, characterization and analysis of the existing process in the sand plant of a jobbing foundry in Coimbatore, using statistical techniques.

LITERATURE REVIEW

Subham Sharma et al [1] discussed on the casting defects and analysis of various defects using various quality tools. Pareto chart was used to identify the reasons for the defects and to classify them. It was mentioned that the application of quality tools brought about a reduction in the incidence of blow holes from 4.54% to 1.92%. D N Shivappa [2] analyzed casting defects and identified remedial measures by application of quality control tools. Major defects were identified, remedial measures were implemented and data collected after the implementation of the remedial measures indicated reduction in the quantum of rejections. Gilberto Santos [3] discussed about a modular tool “Qualifound” developed for quality improvement in a foundry. M. R Latte et al [4] carried out defect analysis of cylinder block with particular attention to blow holes. Rejection data was collected and Pareto chart was used to identify the vital few and trivial many. Cause and effect diagram was used to identify the root causes of the blow holes. Implementation of corrective measures resulted in a reduction in rejections and an increase in yield. Mohinuddin Ahmed [5] carried out an application of Pareto analysis and cause and effect diagram for minimizing rejection of raw materials in lamp production process. S A Patil et al [6] applied quality tools to identify major defects in a foundry and to improve productivity. Major

defect was found to be cold shut. The remedial measure introduced was the change in pouring temperature. Vaibhav Nerle [7] carried out an analysis of sand drop defect to reduce the rejection level of cylinder block casting. B R Jadhav [8] analyzed cold shut defect using 7 quality control tools. Bhupinder Singh [9] carried out rejection cost analysis due to misrun using six sigma tools. Three important parts of the industry were identified for complete analysis. Improvements were suggested using DMAIC approach.

Further, it was inferred that Pareto chart is used to identify the vital few and trivial many reasons for a problem; Cause and effect diagram is used to exhaustively enumerate the potential causes of a problem and further help identify the root cause of a problem; Check sheet is used for useful and intelligent information gathering; Brain storming is used to generate critical ideas about a point under discussion and finally a control chart is used assess, monitor and control a process.

Although literatures abound in this area, there are a very few literature that explain the systematic procedure of applying statistical tools in a foundry environment for realizing process or product improvement. It is with this intent that this work was carried out.

Problem Definition

A jobbing foundry in Coimbatore producing metallurgically critical castings for a variety of applications including automotive segment was suffering from a perennial problem of rejections. This foundry has a fully automatic disamatic molding line, a semi-automatic molding line using ARPA 450 and a hand-molding line. The author was approached by a team of personnel from the foundry as a part of industrial consultancy. A need was indicated for suggesting a suitable methodology for analyzing and reducing rejections. This was followed by a visit to the foundry and collection of historic data pertaining to rejections. Although systems and procedures were in place for collecting and recording data, these were not of much utility as these procedures were carried out on a routine basis as a ritual without any meaning. On one hand the reports generated by the top management indicated increase in cost of poor quality due to rejections. On the other hand, no such signs or symptoms were felt by the operating personnel as they were driven by goal post mentality. Hence a need was identified for articulating in a simple manner the procedure to analyze and interpret the rejection data as a first step and then take up the methodology of addressing the root cause of rejections. In this paper, attention is focused only on the first part namely on the application of data reduction techniques and their interpretation.

Objectives

The objective of this work is to demonstrate the application of simple statistical tools to process data for identifying and fixing a problem.

Historical Data Collection And Analysis

As a first step towards process diagnosis, rejection data was collected for a period of two years to understand the consistency of the process. The data was collected in the format shown in Table 1, month-wise for the years 2018 and 2019.

Table 1 Rejection data collection format

Month	Month XXXX	
	Weight (Kg.)	Value (Rs.)
Total Production		
Good Casting		
Floor rejection		
Floor Rejection %		

The floor rejection data, in percentage, for two years is represented as a trend chart as shown in Figure 1. The internal target set by the management for the rejections is 4%.

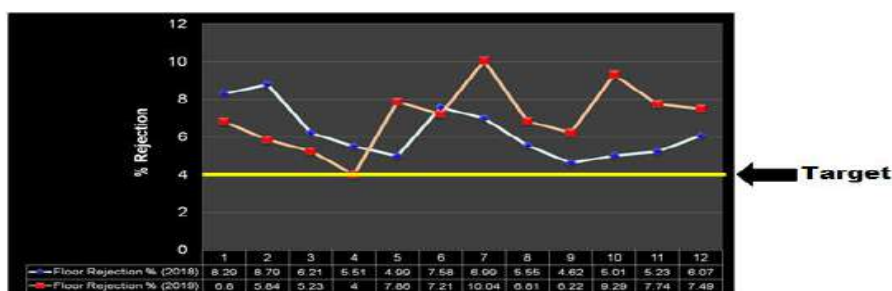


Figure 1 Trend chart of floor rejections for 2018 and 2019

Two things are worth noting. First, the average level of rejection in both the years is more than the target, with the level of rejections in 2019 much higher than that in 2018. Second, a cyclic trend can be noticed in the pattern of rejection data. This data, pertaining to rejections due to all the defects, was then broken down further to identify the major reasons contributing to rejections. Pareto analysis was carried out on the rejection data, year-wise, to identify the vital few defects contributing to majority of rejections. This analysis due to the Italian Economist, Wilfredo Pareto, is based on the principle that 80% of the rejections are due to 20% of the causes. These 20% causes are called “vital few” and the remaining is called “trivial many”. The Pareto analysis of the rejection data (weight-basis) pertaining to the year 2018 was carried out using Minitab software and is shown in Figure 2. Similar analysis was carried out for the year 2019 and its Pareto chart is presented in Figure 3.

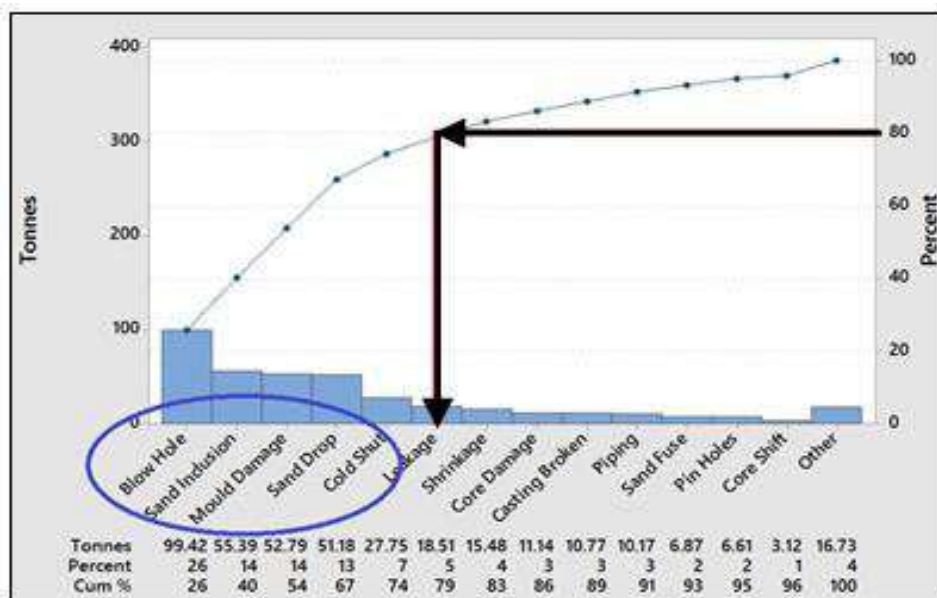


Figure 2 Pareto analysis of rejections for 2018

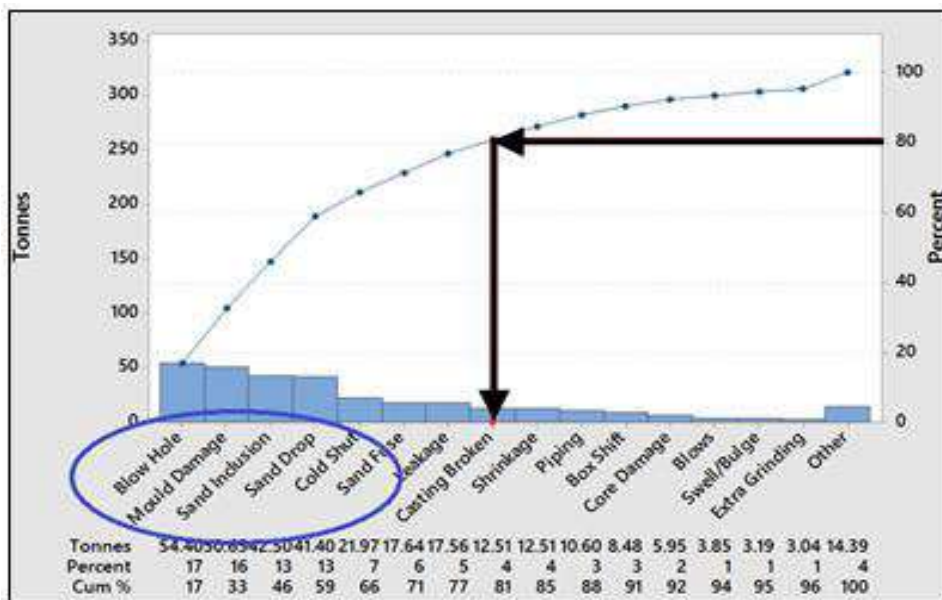


Figure 3 Pareto analysis of rejections for 2019

Let A and B denote the set of vital few causes for the years 2018 and 2019. We have, $A = \{BH, SI, MD, SD, CS, L\}$

$B = \{BH, SI, MD, SD, CS, SF, L, CB\}$

Defects which are common to both the years is simply given by their intersection. Therefore,

$A \cap B = \{BH, SI, MD, SD, CS, L\}$

This means that 80% of the rejections can be attacked by addressing these causes.

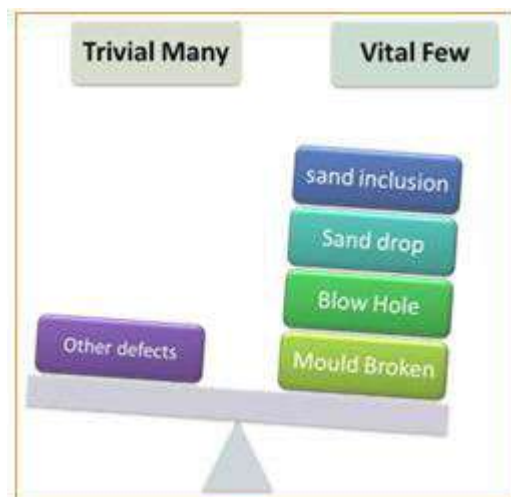


Figure 3a. Analogy for vital few and trivial many

Hence, data pertaining to these causes were pulled out of the original data set and analyzed further for their contributions to rejections both in terms of weight as well as value. The comparison of rejections in terms of weight due to vital few causes for both the years is presented in Figure 4.

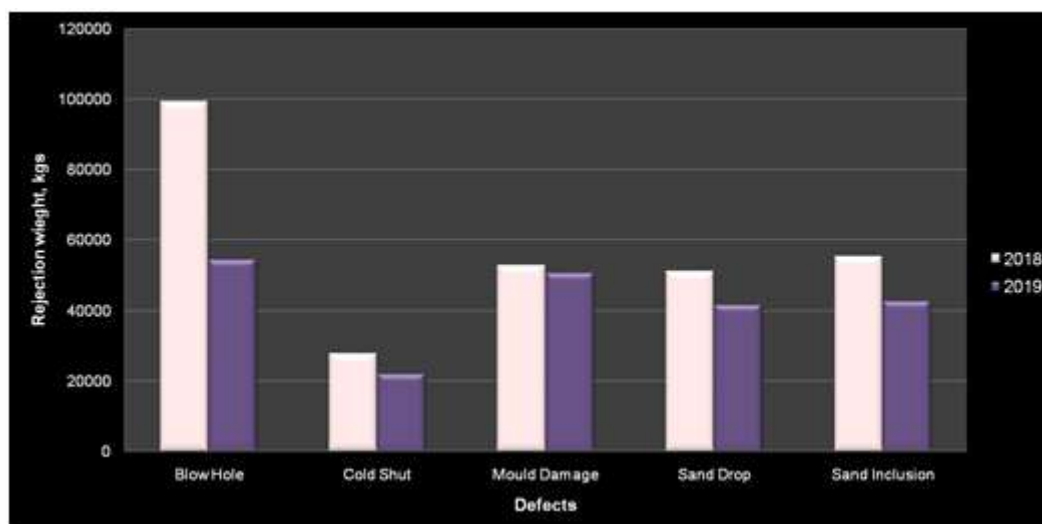


Figure 4 Cause-wise comparison of rejections in 2018 and 2019

The cumulative rejection in terms of weight and value are shown in Figures 5 and 6.

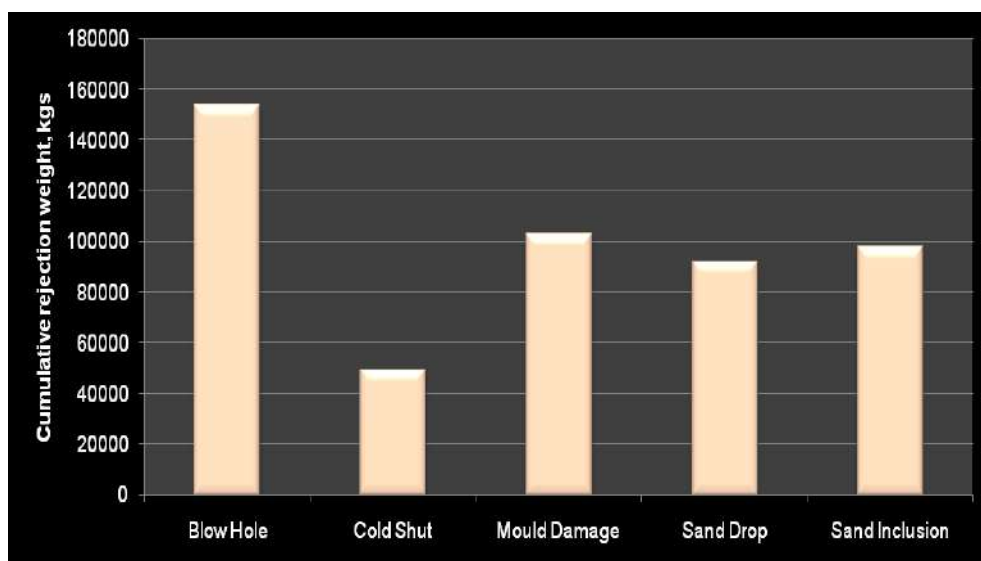


Figure 5 Cumulative rejection (Weight, kgs)

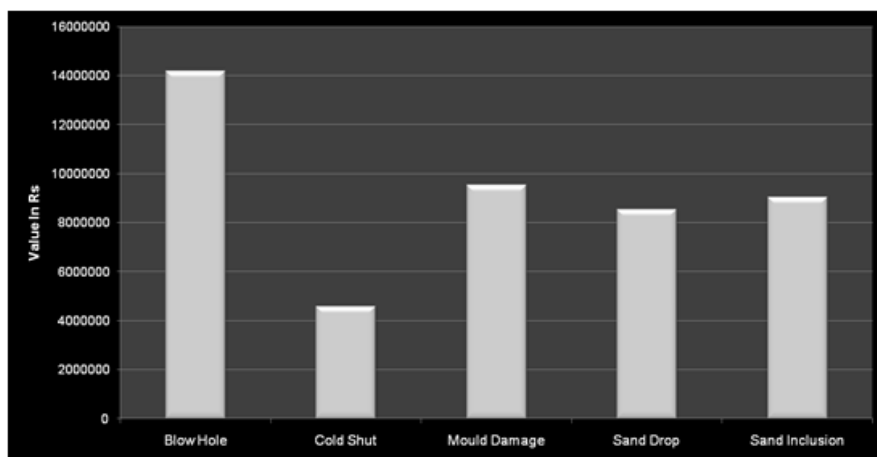


Figure 6 Cumulative rejections (Value, Rs.) ROOT CAUSE ANALYSIS

Pareto analysis indicated the need to address the five causes as discussed in the previous section. This was followed by a root cause analysis for each of the defect. Root cause analysis was carried out by an exhaustive enumeration of the ways and means by which various process functions can lead to a defect or alternately, the ways by which man, machine, method, material or environment can lead to the defect. In the present case, the relevant information was obtained on the basis of extensive survey of domain specific literature and interaction with the cross-functional team in the foundry and was recorded in the form of a fish bone diagram. Fish bone diagrams for the vital few defects were created using Minitab software. Fish bone diagrams for blow hole and sand drop/ sand inclusion defects are shown in Figures 7 and 8.

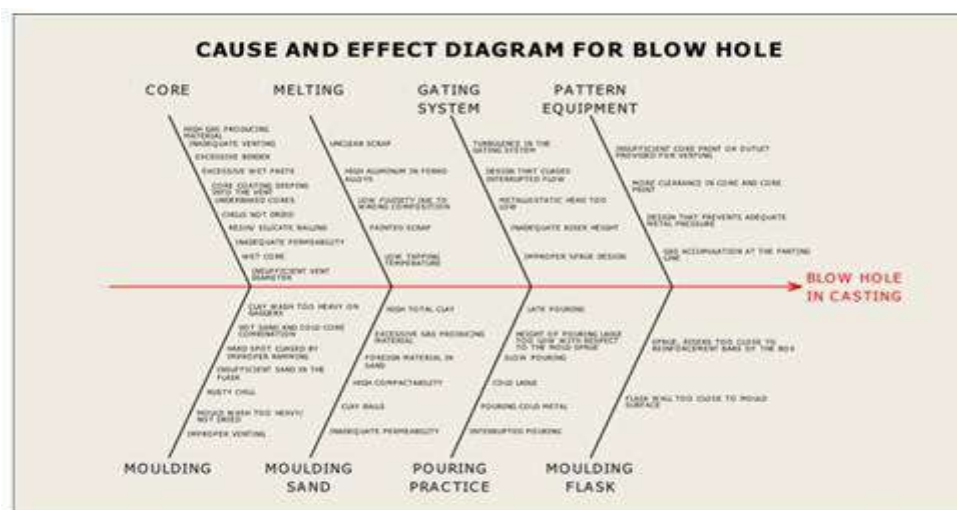


Figure 7 Cause and Effect diagram for blow hole

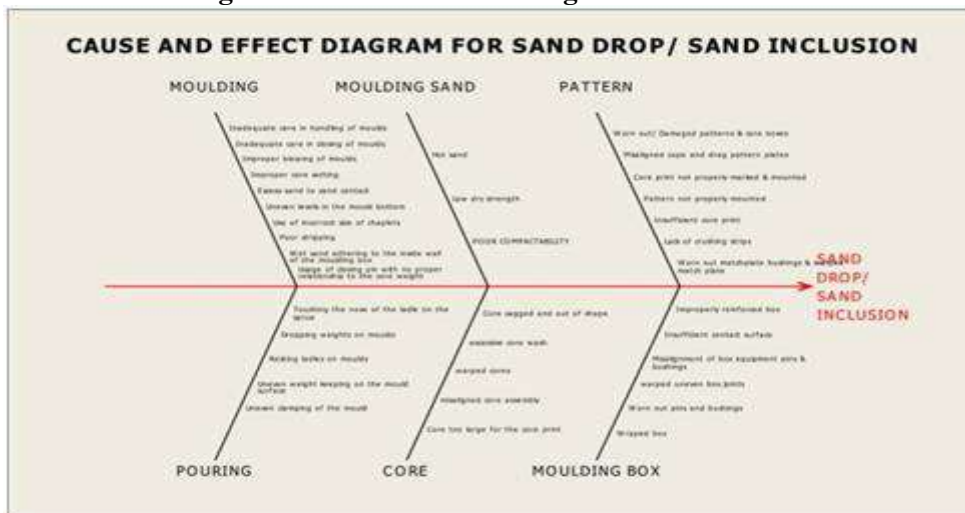


Figure 8 Cause and Effect diagram for sand drop/ sand inclusion

Further rounds of discussion with the cross-functional team in the foundry and careful review of process documents and records maintained at various sections in the foundry indicated the probable cause of the blow hole to be moisture content in the molding sand and that for sand drop and sand inclusion to be compactability of the molding sand. With the permission of the plant manager and the top management, systematic analysis of these two sand properties was initiated.

Analysis of Sand Properties

Any process improvement strategy begins with the assessment of the current situation followed by gap analysis and finally a decision on what is to be done to close the gap. The approach adopted in the present work is on similar lines and the steps followed are

1. Collection of historic data pertaining to moisture and compactability to study the current level of process performance
2. Description of process performance using data reduction techniques
3. Assessment of process control and stability using control charts
4. Process capability analysis for the current process and
5. Gap analysis

Historical Data Collection

Data pertaining to moisture in the molding sand and its compactability was collected separately for ARPA and DISA lines for three months namely November 2019, December 2019 and January 2020. Moisture and compactability were checked five times in a shift for two shifts and the data as appearing in the records were collected month-wise and shift-wise in the format shown in Table 2.

Table 2 Data collection format

Date	Month:					Shift:				
	ARPA					DISA				
	1	2	3	4	5	1	2	3	4	5
XXXX										
XXXX										

DESCRIPTION OF PROCESS PERFORMANCE

Moisture and compactability data collected as per the format discussed in the previous section present a meaningless jumble. Data reduction techniques are usually applied to such large masses of data for two reasons.

1. Condensing the information contained in the observations and
2. Presenting the essential information in a concise form more readily interpretable than the unorganized mass of original data.

In order that useful information and meaningful conclusions be drawn from the moisture and compactability data, a simple technique namely, histogram, was used.

Procedure for Histogram Construction:

1. Count the total number of observations in the data.
2. Calculate the range of data values i.e., max. value minus min. value.
3. Decide on the number of class intervals to be used. For this, either Sturges' rule or empirical rules can be used. **Sturges' rule** is given by

$$K = 1 + 3.3 \lambda \log_{10} N$$

where K is the number of cells and N is the number of observations. Another simple relation given by Juran's handbook [] is

$$K = 1.5 \lambda \sqrt{N} + 0.5$$

4. Calculate the width of the class intervals.
5. Lower boundary of the first class interval is given by

(1)

(2)

$$LB = \text{Minimumvalue} - \frac{1}{2} \text{Leastcount}$$

(3)

where minimum value refers to the smallest data value and least count refers to the data least count. Upper boundary values are obtained by adding the width of the class interval to the lowerboundary value.

6. Construct a frequency distribution with the cell boundary values obtained.
7. Represent the frequency distribution graphically with the class intervals along the x-axis and the corresponding frequency along the y-axis.

The histograms obtained for various combinations are arranged inside a nested table shown in Figures 9 to 12 so as to permit easy visual comparison of process performance across data categories.

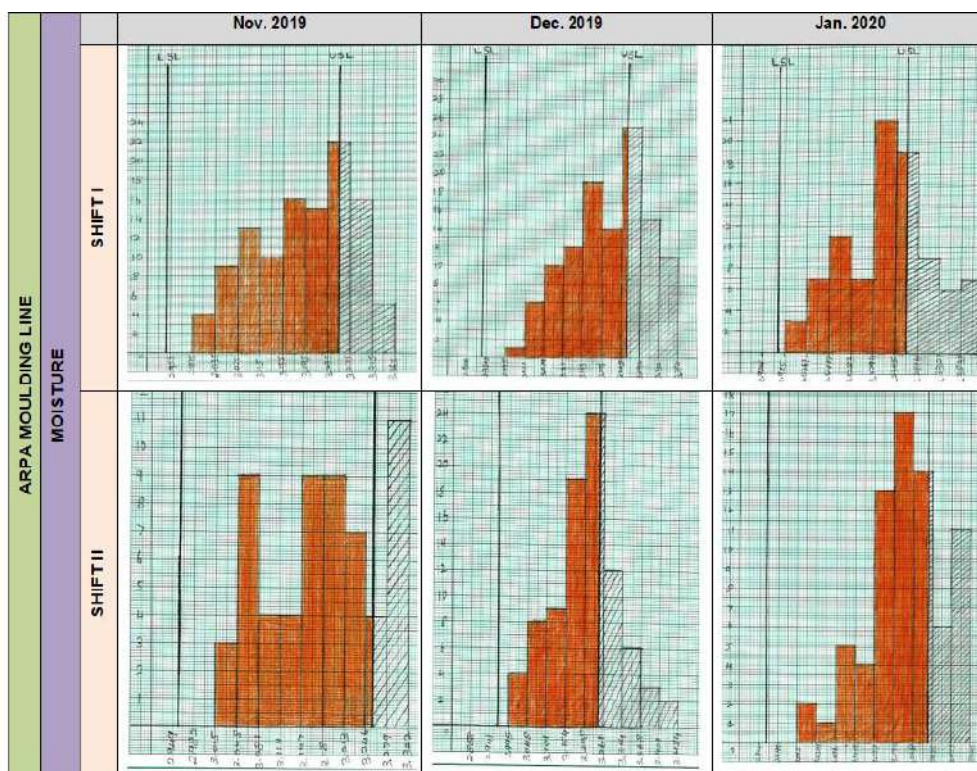


Figure 9 Histograms for ARPA line, Moisture

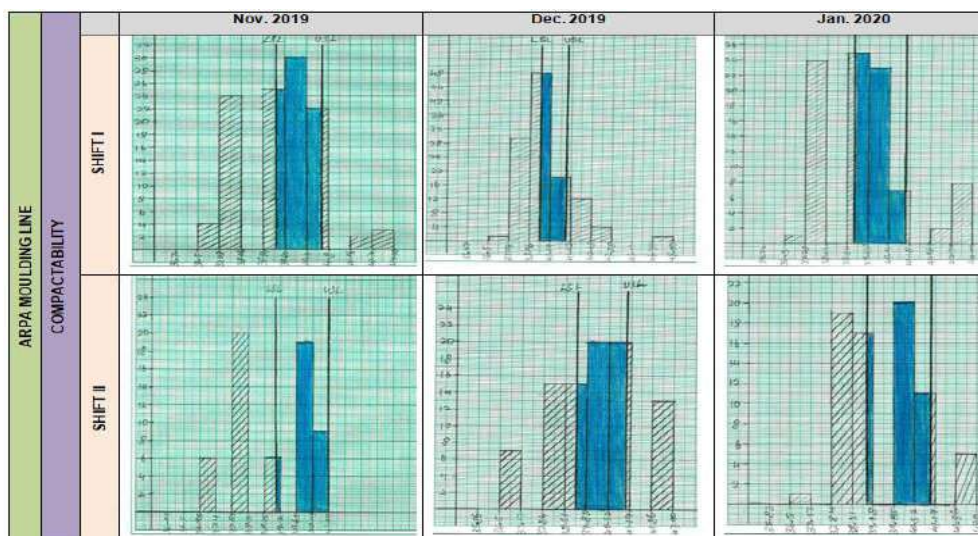


Figure 10 Histograms for ARPA line, Compactability

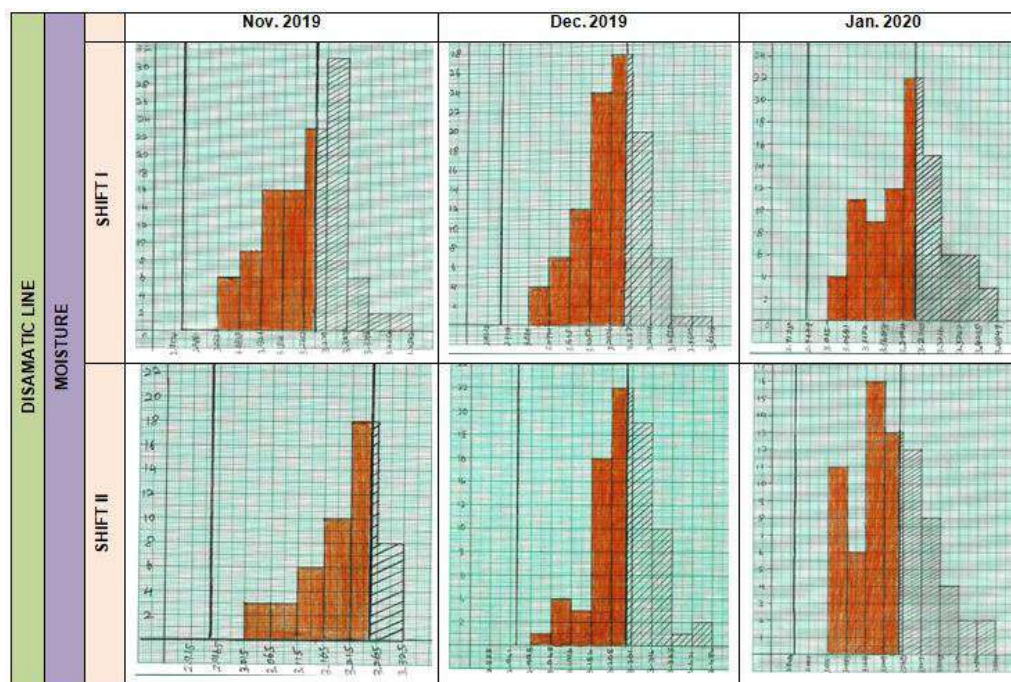


Figure 11 Histograms for Disamatic line, Moisture

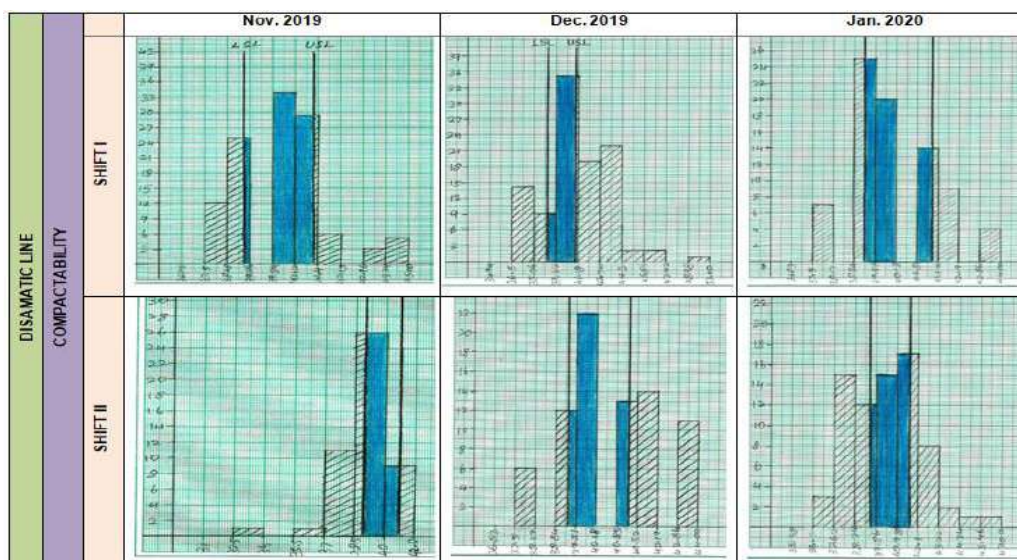


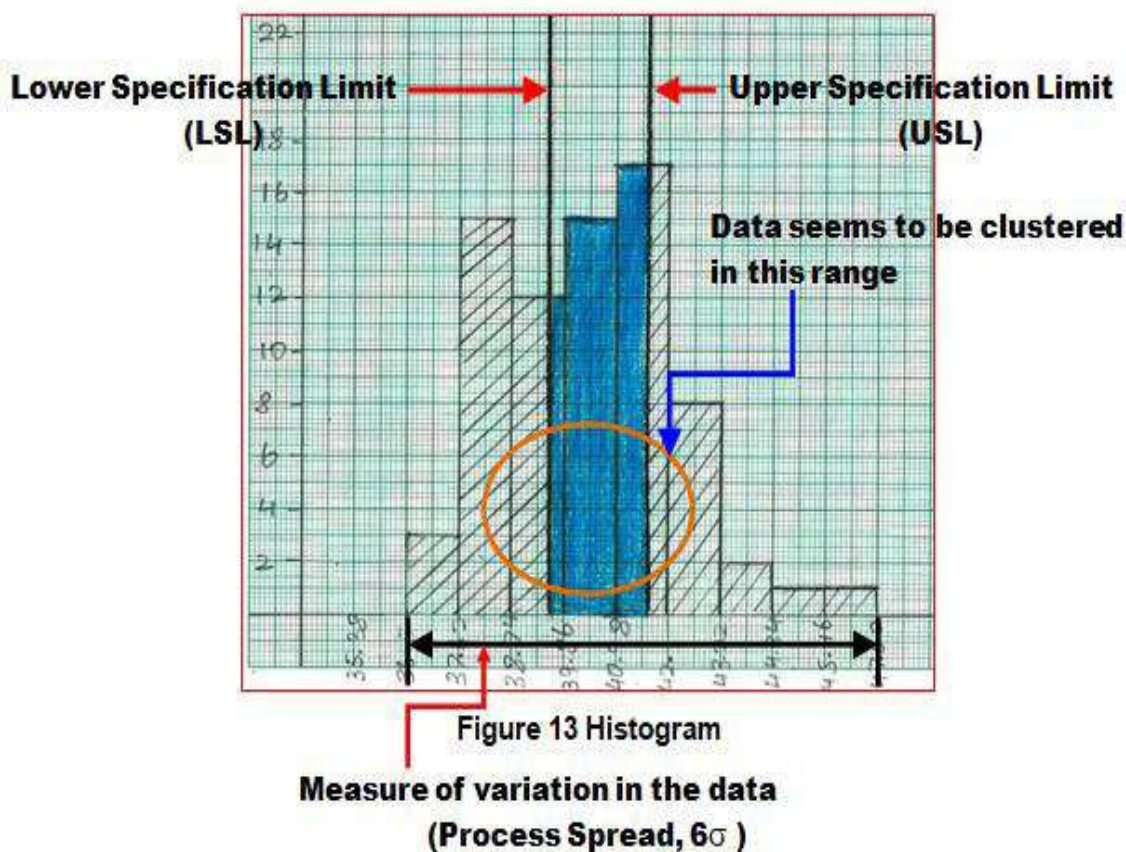
Figure 12 Histograms for Disamatic line, Compactability

Interpretation of Histograms

To interpret the histograms shown in Figures 9 to 12, let us take for example a histogram pertaining to compactability variation shown in Figure 13. It can be seen that the compactability data varies from 36.00 to 47.00 and that the variation of data more or less follows a normal distribution. Also, the data seems to be centered between 38.7 and 42.1 which mean that the mean of this distribution lies in this interval. More important, the pattern of variation of the data can be better visualized in this form than when this data was in the form of numbers in a table. Thus three important pieces of information can be obtained from such a representation.

1. The pattern of variation of the data
2. The amount of variation in the data
3. The central tendency of the data.

In the problem of condensing and summarizing the information contained in the frequency distribution of a sample of observations, certain functions of the distribution are useful. Two simple and useful functions of the observed distribution are the average and the standard deviation.



For the case shown in Figure 13, the average or the central tendency of the data is approximately 40.42 and process variation or spread is 11 units. Similar interpretations can be done for all the histograms presented in Figures 9 to 12. As a first step in the analysis of past data, it now becomes possible to quantify approximately the central tendency and the variation in the data set. Control charts were then employed to understand the whether the process was operating in a state of statistical control i.e., whether the process was under the influence of chance causes alone or whether assignable causes of variation were acting on the process.

Process Diagnosis Using Control Chart

Variation in a process characteristic is usually due to a very large number of causes. The vast majority of causes of variation may be found to be inconsequential and cannot be identified. These are termed **chance causes**. Those causes which can be identified are known as **assignable causes**.

A process operating under the influence of chance causes only is said to be in a state of statistical control. Generally, the state of statistical control is established using a control chart technique. Lack of statistical control in data indicates that observed variations are greater than should be attributed to chance. Lack of control indicates one or more assignable causes are operative. The control chart method provides a criterion for detecting the presence of assignable causes of variation in a process and hence provides a basis for action. The criterion of the quality control chart is derived from laws of chance variations for such samples, and failure to satisfy this criterion is taken as evidence of the presence of an operative assignable cause of variation.

A control chart displays lack of control when the pattern of plotted points exhibit nonrandom behavior that in turn signals the presence of an assignable cause of variation or indication of some source of trouble in future. It is common practice to think of process capability in terms of the predicted proportion of the process output falling within product specifications or tolerances. Capability requires a comparison of the process output with a customer requirement (or a specification). This comparison becomes the essence of all process capability measures.

To check whether moisture and compactability were in a state of statistical control, the moisture and compactability data given in Table 2 were subject to control charting. Since moisture and compactability are variable quality characteristics, X Bar and R charts were selected. Bowker [1] Grant [2] and provide an excellent account of the control charting procedure, its implementation in a real time situation and the method of interpretation.

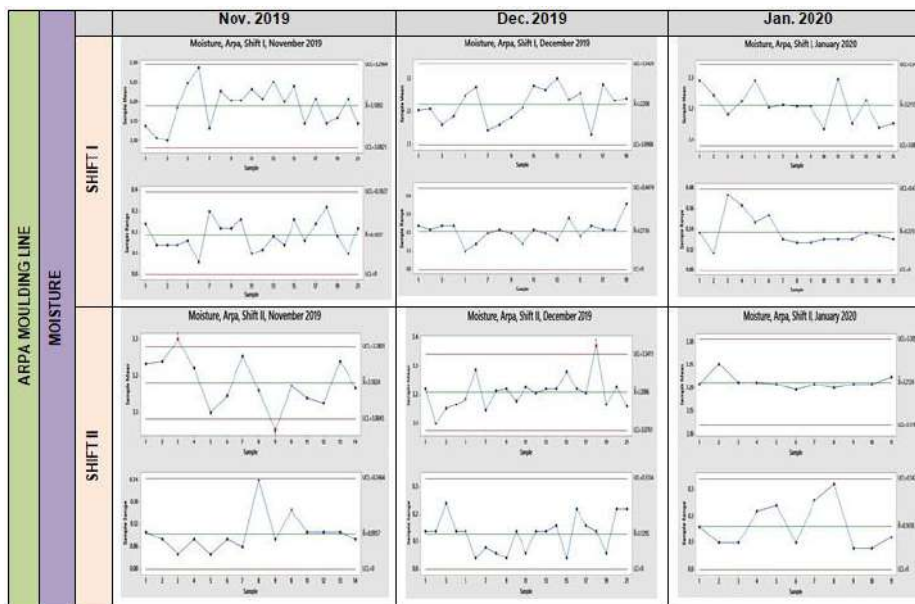


Figure 14 Control charts for ARPA line, Moisture

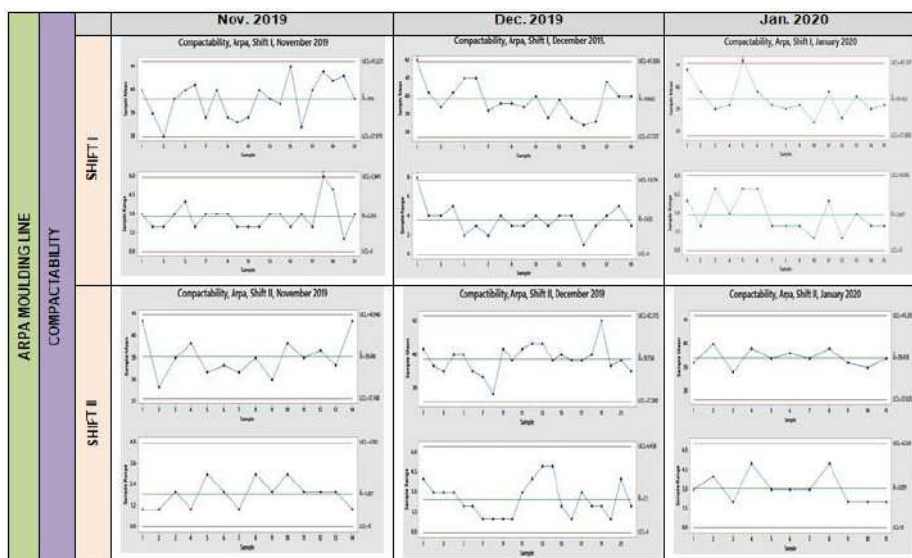


Figure 15 Control charts for ARPA line, Compactability

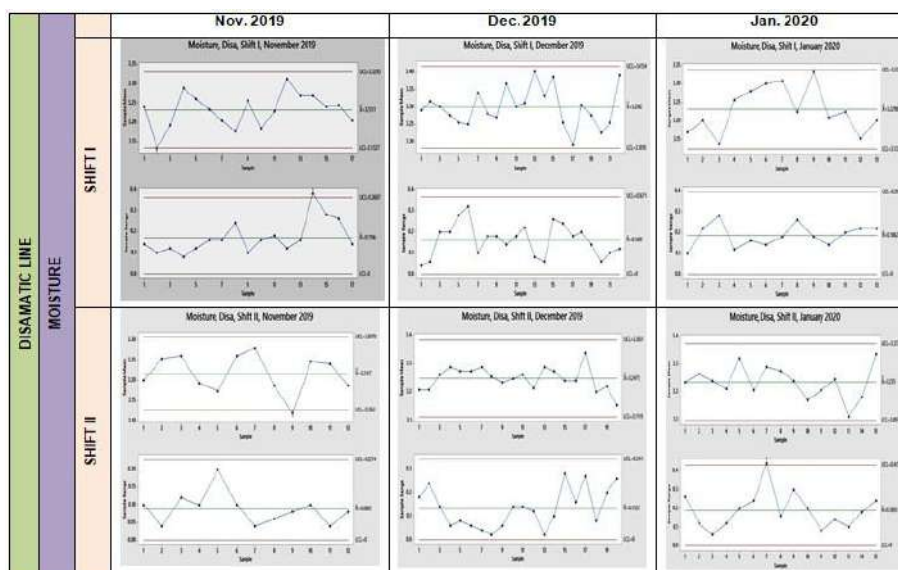


Figure 16 Control charts for Disamatic line, Moisture

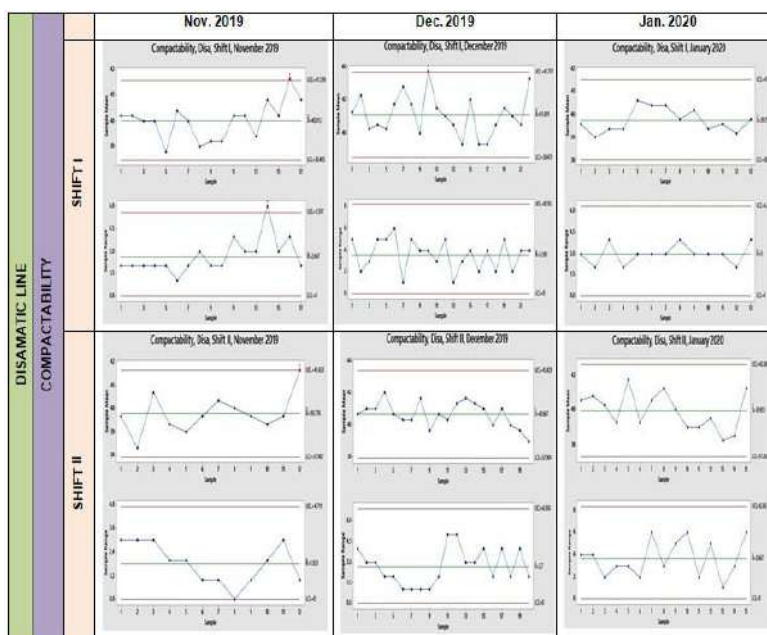


Figure 17 Control charts for Disamatic line, Compactability

On the lines of interpretation given in [1] and [2], it can easily be seen that all the control charts shown in Figures 14 to 17 indicate **lack of statistical control with respect to moisture and compactability**. Also, the application of various rules of non-random behavior given by Montgomery [3] also confirm that the **current process (sand preparation) is in a deep state of trouble**. Points and patterns indicating troubles in various control charts are shown encircled with color for brevity.

Process Capability Analysis

Process capability is the ability of the process to hold on to the tolerances. It is a common practice to think of process capability in terms of the predicted proportion of the process output falling within product specifications or tolerances. Capability requires a comparison of the process output with a customer requirement (or a specification). Two fundamental Process capability indices are the Cp and Cpk.

$$C_p = \frac{\text{Tolerance}}{6\sigma} \quad (2)$$

$$C_{pk} = \min \left(\frac{(USL - \bar{x})}{3\sigma}, \frac{(\bar{x} - LSL)}{3\sigma} \right) \quad (2)$$

where tolerance is the difference between the upper and lower specification limits and 6σ is a measure of the process spread. This can most simply be obtained by measuring the width of the histogram of the corresponding data. When a process is just capable, Cp is equal to 1. When Cp is less than 1, it simply means that the denominator i.e., the process spread or variation is greater than the numerator which is the tolerance associated with the quality characteristic. A Cp value greater than 1 implies that the process is capable.

For established and running production processes, recommended value of Cpk is 1.33. Process capability analyses using Cp and Cpk were carried out on the data presented in Table 2. This analysis can very easily be done using Minitab software or by merely superposing the specification limits for these parameters set by the foundry on a histogram as shown in Figure 13. In the present work, the latter approach is followed as it is very easy to pull out the necessary data values from the histogram provided adequate care is taken during its construction. Further, superimposition of specification limits on a histogram permits a better visual comparison of the process spread against tolerance thus enabling an appreciation of the concept of process capability. The specification limits internally set by the foundry for moisture and compactability are Moisture: 2.95 to 3.25%

Compactability: 39 to 41

The process capability indices obtained for various cases are shown in Table 3.

Table 3 Process Capability values

Machine	Sand Property	Shift	NOVEMBER2019		DECEMBER2019		JANUARY2020	
			Cp	Cpk	Cp	Cpk	Cp	Cpk
ARPA MOULDI NGLINE	Moisture	I	0.81	0.33	0.76	0.13	0.63	0.14
		II	0.97	0.44	0.61	0.13	0.91	0.21
	Compactability	I	0.26	0.14	0.17	0.14	0.17	0.25
		II	0.44	0.03	0.30	0.25	0.30	0.12
DISAMA TICLINE	Moisture	I	0.66	0.07	0.50	0.06	0.63	0.08
		II	0.27	0.38	0.61	0.98	0.61	0.16
	Compactability	I	0.26	0.22	0.13	0.29	0.01	0.12
		II	0.44	0.20	0.30	0.10	0.19	0.14

A careful review of the various process capability values clearly indicates that the **process is NOT CAPABLE** and that in many cases, the values are much less than unity. This under- capability is to be suspected and expected since the process is also not in statistical control as discussed in an earlier section. The results of all the previous analysis carried out were discussed with the top management and the necessity for a fundamental and systemic change in the process was explained. Since moisture and compactability were the parameters chosen for study, a careful review of foundry literature and several rounds of discussion with the foundry personnel indicated that compactability is a better and global parameter for foundry control than moisture. Hence it was decided to focus on reducing variation in compactability. Further rounds of brainstorming on the reasons for compactability variation in the foundry resulted in the development of a fish bone diagram for compactability variation as shown in Figure 18. The outcome of a root cause analysis on a miniscule level involving all process heads and the top management is presented in Table 4.

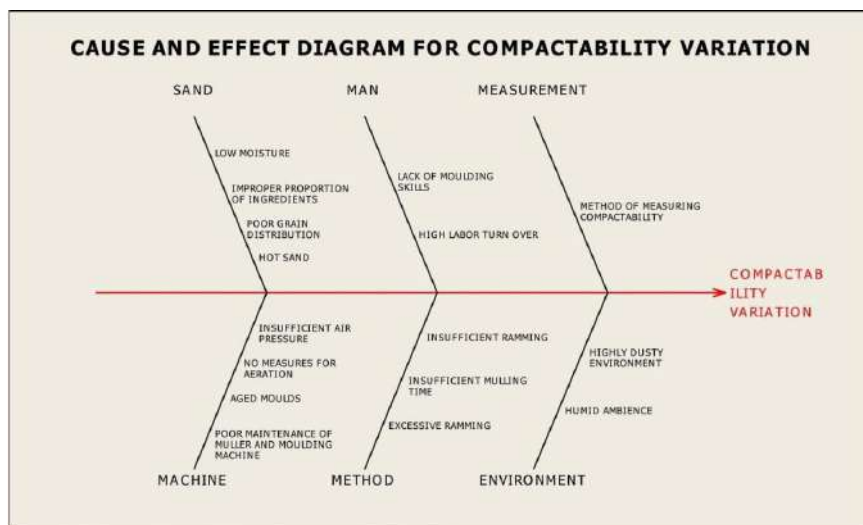


Figure 18 Fish bone diagram for compactability variation Table 4 Root cause evaluation worksheet

Physical Condition	Factors affecting the physical condition	Process parameters relating to physical condition	Root cause
High temperature of return sand	Long cooling times	High return sand temperature	Absence of sandcooler
	High pouring temperature		
	Recycling beyond threshold		
High percentage of free moisture	Knocking out unpoured moulds	Immediate knock of all unpoured moulds	Absence of sandcooler
	High sand to metal ratio	Standardize the sand to metal ratio and then freeze the flask size	Lack of standardization

Variation in moisture addition	Uncalibrated addition of moisture	Excessive moisture	Absence of provision for calibration or inadequate care during setting/wrong setting
Manual addition of bentonite	Absence of mechanization	High GCS/active clay	Absence of weighed additions
Mouldability based moisture addition due to operator's insistence	Patterns with nicks, dents and undercuts	-	Lack of Training
	Pre-conceived notions towards productivity	-	

Absence of sand cooler was identified as the root cause given the volume of castings produced by the foundry on a daily basis, the volume of sand used and related parameters. It turned out that infrastructural improvement in the sand plant and workforce training is very much essential for eliminating/ minimizing the variation in compactability. A detailed report on the status of rejections, their analyses, interpretations and suggestions were presented to the top management for their consideration and action. The need for training/ recruiting skilled workforce in areas requiring competency coupled with presence of mind was accepted by the top management while purchase of sand cooler although agreed as important was kept in abeyance provisionally for want of funds.

CONCLUSIONS

The utility of simple statistical techniques for process diagnosis and improvement in a foundry environment was illustrated with a simple case study. Systematic application of simple quality control tools facilitates a better understanding of the current state of the process. Application of statistical tools and techniques for process data demands lot of practice, patience, commitment and proper attitude. Statistical outlook, statistical training and statistically minded engineers and shop floor personnel can help bring about a fundamental change in the manner in which a process data is looked at. It is a common feeling among many in the shop floor that these tools and techniques are a mere paper work and a ritual without any meaning. It should also be kept in mind that a mere application of statistical techniques does not guarantee ready-made solution for every problem. Rather, these tools and techniques when applied with proper discipline points its fingers on where to look for. This coupled with domain-specific knowledge can help identify the problem thus helping an organization in its growth in the path of continual improvement bringing in its wake improvements in quality, productivity and hence profit.

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Filling The Skill Gap in AEC Workers Using the Virtual Reality Technology

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ABSTRACT

AEC (Architecture, Engineering and Construction) industry are growing rapidly since the late 2009, This is mainly attributed to the rapid recovery and growth of the economy after the 2008 crash. AEC organizations, especially the construction firms are hiring a lot of contract workers to match the growth in the industry. But many firms are finding it hard to acquire construction workers with the right skill level. Even if they do manage to hire the workers, retaining them created new challenges as they were demanding competitive pays. This made many construction firms to rise in the upper ceiling of pay for their construction workers. In many cases, this cost is billed to the customers. While a few customers managed to pay the higher the expected price for their infrastructure projects, many decided to halt the projects till they can gather the funds required or wait for the average wage to fall. In this paper we have developed a Virtual Reality (VR) application to increase the skill level of construction workers. Through proper training, low skilled workers can be converted to skilled workers in short period of time. This will eventually relieve the stress in the labor market. In this paper, we have shared the preliminary results of our work. We will be publishing the final outcomes soon. We are confident that this work will provide job opportunities for the low skilled workers, especially in the underdeveloped and developing nations which have a series of major infrastructure development project in their short and medium term growth plans.

Keywords: Construction, training, virtual reality and sustainable development goals

INTRODUCTION

As the global economy recovers from the recent COVID-19 pandemic, demand for office space is expected to grow [1]. AEC's are rapidly developing real estate assets that they hope to sell or lease to their clients after the pandemic [2]. This rush to develop infrastructure is straining the labor market. Presently, many real estate firms are facing difficulties in recruiting skilled worker. Thus, many firms are left with recruiting who they can and train them to meet the requirements of their work. This method is also cost effective when compared to hiring someone with high skills for high pay. In this work, we are proposing VR based training of construction workers. We believe this will not only reduce the strain on the job market, but also will increase the employability of low skill workers.

The healthcare industry is using the VR technology to train their existing staffs and using it as an education tool to train their students [3, 4, 5, 6 and 7]. VR technology is proven to be effective in training sports personnel's [8,9 and 10], armed forces [11, 12 and 13], and even the retail businesses [14]. This technology although old is attracting a lot of eyes in the recent year. VR technology leverages the advancements in tracking [15] and computation technologies [16] to generate an interactive virtual environment. The technology when used for training, it reduces both time of training [17, 18 and 19] and participation rate amongst the trainees [20, 21 and 22]. Although the cost of adapting VR technology is high [23], many firms still prefer it as it is the most suitable solution available presently which also offers scalability [24]. Adopting VR technology for training will save cost on the long term [25, 26 and 27]. Also, this technology eliminated the need for skilled trainer. Several researchers have attempted self-assisted training using the VR technology [28 and 29]. Another reason why we are proposing to train construction workers using VR technology is because of the advancements in cloud computing, Artificial Intelligence and networking technologies. These technologies have the potential to scale the deployment of VR based solutions and penetrate new field of applications which are not yet explored due to limitation in the existing technologies [30, 31 and 32]. We believe that the VR technology will act as the foundation for the future VR applications. Organizations can benefit from the growth of this technology by reducing the cost and time in training their workforce.

METHOD

We have adopted a systematic approach to build the VR application (Fig.1). Prior to building the virtual reality application, we have developed a story board to visualize our final application and to design the appropriate User Interface (UI) and interaction [33 and 34]. Fig. 2, 3 and 4 represents the storyboards with the UI design, training procedure and evaluate method respectively. We set a deadline of six months to finish this work, and we managed to build the application within the planned deadline. In this study, we have used Unity for the

application development and the HTC VIVE Head Mounted Display to immerse the trainee into the virtual environment. We have used the HTC VIVE's handheld controller for interaction purposes. The HTC VIVE system offers good level of interaction and immersion. It is to be noted that the application can be made to run on any HMD. We have used HTC VIVE because of its spread in the market space and higher capabilities when compared to other HMDs [35, 36 and 37]. The models for the virtual environment were built using Blender. The models are made to the scale. Performance parameters were kept at medium settings while building the application. We applied textures wherever possible to reduce the load on CPU and GPU. The application is built to run on windows workstations. Since, the application is built on Unity, it is possible to build the program to run on other platforms such as iOS and Linux without changing the core application. We intend to evaluate our work with inputs from three AEC firms and publish the results soon.

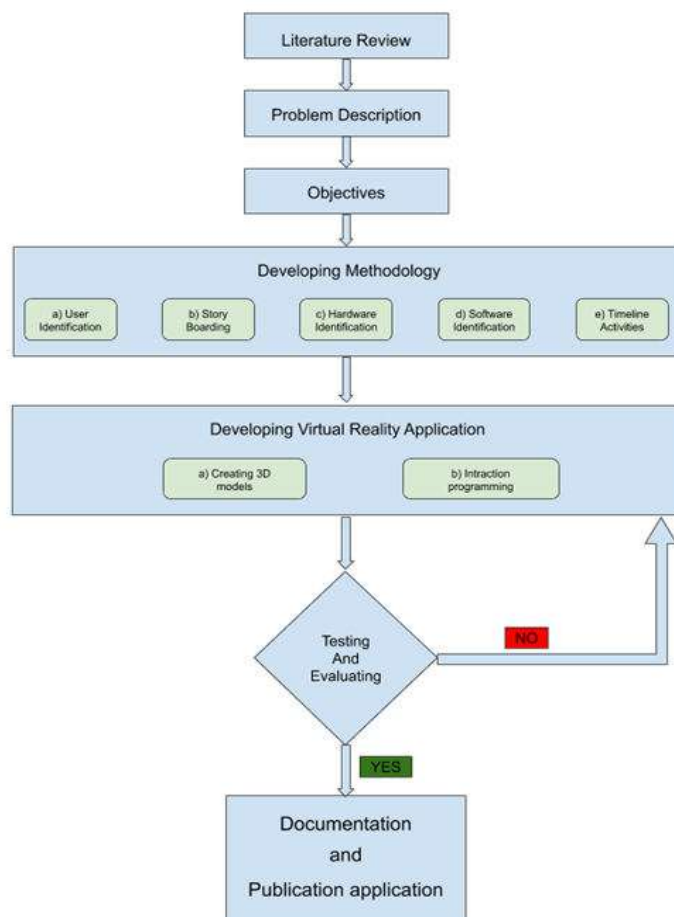


Fig. 1. Systematic Approach that we have adopted to build the VR based Training Application

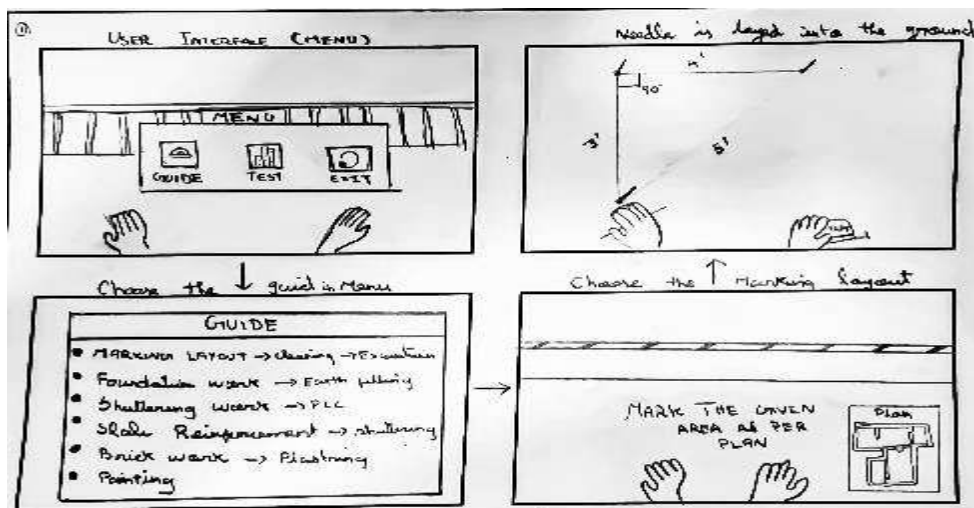


Fig. 2. Story Board - User is navigating through the UI

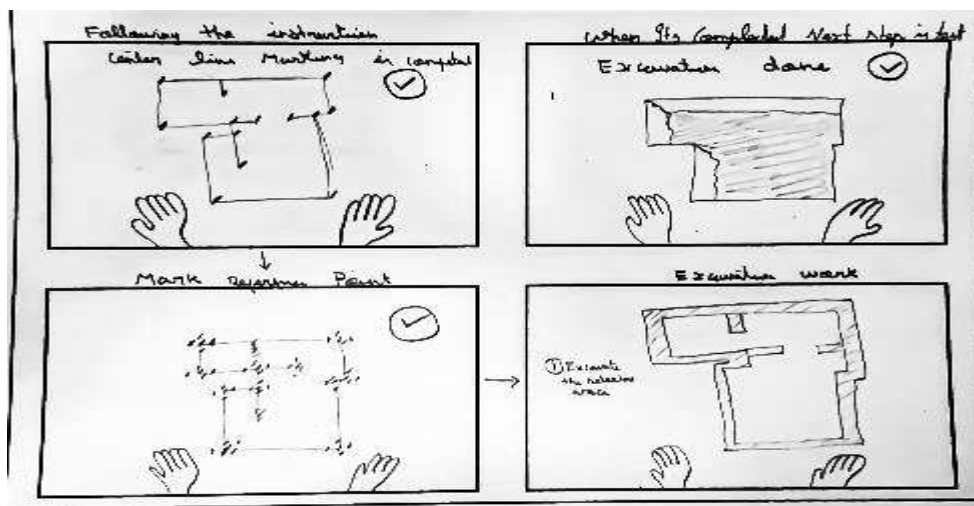


Fig. 3. Story Board – User is following the instructions provided and executing the same in the virtual world

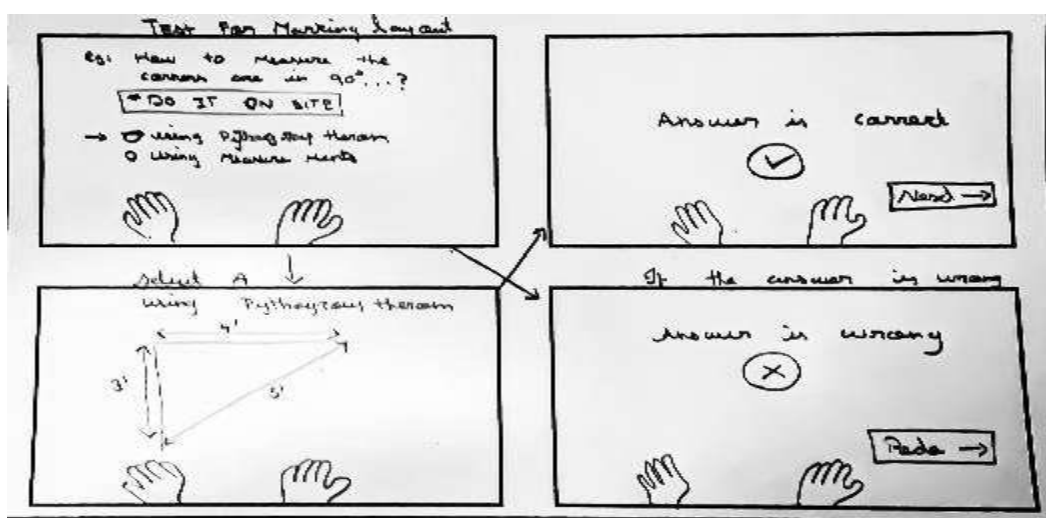


Fig. 4. Story Board - User is tested for his knowledge in the virtual world

DISCUSSION

We have built a VR application that the AEC firms can use to train their construction workers. The application will assist the trainee in learning various operations that are usually carried out at a construction site. The application is built with the principles of “Learning by Doing”. Thus, the trainee will be performing the tasks assigned to him in the virtual world which will be monitored by the software application for the correctness. If the trainee deviates from the assigned task, the trainee will be prompted to repeat the operation. Fig. 5 and 6 are the first-person view of what the trainee is seeing through his HMD. In the figure shown (Fig 5 and 6), the trainee is asked to select the site plan to interpret it. After completing the task, the trainee can test his knowledge by taking a short quiz (Fig. 7). The trainee will be taking the quiz inside the virtual environment, if his scores in the quiz are not satisfactory or if the trainee is passionate about learning new things, the trainee can use the VR application to learn and grow.



Fig. 5. UI Prompting the Trainee to Select the Site Plan



Fig 6. Viewing the plan in the virtual environment

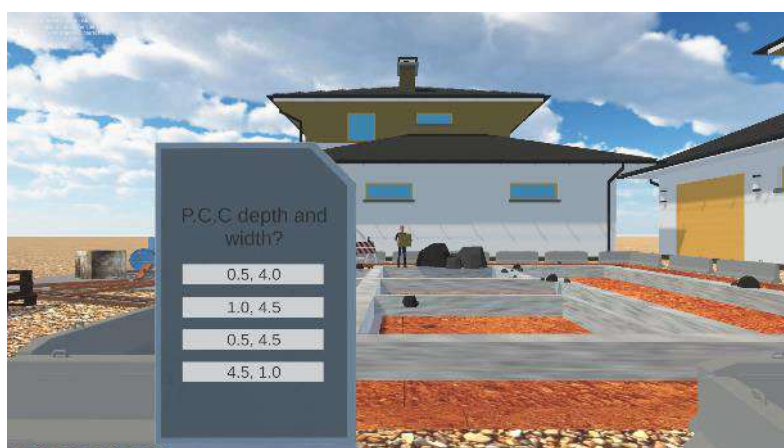


Fig 7. Trainee is tested in the virtual environment

CONCLUSIONS

In this paper, we have discussed in detail the procedure that we have adopted to build the VR based training application to solve the skill shortage problem in the AEC industry. We are planning to evaluate our application with assistance from a few AEC firms in the county. We will be publishing the results of the evaluation in the next paper.

ACKNOWLEDGMENT

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Green Entrepreneurship Inclination among Young Generation towards a Green Economy in Salem District

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ABSTRACT

Research on green agents has been upon particular specialists, dismissing increasingly broad money related and social settings inside which they work. By looking progressively broad frameworks of help, we suggest that discussions of the businessman upgrading and changing vital approaches are misrepresentative. Strategy/approach – Semi-organized meetings to examine green business enterprise with green structure organizations and arrangement creators. Discoveries – Combined with new requests from shoppers for all the more ecologically the neighborly items and administrations, changing state of national and worldwide economies are prompting new types of business. We recognize various strains between approach goals and organizations' were encountered on the ground. Research confinements/suggestions – until this point, inquiries has been embraced in the Salem region. Innovation/estimation of part – By consolidating strategy and bolster associations, and casual systems of help, the section difficulties the prevailing perspective on the solitary enterprising legend and focuses to the essentialness of systems for encouraging green business enterprise. This will be of significance for approach producers and funders of business programs.

INTRODUCTION

It is our obligation to manage the home we live in because Planet Earth is our home. Environmental challenges such as "global warming" are well known to pose a threat to the ecosystem and our own existence. Because of technical advancement, changes in the economics, and political influences, organizations all over the world are experiencing things that are fluctuating more than ever before. True, there has been a considerable shift in likes and inclinations as a result of advancements in innovation and alterations in consumer lifestyles. Various examinations into customer preferences have clearly revealed that customers are now aware of their own health and condition. It could be a major point that each company is seeking to fill the need by supplying environmentally friendly products and will, in general, adhere to green advertising practices. This perception has spawned a new breed of entrepreneurs known as "green business visionaries," who seek to tap into this hitherto untapped market by delivering environmentally friendly products and employing environmentally friendly procedures to attract customers. Since a decade ago, the concept of green enterprise has gradually gained traction and has snatched the attention of the entire world. As a result, it's possible that the concept of green products and green marketing is slowly but steadily gaining traction in the market. It could also be a possibility for businesses who believe in developing and improving their products and services in an environmentally friendly manner. This could be an ideal time for entrepreneurs who want to take advantage of the growing green market.

Concept of Green Entrepreneurs

Entrepreneurs are those who like establishing, advancing, and maintaining monetary activities with the purpose of generating and appropriating wealth. The individual as a business creative is an important component of monetary innovation and financial change. However, the rise of a businessperson in the public eye is heavily reliant on the interconnected societal, monetary, social, strict, and mental variables.

Defining entrepreneurship might seem simple, but it is not so in practice. This is because there are about as many entrepreneurship definitions as there are people who have written on the subject. Each person seems to have his individual thoughts about what it and how best to classify it. The following are the fundamental characteristics extracted regarding green entrepreneurs based on basic definitions provided by writers.

- They initiate new unsafe business adventures wherein the result of the business is dubious.
- They are inalienably propelled. Their point behind maintaining a business responsibility isn't simply acquiring benefit yet additionally serving the general public.
- They intentionally target covering those monetary exercises that will have a general beneficial outcome on the regular habitat and on financial manageability and a superior future.

- They face colossal difficulties, for example, responsibility from the open segment, providers and purchasers.

Objectives of the Study

- To distinguish the components to energize green business people in Salem District.
- To inspect the systems of the Green business visionaries gainful to support its business in Salem District.
- To propose the imaginative arrangements in compatibility of making effective Green business person in Salem District.
- Relevance of Green Entrepreneurship in empowering business development and monetary flourishing in Salem District.

Significance of Study

Green development has remained a first-class term for large corporations and established partnerships, as well as a tool for corporate social responsibility and improved reputation. However, with shifting customer behavior and growing breakthroughs in training, pay, and other social records, green business is catching the attention of the younger generation, and government open establishments are playing a positive role in strengthening ecological worries. The following decade will undoubtedly observe fast globalization, industrialization, innovation extending in the economy. Assets, being constrained, the globe needs to discover intends to reach in a way which isn't negative to normal assets and to endurance of humankind on this planet.

Consequence of the Study

As the job of women in the field of monetary advancement is to be given need, Indian Government has found a way to include green business enterprise by giving them money related and non budgetary help. Presently it is discovered that some green business visionaries effectively run their venture. Regardless of the exertion of the Government, the development of green business visionaries is still not to the desire for the Government. There are numerous purposes behind the moderate development of the green business visionaries. Some of them are not appropriately instructed, they don't know about the help accessible to them and they are not getting required help from the general public. Empowering creative activities is the best method to keep up or increase the speed of financial development. It is necessary to consider the green enterprise trend among young age of business enterprise development for this.

Scope of the Study

The current study equips the researcher with knowledge of the green enterprise trend among Salem's younger residents. This research is extremely relevant to the present topic of green commercial enterprise development. An attempt has been made to determine the many causes of the aforementioned problem. This study also suggests important therapeutic methods to reduce the challenges that green business visionaries have in starting - and maintaining - their businesses.

Research Methodology

The nature of the research topic and data accessible from primary sources lead to the conclusion that a "Judgement Study" is the best technique to complete the assignment.

Data Collection

The study used both primary and secondary sources of information. The primary data was obtained directly from a Salem District green entrepreneur. The secondary data was gathered from books, records, and reports and used at appropriate places in the current study.

Sampling Design

The sample procedure is solely based on the examiner's or Research's assessment. The study lacks information about the population from whom the sample must be taken. Although the population's features or qualities are unknown, a sample must be chosen. The judgement sampling method is employed in this case. The field investigator decided that the sample would be made up of any item he wanted.

KMO AND BARTLETT'S TEST

Bartlett's Test of Sphericity	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.688
	Approx. Chi-Square	975.526
	Df	21
	Sig.	0.000

Source: Computed from Primary Data

Bartlett's trial of Sphericity assesses the invalid theory that the connection framework is a character grid (every one of the qualities in the corner to corner are 1 and all the off-inclining esteems (connections) are zero), which would demonstrate no connections among the factors, and in this way no premise on which to continue with factor investigation. A critical test outcome enables us to dismiss this speculation.

EXTRACTION METHOD: PRINCIPAL COMPONENT ANALYSIS COMMUNALITIES

S.No	Factors	Extraction
1	I believe entrepreneurship is an honorable profession.	0.744
2	I feel entrepreneurs have a sense of social justice.	0.703
3	I believe entrepreneurs are optimistic.	0.865
4	I think entrepreneurs will do whatever it takes to make hisBusiness a success.	0.567
5	I think entrepreneurs exploit environment for makingmoney.	0.678
6	I believe that entrepreneurs are adventurous	0.716
7	I feel entrepreneurs are able and willing to take risk.	0.703

INTERPRETATION

The above table shows that commonness esteems. This is caught by the separated components. As the extent Communality can be characterized of difference in any of the first factors; the historical backdrop of the determined segments is illustrated in the Total Variance Explained table. It is noticed that the main segment represents the most difference 86.5%, the second records for the second most noteworthy sum 74.4%, etc.

TOTAL VARIANCE EXPLAINED

Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation sum of squared loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.866	40.946	40.946	2.866	40.946	40.946	2.863	40.902	40.902
2	1.102	15.740	56.687	1.102	15.740	56.687	1.089	15.551	56.453
3	1.007	14.390	71.077	1.007	14.390	71.077	1.024	14.624	71.077
4	0.890	12.717	83.794						
5	0.720	10.291	94.085						
6	0.241	3.447	97.531						
7	0.173	2.469	100.000						

Extraction Method: Principal Component Analysis

INTERPRETATION

Three segments are removed on the grounds that Eigen esteems are > 1. This implies 71.077% of the difference is being caught by the extricated factors together while the variable Elevators inside the store displays a low commonness estimation of 0.890 Together they represent roughly 71.077% of the fluctuation. From the table it very well may be seen that 5 components were separated and held. This suggests just 89% of the change in factor is caught by the separated variables. The historical backdrop of the determined segments is illustrated in the above table.

ROTATED COMPONENT MATRIX

S.NO	FACTORS	COMPONENT		
		1	2	3
1	I believe entrepreneurship is an honorable profession.	0.862	0.015	-0.022
2	I feel entrepreneurs have a sense of social justice.	0.838	0.008	-0.025
3	I believe entrepreneurs are optimistic.	-0.008	-0.007	0.930
4	I think entrepreneurs will do whatever it takes to make hisBusiness a success.	-0.051	-0.683	0.312
5	I think entrepreneurs exploit environment for makingmoney.	-0.044	0.786	0.241
6	I believe that entrepreneurs are adventurous	0.844	-0.49	0.34
7	I feel entrepreneurs are able and willing to take risk.	0.837	0.035	-0.36

***Extraction Method:** Principal Component Analysis.

***Rotation Method:** Varimax with Kaiser Normalization

Recommendation

Subsequently, India, of today, is quick changing into an information based economy and with the high potential and capable pool of HR, it is unavoidable to tackle this pool to making an independent country of green business visionaries. It is significant, at this crossroads, to submit towards building and empowering such condition to create fruitful business people. A few suggestions can be sketched out to make this alternative a suitable one at individual, network and national level.

Enhancing Green Skills

Green enterprise can't be important except if these business people comprehend the genuine significance of green business. Green abilities are the preparation and information and experience that can be used in adjusting innovation or materials that limit natural risk.

Incubators of Innovation:

Stage for brooding of imaginative thoughts before they are gotten under way should be set up and an eco framework which supports testing of thoughts need to made and upheld. A solid framework would energize an ever increasing number of youthful business visionaries to explore different avenues regarding thoughts and test steering assimilates a lot of hazard.

Public- Private – Community – Partnership

The foundation of the manageability of green ventures is a beneficial partnership. The ternion can provide the crucial component for using development, innovative adaptation, and adaptability to reach the pyramid's base.

Policy- Designing

Strategy way to deal with urging green endeavors should be set up and actualized adequately to accomplish solid consequences of changing the social and monetary scene of the nation. Strategy activities go far in creating certainty and potential to start into green endeavors.

Greater Awareness and Attitude Building for Purchasing:

Requirement for an inspirational frame of mind towards buying natural items is basic to make interest for these items and guaranteeing a development for more areas to embrace green procedures. Subsequently, mindfulness drives alongside show of better item ascribes should be attempted through a very much structured correspondence technique and positive expression of – mouth.

Start- up Capital:

A beginning economy and a youthful enterprising country, similar to, India, experience the ill effects of a greatest restriction as far as innovative activity and that is absence of money related help and nonattendance of home loan free advances. This factor hinders a great deal of youthful business people from undertaking a hazard in the unchartered domains. Instruments like funding, holy messenger financial specialists unsubsidized and simple to acquire business credits should be fortified to expedite a bigger extent of populace board.

CONCLUSION

Along these lines, the degree for green business enterprise is consistently developing and the earth business is ready to lead from the front as far as work and income age. The millennial respondents know about the rising open doors in the earth business and are focused on financial improvement in the most reasonable way with ecological, social and moral qualities assimilated in their green endeavors. This positive inclination must be relevantly bolstered by satisfactory biological system which joins pioneering, preparing, innovation, budgetary help, charge occasion advantages, and concessions to use the developing inspiration of the youthful populace. Green business is the most economical answer for the rising unevenness of nature and quick devastation of characteristic assets. A conscious concentration to embrace Green economy must be cultivated for the advancement of green ventures which would upgrade the flexibility of economy and a characteristic bio framework. They offer huge commitment, in giving business and creating salary as well as fill in as motors of progress, harbingers of development, new thoughts and go about as impetus to adjusting new innovations with adaptability and maintainability. The future belongs to the young, who are acquiring limited shared assets and are thus resolved to meet the growing requirements of the population through productive and viable asset utilization while being environmentally and socially responsible.

Data Availability Statement

Absence of the data due to confidentiality issues.

Ethics approval statement

I Accept that the content hasn't been plagiarised

Declaration of Conflict of Interests

The author declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article

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Hybrid Encryption Algorithm for Security of Images against Cryptographic Attacks

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ABSTRACT

Recently, the establishment of secured interchanging of data is a bombarding task. The growth of information increases day by day because of the technological developments. Thus, security has gained vast significance and became an essential task from the perspective of users. Various types of information are being communicated through public channels. Though several cryptographic algorithms are developed to preserve the shared information, yet some conventional threats are not being eradicated. So, we propose hybrid encryption algorithm that makes the security system stronger than usual. Here, a modified - Advanced Encryption Standard (AES) algorithm is presented. Key generation phase is the critical and important part of it. It should be strongly designed such that anonymous cannot predict the keys for altering the information. Genetic algorithm (GA) is adopted for optimization of keys. Genetic operators are infused with the data and the genetic keys for encrypting the data. Lastly, the similar procedure is carried for decryption process.

Keywords: Information Exchange, Genetic operators, Key generation, AES and Image Security.

1. INTRODUCTION

Recent developments in arena of information processing technologies have influenced the growing of information exchanging process across the public networks. The sharing of multimedia contents across public networks has become a daily part of human life. Attackers can impersonate a company and fool the data security measures into revealing personal and organizational level information. Because hackers are all over and nothing is secure, businesses must implement security actions. Thus, security essays an essential role in several real time applications like Facebook, twitter etc [1]. Ensuring security is a hard task because attackers are developing sophisticated methods to circumvent companies' security and safety policies.

Encryption is most feasible option offered to preserve the data. The important and sensitive data being constructed in an illegible form is called encryption [2]. In the present scenario, a huge quantity of data is generated which opts global and local networks. Data is being exchanged in different forms, such as audio, image and other files. In specific to the image has to be secured at a high level in this digital world. In a nutshell, encryption is used whenever there are remote possibility of risk. Therefore, encrypting the images [3] has become crucial factor of the research area of the study.

Imaging security [4] is a significant issue in communication. The fact behind the cryptographic schemes is to convert plain text into ciphertext using secret keys. As we know, the cryptographic algorithms such as data encryption standards, AES [5], RSA, SHA etc are widely explored for protecting the information. For the image sharing systems, the mechanism of sharing images should be done effectively. To evaluate image encryption schemes, image properties such as texture, smoothness, and edges are to be carefully examined in order to find greatest and most reliable solution.

The research paper is organized as: Section 2 discusses the literature review; Section 3 we provide a detailed overview of the research methodology; Section 4 states the experimental analysis and obtained results and lastly in section 5 the conclusion is presented.

2. LITERATURE REVIEW

Various cryptographic algorithms were explored by researchers. Still, the proficiency of the cryptographic algorithms is not achieved in large-scale applications. The authors in [6] proposed a cryptanalytic model that combined the concept of hyper chaotic encryption of images and DNA encryption scheme. It is inferred from the study that the process lowered effectiveness of detecting the chosen-plaintext attack. Every image pixel was investigated by the schemes like permutation, substitution, and forward diffusion. The mechanism has achieved minimized computational time with the lowered permutation effects i.e., the efficiency degrades if there are any modifications in the pixel combination.

The authors in [7] represented a chaos-based encryption technique for images in the medical field. Here, the key generation was improved by DNA computation technologies. SHA 256 hash function was adopted to generate secret keys for chaotic systems. It is dynamic in nature; a high complexity was observed in the encryption

process. Along with that, a linear congruential geometry was implemented for finding advance encryption model for all environments.

In [8], for a double chaotic system, the researchers proposed a DNA encryption process. The chaotic part is optimized by two slave lasers-based encryption schemes. During security constraints, the chaotic carrier was upgraded by the mechanism of encrypting and decrypting. Likewise, conventional attacks were detected under the chaos synchronization process. Key space considered by the encryption technique is greater than the decrypting mechanism. Pixel distribution becomes uneven when the quantity of image input alters.

In [9], the researchers designed an encryption technique under public-key cryptosystems that handled the multiple images. Here, the ghost imaging model was implemented to manage those multiple images. It was inferred that quality of reconstructing the images after decryption images has lowered the information entropy rate. Due to random sampling performed using permutation operator, the pixel patterns were distorted. Likewise, the noise in images was not concentrated which also decreased the reconstruction quality.

The authors in [10] introduced 2D logistic adjusted sine map-based encryption technique on images which has proved strong security for almost several real-time applications. The system elevated the computational capability when parallel processing was increased.

3. PROPOSED METHODOLOGY

Here we provide detailed knowledge about the structural overview of the projected technique.

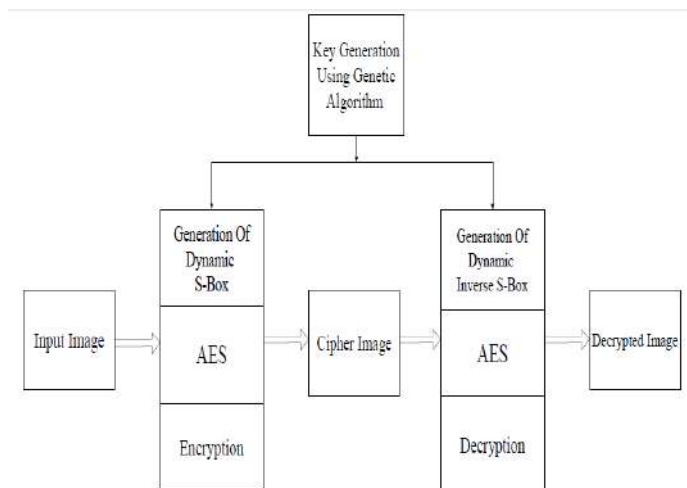


Figure 1 - Proposed Modified-AES Algorithm

Details about the various phases are explained as follows

3.1 Data collection and pre-processing:

Pictures are collected from a public library. The obtained images are subjected to irrelevant noises which are pre-processed using simple random sampling and the gray conversion scale modelling.

3.2 Encryption and Decryption Process:

The gray-scale images are input to modified AES. The major strength is generating private keys that are optimised using GA. The efficiency of the AES algorithm is solely determined by the length of the key which is optimized by GA. Generally, it takes 128 bits key length for cryptographic process of the data. The work is processed by AddRound key which has 9 rounds. For each round, four words will be used as round key.

3.2.1 ADVANCED ENCRYPTION STANDARD:

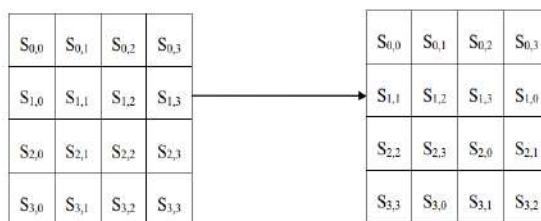
a) Bytes substitution process:

The procedure begins by performing the lookup using 16×16 matrix of byte values known as s-box. Random permutation is carried out over the pixel samples. The value of S-box will support in developing the S-box tables to execute multiplicative inverse operation for all the entries. To strengthen security of AES cipher, dynamic S-Boxes is developed by implementing GA.

b) Transformation of shift row:

As the row of shifts passes towards individual bytes by altering each row. The second row will be shifted by one byte, and the third followed by fourth rows are shifted by continuing with the second row. It is given as

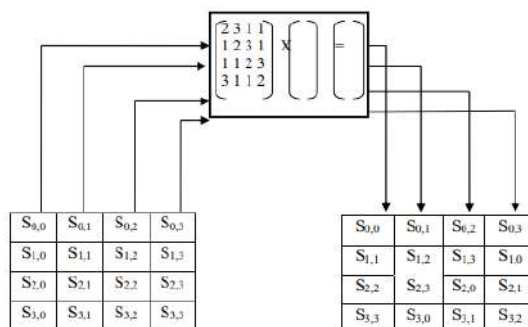
Figure 2 - Rows transformation process



c) Transformation of column mix:

Now operations will be performed on columns. Each column is replaced with new values obtained by combining four bytes in column. It is resultant of product matrix, i.e., sum of elements from 1st row to 1st column.

Figure 3 - Column transformation



3.2.2 Encryption Process

Here, initial text has been taken as population of GA. It is assumed that each and every byte is generated with parent bits (genes). And also, it is strictly followed that each parent takes only 2 rounds, after that it is replaced which is known as new generation. The final generation is selected for further rounds in similar way.

3.2.3 Decryption Process

The decryption method, as we know, is the reversible process of the encryption technique. The cipher data is decrypted using a genetic key. Along with the primary key generated from standard AES, the genetic key in first column and first row of table are shifted accordingly until the coordinates are matched.

4. Result Analysis and Discussion

This section shows the experimental analysis of proposed modified-AES algorithm. MATLAB was used for the implementation. The experiment is conducted on two images. Figure 4A represents a JPEG image with dimension 640 x 1758 and Figure 4B represents a PNG image with dimension 206 x 1035.

Figure 4 – Original Image

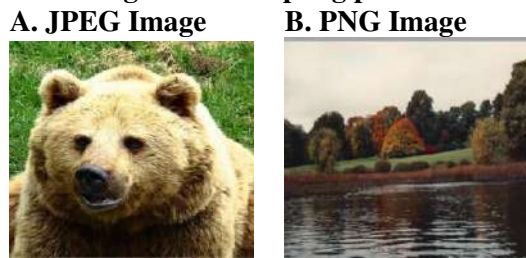
A. JPEG Image

B. PNG Image



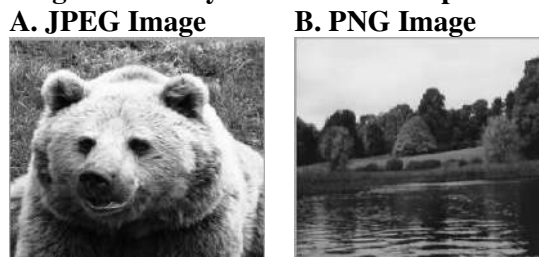
Initially, the input images are pre-processed using the sampling and gray conversion process. The figure 5 depicts pre-processing done by sampling method. Initially, the input images are taken, then the sampling operator is done. There is a significant difference in the arrangement of the pixels, which is discovered. Following the sampling process, an image of fine grain is obtained.

Figure 5 - Sampling process



The figure 6 presents the gray-scale conversion process. The colour image is first converted into grayscale images during the encryption process. The RGB values are computed with possible combinations of 1 and 0.

Figure 6 - Gray-scale conversion process



The figure 7 presents the AES encryption process. Here, the primary key is optimized by using genetic algorithm.

Figure 7 – AES Encryption process

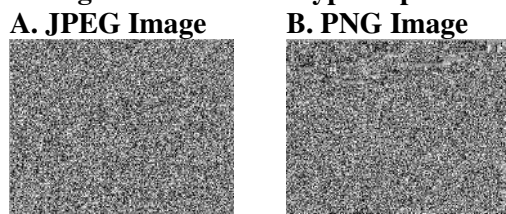


Figure 8 presents decryption process. Cipher image is decrypted by performing reverse operation of AES. As previously stated, image encryption - decryption may include some form of loss function. If the observed information loss is lesser than the actual values, system is declared as an effective scheme.

Figure 8 - AES Decryption process



Performance metrics includes Entropy, Correlation coefficient, Peak Signal to Noise ratio (PSNR) and Mean Square Error (MSE) are examined and reviewed here. Table 1 presents the performance value of the system.

Table 1 – Performance Metrics

Performance metrics	JPEG Image	PNG Image
Entropy	7.885	7.018
Correlation coefficient	0.9569	0.9867
PSNR	55.68	50.25
MSE	65.60	26.73

5. CONCLUSION

In our research paper, we design a novel and lightweight AES which preserves the information stored in the images. The security over the image encryption process requires a higher level of security to accommodate the security constraints of real-time applications. Here, AES key is optimized using GA which makes the lightweight design. Key generation takes place by significant parameters of GA like selection followed by crossover and finally mutation. These are then fed into the substitutional key phase of S-box in AES which ensures stronger security. The proposed experimental results have stated that the optimal key generation has reduces brute force attacks.

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E-Portfolio: A Tool to Enhance Constructivist Online Learning Environment (COLE) in Higher Education

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ABSTRACT

Technology has created ample opportunities and ways to develop new pedagogical approaches to education. In order to generate a positive learning environment for the active participation of students, it is necessary to incorporate technology into education. The learning environment significantly affects the degree of accomplishment and therefore stimuli-rich environments improve the learners' output. There are many theories of learning that are closely related to technology. The theory of constructivism seems to have gain momentum and popularity in today's world. The numbers of e-learning technologies, especially social networking websites are one of the effective tools for creating and enriching constructivist educational environments. Currently there is an evolution in the field of education with the shifting of attention from conventional approach to innovative approach. But, the objective of HE (Higher Education) may not be able to achieve without implementing innovative technique. E-p (E-portfolio) is one of the tools that can be adopted to blend the constructivist theory with online learning. This paper explores the concept of E-p, constructivism in HE, constructivist learning environment, followed by a discussion of e-portfolio for constructivist online learning and offers the rationale for considering the introduction of E-p in H E. It also describes how the use of e-portfolios in the higher education provides authentic learning experience and how it can connect students' academic experiences with employer expectations. It elaborates on e-portfolio as a tool in creating and designing a constructivist online learning environment.

Keywords: Learning environment, E-p, constructivism, HE, employability skills, online learning.

INTRODUCTION

The changes in the world scenario due to covid-19 pandemic outbreak are one of the main reasons in appealing the teachers to utilizing advance form of online learning technique making it compulsion even in the secluded areas of India for continuing education. The objective of higher education may not be able to achieve without implementing innovative technique. The fact that there is a rising number of educated unemployed youth is the indication of the existence of employability skills gap between output of academic education and corporate world. In this respect, to promote employability skills and to bridge the skill gap, a new approach and a new learning environment need to be developed. There is, in fact, an evolution in education, with a shift in emphasis from a conventional approach to a new approach. Technology has created ample opportunities and ways to develop new pedagogical approaches to education. In order to generate a positive learning environment for the active participation of students, it is necessary to incorporate technology into education. The lack of e-learning has prevented many learners from having full access to its benefits. There are many theories of learning that are closely related to technology. Constructivism is one of the most sought after theories of learning in today's world. The popularity of this theory can be attributed to the frustrations encountered by educators with behaviourist instructional methods. "With the emergence of collaborative technologies, it has been recognized that behaviourist models do not fit with contemporary teaching and learning environments" (Kundi & Nawaz, 2010), therefore, in the latest fashion of e-learning mode, it is necessary to include cognitive resources so that the teacher and student can be adapted to intellectual relationships to promote engaging, critical thinking and higher-order learning and to provide specific material experiences (Young, 2003). E-p is one of the potential technological means as it is flexible in monitoring and assessing student academic achievement in education (Stefani et al., 2007). Congenial learning environment that sustains a constructivism is valuable for the students in the existing generation as it increases motivation and retains the information, knowledge and skills by actively engaging the learners. In a collaborative framework, the constructivist philosophy maintains constructive learning where the construction of new knowledge is made possible based on students' previous skills and understanding. The numbers of e-learning technologies, especially social networking websites are one of the effective tools for creating and enriching constructivist educational environments. In this regard, E-p is one of the valuable tool for constructivist learning supporting and fulfilling a wide range of educational concepts and activities.

E-portfolio

Usually, the word 'portfolio' is a compilation of artifacts that users show or represent their skills, achievements and provide proof of the outcome of learning. With the advancement in the technology sector, the idea of E-p has now replaced the conventional paper-based portfolio. The E-p is a multimedia compilation of data demonstrating the learning and achievement of students. "E-portfolio have been found to foster active learning, motivate learning and empower students, which support the constructivist theory of learning" (Mason et al., 2004). It is one of the flexible alternative tools for student, teachers and administrator to assess and evaluate the learning outcome of the learners. An E-p is defined as " a digitized collection of artifacts, including demonstrations, resources, and accomplishments that represent an individual, group, community, organization, or institution" (Lorenzo & Ittelson, 2005). E-p has evolved and gained more momentum and popularity as a teaching- learning platform in HE over the past few decades (Bryant & Chittum, 2013; Deneen, 2013; Lorenzo & Ittelson, 2005, Miller; R., & Morgaine, 2009; Shroff et al., 2013) and there is a need to redefine the philosophy and pedagogy of education to address to the needs of learners in a rapidly evolving environment.

Constructivist Discourses in HE

"Based on the works of Jean Piaget, Lev Vygotsky, Jerome Bruner, Howard Gardner and Nelson Goodman, the theory of constructivism arose from the field of cognitive science" (Nunes & Mcpherson, 2003). "Constructivist theory has encouraged educators to build constructivist pedagogy since its inception as epistemology and philosophy" (Yilmaz, 2008). In constructivism, learners play an active role along with personal and social experience in constructing new knowledge. Constructivist pedagogy is "the creation of classroom environments, activities, and methods that are grounded in a constructivist theory of learning, with goals that focus on individual students developing deep understandings in the subject matter of interest and habits of mind that aid in future learning" (Yilmaz, 2008). In 1966, Jerome Bruner developed the constructivism theory. In the development of constructivist theories, Jean Piaget and Lev Vygotsky played pivotal roles. Adopting these theories can promote in-depth learning and practical application. It can also enhance learner's ability to tackle real-life and practical challenges.

"Within the formal education, the constructivist view is progressively been acknowledge at least at a discursive level and almost all the emerging online learning literature refers to learning as a social experience, and assumes that flexibility offered by online technologies can help support the needs of diverse learners" (Gulati, 2004). In the Indian context, generally many learners in the higher education level have probably already grasps enough related knowledge and information in theoretical aspects in their concern areas of studies, but it is doubtful that they have reached the realms of practical arenas and are competent enough to form new knowledge and skills. Shortage of proper facilities and infrastructure is one of the main reasons that teachers still opt for traditional classroom mode. One of the key objectives of HE is to address the unemployment issues that concern many young people. And one of the causes of educated unemployed youth includes the lack of employability skills, the skills that are not aptly taught in the academic classroom. Education in the limited four wall classroom environment does not favourably bridge the skills gap. The skills that the employers are looking for from the perspective employee do not match due to lack of advanced tools and facilities to foster constructive learning environment. Rather than waiting to be spoon fed, teachers as facilitators must motivate learners to think, pose questions, seek answers to problems, and build knowledge. Traditionally, in formal education, many presume that knowledge are imparted or pass on by teacher to learner in the form of lecture and instruction. There is no doubt that this system is effective to some extent. But to hold the concept that accumulation of huge numbers of information and facts is not the real indication of true education. Heavily engrossing to this view hinders the various preferences of learning.

Constructivist Online learning environment (COLE)

The learning environment significantly affects the degree of accomplishment and therefore stimuli-rich environments improve the learners 'output. "Constructivism is based on the belief that "knowledge is not passively received but actively built up by the cognising subject and the function of cognition is adaptive ...and serves the organisation of the experiential world, not the discovery of ontological reality" (von Glasersfeld, 1989). In the constructivist learning setting, students gain knowledge based on the previous information and experiences. Child's active involvement in the society accelerates their learning. Unlike behaviourism, his theory does not advocate controlled or structured learning environment.

Integration of E-p with the constructivist pedagogies and social learning will have insightful learning in education. Currently there is an evolution in the field of education with the shifting of attention from conventional approach to innovative approach. ICT has brought various challenges and opportunities to devise new pedagogical approaches in education. Although constructivist-based pedagogy is rare in today's fast-paced

approach to education, it seems that constructivist approach has emerged as one of the most significant positive effects in higher of education. At the crucial juncture of the pandemic situation of COVID-19, the observation, performance measurement of students at the premises is constrained and therefore did not provide the right positive reinforcement in the instructional process. There is a need for inculcating the virtual learning considering the unprecedented learning situation. The behaviourist approach put the duty of learning squarely on the teachers' shoulders. The learning environment needs to be restructured, followed by ample motivation to foster student effectiveness. In order to achieve the purpose of education, conventional teaching strategies need to be substituted.

The constructivist theory of learning has influences in different stages of education today in the area of instructional practices, technique, curricula, evaluation, and assessment. Constructivism emphasise students' mutual learning, ideas sharing, cooperative and collaborative learning, co-curricular activities, reflective practice etc. Learners must not be a passive listener but must get actively involved in the process of learning. Constructivist learning environment promote profound learning and endorse practical application of the acquired knowledge. The amalgamation of E-p into curricula provides remarkable potential for directly elevating constructivist learning theories to build modern learning environments. As many studies shows the positive results of integrating E-p as a platform in constructivist learning environment. Emerging technology, such as the use of multimedia, may give rich opportunities for constructivist approaches in education. Instead of dictating autocratically, rather it is the teachers' responsibility to inspire and guide the students. Constructivist teaching provides practical, authentic environments for learners in which they can search for patterns, generate and formulate their own ideas, principles, and strategies. "The classroom becomes a micro-society where learners participate in activity, debate, and reflection jointly" (Yilmaz, 2008). Learning will be more effective and meaningful if the teachers facilitate the learners with congenial learning environment where they can collaborate and work together as a team. Self-reflection practices must be emphasized to enlarge the mental horizons and to unearth a learner's inherent trait of the learners in a COLE.

In a constructivist learning environment, the role of the teachers is to facilitate, guide and generate a learning activities and experiences where the learners can collaborate and co-operate to make learning more effective. Therefore, (Pigliapoco et al., 2006) considered that the active learning, context-specific learning, social learning and formative evaluation are the main aspects of the constructivist approach that must be emphasised while designing the virtual classroom. Students' capabilities such as self-directed learning, critical thinking, analytical skills, and communication skills can all be developed through constructivist approach (Sejzi & Aris, 2012).

E-portfolio as a tool for assessing students' employability skills in the COLE

Merely presenting or transferring information to the learners has not become the best option in the virtual learning era, but to harness the hidden potential embedded in the learners is the most significant in the education. Different learning philosophies, such as behaviourism, objectivism, constructivism, cognitive constructivism and social constructivism, are closely linked with the advancement in ICT and has pave the way for adopting innovative method of teaching in relevant the existing need of the society (Kundi & Nawaz, 2010). Out of all the theories mentioned, "in e-learning courses, constructivism tends to be the most common method" (Stefani et al., 2007). Theoretical and empirical researches in education currently support a model of knowledge creation over the conventional model of transmission of information. Incorporation of online learning may not be as simple as conventional teaching-learning mode but it looks convincing enough to instigate innovative way of imparting education in today rapidly changing world. The various features of e-portfolio most appropriately will serve as an online learning tool in the education arena.

Constructivism is a theory for acquisition of knowledge that needs to reconsider in relevant to the current trend of virtual learning. Virtual learning environment will be of no avail if learning cannot take place authentically. In constructivist online learning environment, the educator has to simulate a situation where the learners could operate autonomously, engage themselves and connecting with their peers group for discussion and feedback with timely intervention when necessary. Virtual learning has many advantages if implemented properly.

In constructivist online learning, the learners must be exploratory, involving, engaging, self-regulatory, and must practice reflections to enhance their skills and knowledge. As an online platform, E-p is capable of having a large amount of different contents, expertise and skills accessible to users, unlike conventional classroom learning. But Lack of facilities and poor connectivity of internet may hinder the pattern of education. (Bangert, 2004) stated that "the majority of the Web-based courses today are designed using constructivist educational principles". E-p tool integration could enrich the principles of constructivism in higher education.

E-p can be used in educational institutions as a teaching, learning, and assessment tool. The commercial websites such as Google sites platform can be adopted to create e-portfolio where it is free and easy to create. The users can collaborate with others users to create the content of the pages. The users can also easily share texts, audio, videos, photos, presentations, or any learning materials with others as it is integrated with other Google Apps and tools. The educators can create class webpage to post assignments, update upcoming events, rubrics and tutorials for the learners to obtain all the necessary resources and contents of their courses. Student's performance, achievement, strength and weaknesses can be assess using this tool enhance their learning by giving proper feedback. Students can also create E-P to create contents, communicate, collaborate and share ideas with their peers to facilitate their learning. It can be used for their personal and academic work to enhance their career. Figure 1 is the proposed conceptual e-portfolio Model that can be designed on Google sites for Constructivist Online Learning Environment (COLE).

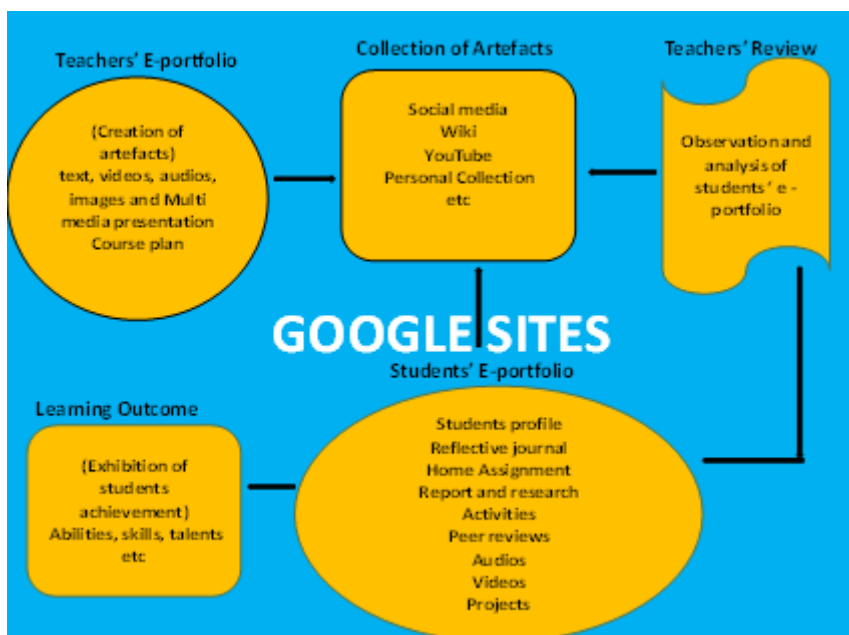


Figure1. Conceptual e-portfolio Model as designed on Google sites for Constructivist Online Learning Environment (COLE)

Creating and implementing e-portfolio can develop the valuable skills that are mostly sought after in today's corporate world like the technological skills, critical and higher order thinking, communication skills, time management skills, creative and reflective skills, collaboration skills, and metacognition skills. In contrast to the four-walled classroom environment, the usage of E-p platforms in education aligns with the constructivist theory of education because users can study individually without any constraints. This tool will trigger autonomous learning accompanied by Team work through sharing of ePortfolio with their peers group.

Rationale to execute E-p in H E

Many studies revealed the positive effects of using E-p as a tool in educational setting. (Alajmi, 2019) points out that the use of E-P enhances strengths, expertise and knowledge. Studies conducted by (Chang et al., 2014) found that the user of E-p have higher knowledge amassment. In the final examination, the students who used E-p outperformed those who did not use (Händel et al., 2018). (Encalada et al., 2018) identify that "e-portfolio improves the interaction of students at any time and place, asynchronously, facilitates the understanding of the functional elements of each of the stages of the Lesson Study and strengthens its application in the pre professional practices, constituting an emergent tool to promote the shared learning".

(Karami et al., 2019) also point out that "there is a significant effect on students' writing proficiency and their use of self-regulated strategies". Based on its uses and purposes, E-portfolio is categories as Students' E-p, teacher's E-p and institutional E-p (Lorenzo & Ittelson, 2005). The educational E-p has features for interaction and reflection that teachers specifically designed or developed to use as a tools for teaching, assessing and to provide feedback to the learners. These are self-management tools encouraging autonomous learning. The use of this tool support students credential documentation and career preparation keeping the future employment perspective in mind. E-p has become an innovative resource for blended for the continuity of education.

The teacher can track the learners by mentoring them in a proper channel. E-p is one of the emerging technological solutions to assess the achievement of the students in higher education particularly in a situation where there is a restraint from classroom learning. The students who are secluded from the colleges and university campus can showcase their learning achievement using multimedia evidence.

The outbreak of the COVID-19 pandemic has a significant impact in education sector, making it mandatory to use e-learning as a way to continue the cycle of education. Considering the flexibility and multi-faceted nature of the E-p, it is a potential platform to create a constructivist learning in higher education as education today is turning towards student-centered learning with active involvement on their part in constructing knowledge and skills. It is the appropriate tools in the present era where virtual learning is gaining momentum to a large extent. It can meet the growing demand of the students and teachers. The students can generate authentic contents, knowledge and skills as the students can take full control of their own learning process. It can act as a compass for the users as they can self-regulate and monitor their own personal learning under the careful conservation of the teachers by giving feedback. They can also organise, structure and provide their own experiences, achievement and evidences. E-p implementation enhance learners' self-discovery and the growth of skills and knowledge (Chaudhuri & Cabau, 2017).

There are many effective E-p platforms that are available but one must search for platforms that are ease of use, easily accessible to profile creation tools where the learners can make personalized changes, upload, add content and connect with the other users for healthy interaction and feedback. E-p can be created using inexpensive platform such as Wix, Weebly, Wordpress, and Google Sites. As long as users have access to the network, E-p users are able to access information and expertise without restrictions. It is not constrained by place and time. It is ease to update materials according to their convenience time and needs removing the hassle of physically distributing the media. The pace of learning fully depends on the users where the learners and instructor could independently decides the pace and instructional sequence of learning. It can be use as a tool to communicate and collaborate removing the physical and location barriers. The learners can use E-p as a self-reflective tool and the constant use of it encourage personal and professional development.

CONCLUSION

Change is the law of nature; therefore, our society is bound to change in one way or the other. In every realms of our society, education is one of the most important medium to bring changes in the society. One of the dreams of every developing nation is to bring the society up to level of developed nation. Therefore, the standard of education must be enhanced by inculcating or developing and adopting the right kind of educational technology by drawing out their innate potential of the learners and sharpening their skills. Considering the flexibility and varied features of E-p, it is one of the best options that can be adopted in enriching the constructivist learning environment in every higher education in India.

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A Study on BSA Adsorption and Biofilm Inhibition Behavior of Poly (N-Tert-Butylacrylamide-Co-Acrylamide/-2-Acrylamido-2-Methyl-1-Propane Sodium Sulphonate) Hydrogel

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ABSTRACT

By free-radical copolymerization, a series of poly (N-tert-Butylacrylamide-co-Acrylamide/-2-Acrylamido-2-Methyl-1-Propane Sodium Sulphonate) hydrogels (HG45, HG46, HG47, and HG48) hydrogels were prepared. Characterisation of poly(NBA-co-Am/AMPSNa)hydrogels was performed by IR spectral studies, SEM, XRD and TGA. The Bovine Serum Albumin (BSA) adsorption on the prepared hydrogels was investigated, at different pH levels as well as the effect of the ionic monomer on adsorption was studied. At 30 °C it was established that there was, maximum BSA adsorption at pH **5.0**, which is closest to BSA's isoelectric pH (pH 4.8). The amount adsorbed increased as the ionic monomer weight increased. SEM, XRD, and Thermal analyses further supported the adsorption. Using the MTP technique, biofilm quantification (**HG47**) for **Staphylococcus aureus** and **Pseudomonas aeruginosa** was evaluated **in vitro**. The hydrogel was reported to have the least of biofilm formation on its surface (**18.85 µg/mL** for **S.aureus** and **24.29 µg/mL** for **P.aeruginosa**), revealing its superior antibiofilm activity and so minimal fouling behaviour. The morphology and viability of bacteria were tested using SEM and fluorescent microscopy, accordingly.

Keywords: Hydrogel, protein adsorption, iso electric point biofilm, micro titer plate assay

1. INTRODUCTION

Hydrogels, three-dimensional networks made composed of a polymer backbone, water, and a high-molecular-weight crosslinking agent, have become more essential in pharmaceutical and medical applications, Artificial organs [1], contact lenses [2], and drug delivery devices [3] are only a few examples. Hydrogels that change phase in response to external stimuli including pH [4], ionic strength, and temperature [5] have recently received a lot of attention.

Hydrogels, particularly poly (acrylamide), cover a wide range of uses in enzyme immobilisation and biomolecule separation procedures [6]. In a variety of domains, immobilisation of labile bioactive substances, cells, and molecules on porous supports is a valuable strategy.

Bovine serum albumin (BSA) is ideal for attachment tests because to its purity, high stability, and water solubility. [7]. It is a soft protein, it can adsorb even when the conditions are exceedingly undesirable, such as on a hydrophilic, electrostatically repelling surface, as structural rearrangements provide a substantial driving force for adsorption. [8]

A biofilm is a bacterial colony that forms on a surface or substratum. Biofilm bacteria are encased in a polymeric extracellular matrix formed by the bacteria. Bacteria on underwater surfaces such as natural aquatic systems, water pipes, living tissues, tooth enamel, indwelling surgical devices, and implantation [9] produce biofilm. When bacteria connect and cling to the surfaces of host tissues implants, biofilm development occurs. On implant devices, these biofilm cause infections which protects the encapsulated bacteria from antibiotic treatment and immune system attack. Enterococcus faecalis, Staphylococcus aureus, Staphylococcus epidermidis, Streptococcus viridans, Escherichia coli, Klebsiella pneumoniae, Proteus mirabilis, and Pseudomonas aeruginosa are the most prevalent biofilm-forming bacteria [10]. Because bacterial biofilms are hard to remove, bactericidal and antifouling coatings have arisen as methods of preventing biofilm formation and infection.

Protein adsorption, cell/bacterial adhesion, and biofilm growth have all been designed into several polymeric materials., including poly (2-hydroxyethyl methacrylate) (polyHEMA) [11], poly(2-hydroxyethyl methacrylate)[12], poly(N-isopropyl acrylamide),[13,14]. Hydrogel-based implant coatings have been the subject of extensive study. Hydrogels have a viscoelastic network structure, flexible material properties. [15].the capacity to deposit onto a variety of material substrates, the incorporation of numerous chemical functions, nanoscale dimensions with complex topologies, Four polymer hydrogels namely polySBAA, polySBMA, polyHEAA, and polyHEA were compared for their anti-fouling activity [16]

Free radical polymerization was followed [17] to make poly (N-tertiarybutyl acrylamide-co-acrylamide/AMPSNa) hydrogels for various ionic monomer amount. The effect of anionic monomer on BSA adsorption of these hydrogels at various pH levels is also investigated. *In vitro*, the efficacy of these hydrogels to inhibit biofilm was also tested using MTP assay against *S.aureus* and *P.aeruginosa*.

2. MATERIALS AND METHODOLOGIES

2.1. Materials:

All chemicals and solvents were of reagent quality and were used as they were acquired commercially, with no further purification. Free-Radical crosslinking copolymerization was followed to make the hydrogels (HG45-HG48). Our laboratory had previously made the HG47 hydrogel[18].

2.2 POLY(NBA-CO-AM/AMPSNA) HYDROGEL- SYNTHESIS

The weight of hydrophobic monomer: N-tertiary butyl acrylamide- NBA (0.5g), hydrophilic monomer Acrylamide – AM (0.5g), were kept constant, and the ionic monomer 2-Acrylamido-2-methyl-1-propane Sodium sulfonate- AMPSNa was increased (0.1g,0.3g,0.5g, and 0.7g) , Methylene bis acrylamide- MBA (0.03g) as cross linker, Potassium persulphate–KPS (0.05g), as Initiator and accelerator-Tetramethylethylenediamine-TEMED were added in methanol water mixture. Sodium hydroxide was used to neutralise the 2-acrylamide-2methylpropanesulfonic acid, resulting in AMPSNa. After 15 minutes of bubbling nitrogen,the materials were put in a 60°C thermostatic water bath for 1 day of polymerization. The hydrogel is produced as a result of the reaction

Infrared spectra of the –poly (NBA-co-AM/AMPSNa) hydrogel (HG47) were recorded on KBr pellets using a Perkin Elmer FT-IR Spectrophotometer

2.3. PROTEIN (BSA) ADSORPTION FROM AQUEOUS SOLUTION USING A HYDROGEL

For adsorption investigations, the dried hydrogels (0.1 g) were soaked in 20 mL of BR buffer (various pH levels) with 4.0 mg/mL of BSA and maintained at 30 °C. Using a UV spectrophotometer set to 279 nm, the concentration of a fraction of the BSA solution was determined. Using the equation below, the amount of BSA (qe) adsorbed by the hydrogel was computed. [18]

$$q_e \text{ (mg/g)} = (C_i - C_e) V/m$$

The amount of BSA adsorbed is represented by q_e . in milligram per gram, C_i stands for the concentration in the beginning, and the equilibrium concentration of a solution is denoted by C_e . The hydrogel's mass is represented by m , while the volume of the solution employed is represented by V .

2.4. Antibiofilm activity of poly(NBA-co-AM/AMPSNa) in vitro

2.4.1. Biofilm inhibition microtiter plate test (MTP)

The MTP assay method used by Christensen et al [19] was used to assess the biofilm inhibitory behaviour of hydrogel. From the stock solution, (HG43), various concentrations such as 1, 2, 4, 8, 16, 32, 64, 128 and 256 $\mu\text{g/mL}$ were taken. The bacterial biofilm was quantified by measuring the intensity (OD) of blue colour of crystal violet stain retained by the microplate reader. The inhibition % was calculated using OD values from the following equation.

$$\% \text{ Biofilm inhibition} = \frac{\text{Control OD} - \text{Test OD}}{\text{Control OD}} \times 100$$

2.4.2. Fluorescence microscopy staining of ETBr/AO

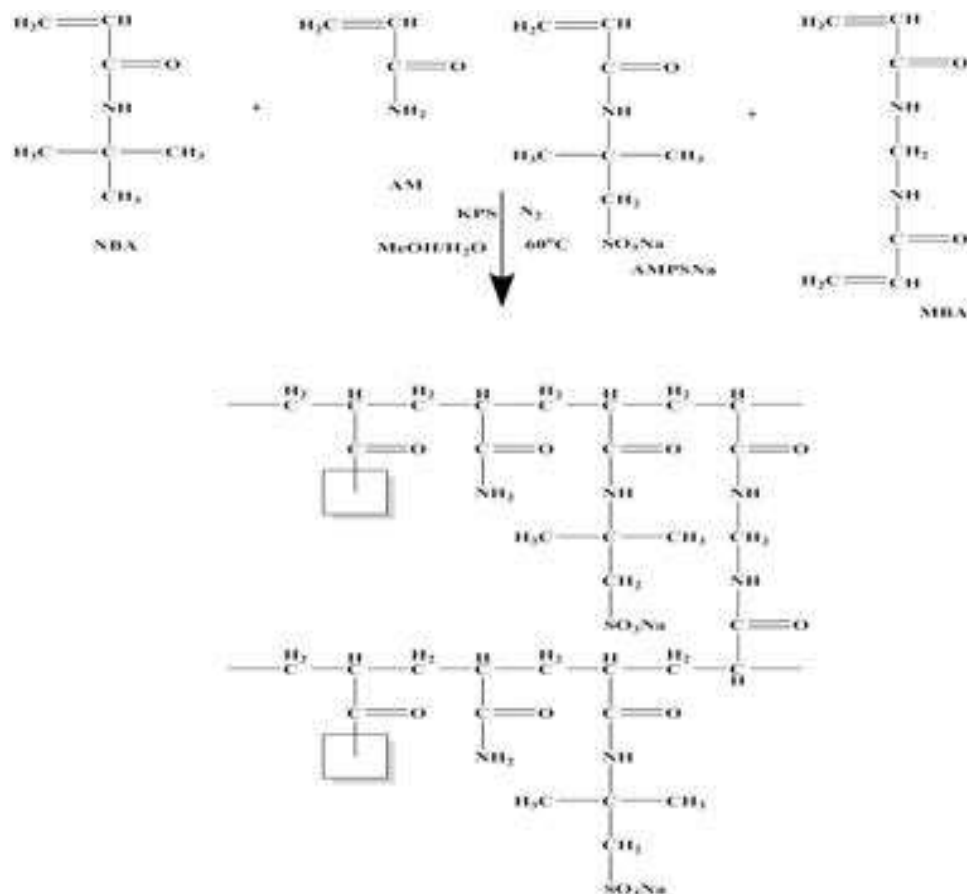
In a 24-well culture plate, 5×10^6 Staphylococcus aureus/Pseudomonas aeruginosa cells were plated on coverslips and treated with 50 $\mu\text{g/mL}$ hydrogel (HG47) in nutrient broth. For 24 hours, In a bacteriological incubator, the plate was incubated at 37°C for 24 hours. Following the incubation period, 50 μL of 1 mg/mL Acridine orange and Ethidium bromide were gently mixed into the wells. After that, the plate was centrifuged for 2 minutes at 800 rpm and then analysed within an hour, with at least 100 cells observed with a fluorescent filter.using a fluorescence microscope

2.4.3. SEM Biofilm Inference

Hg47 was investigated for anti-biofilm ability against *S. aureus* biofilms, and biofilm formation was seen using a scanning electron microscope at 200 X and 10 times magnification.

3.0 .RESULTS AND DISCUSSION

The scheme for the preparation of poly(NBA-co-Am/AMPSNa) is represented in Scheme-1



Scheme 1: Synthesis of poly(NBA-co-Am/AMPSNa) hydrogels

3.1. FTIR studies of poly(NBA-co-Am/AMPSNa) hydrogels

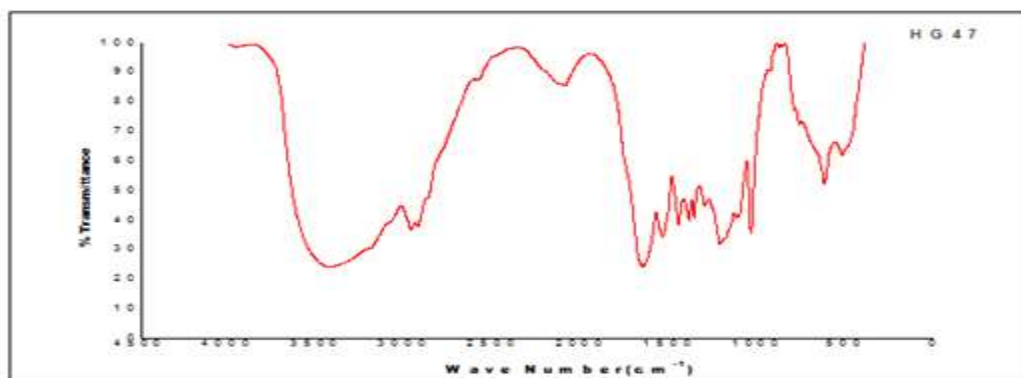


Fig.1. FTIR spectrum of poly(NBA-co-Am/AMPSNa) hydrogel

Existence of peaks in the copolymeric hydrogel chain that correspond to the functional groups of monomeric units was revealed by IR analysis of the hydrogels. (Fig.1) The IR spectra of HG-47 revealed distinctive absorptions around 3416 cm⁻¹, which corresponded to NBA and AM NH stretching. C=O stretching gives the peak at 1631 cm⁻¹. The C-H stretching has a peak at 2930.70 cm⁻¹, while the bending in the (CH₃)₃C has a peak at 1395 cm⁻¹. S=O stretching of SO₃Na of AMPSNa corresponds to a peak at 1350 cm⁻¹. C-H stretching of the polymer backbone causes absorptions at 2978 cm⁻¹. As a result, the IR analysis reveals the presence of all monomers.

3.2. The effect of pH on the adsorption of BSA in poly(NBA-co-Am/AMPSNa) hydrogels

Table.1. Role of pH in BSA adsorption of poly(NBA-co-Am/AMPSNa) hydrogel

pH ↓	Amount of BSA adsorbed /g of dry gel qe(mg/g)			
	AMPSNa → 0.1g	0.3g	0.5g	0.9g
3	72.0	77.0	82.40	85.4
5	99.6	105.6	112.8	119.6
7	68.4	72.0	75.6	84.2
9	61.6	63.8	70.0	72.4

BSA adsorption on hydrogels is largely determined by the hydrogel's swelling behaviour. The adsorption is greatly affected by the pH. The protein is negatively charged at neutral pH because its isoelectric point (IEP) is at pH 4.5–5.0. [20] and at acidic pH it is positively charged. From the values reported, (Table.1.) at pH 5.0, the maximum quantity of albumin macromolecules is adsorbed, i.e. in a solution with a pH near to the BSA pI value. The macromolecules' net charge is close to zero under these conditions, with the same number of positive and negative groups. Because of the mutual electrostatic interaction between these groups, macromolecule conformation is tightly packed, resulting in a high adsorption level on the IEP. The BSA hydrodynamic radius is 3.32 nm at IEP [21], and the α -helix content is 55 percent. The adsorbate's highly compact shape provides for the highest amount of adsorption. Since positively charged protein and negatively charged hydrogel attract each other electrostatically, adsorption was much lower at pH 3, 7, and 9, adsorption is higher at pH 3 than at pH 7 and 9. The BSA hydrodynamic radius is 4.31 nm and the α -helix content is 35 percent] under these conditions. The amount of BSA adsorption is larger at pH 7.0 than at pH 9. Electrostatic repulsion between the adsorbent and the adsorbate occurs at pH 7.0 and pH 9, preventing them from contacting each other. In these circumstances, The dissociation of carboxylic groups in BSA macromolecules makes them negative as well. The altered BSA structure results in a higher adsorption level at pH 7.0 compared to pH 9.

The hydrodynamic radius of macromolecules at pH 7.0 is 3.57 nm, while it is 4.1 nm at pH 9. As a result, a single macromolecule occupies a larger portion of the solid surface at pH 9.0 than it does at pH 7.0, resulting in a smaller adsorption quantity. The adsorbed values are consistent with those previously reported [22,23].

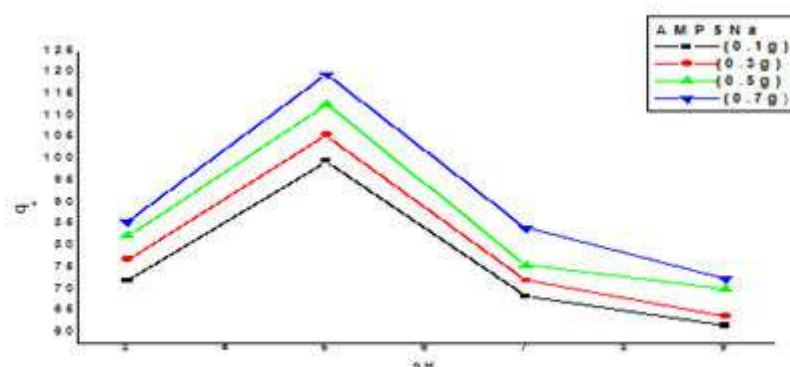


Fig.2. The influence of pH on BSA adsorption by a poly(NBA-co-Am/AMPSNa) hydrogel

Because of the strong interactions between the anionic hydrogel and the BSA biomolecules, the amount of BSA adsorbed increases as the AMPSNa amount rises. (Fig.2.)

3.2.2. Surface morphology of poly(NBA-co-Am/AMPSNa) hydrogels

Previous studies have demonstrated that because of the difference in osmotic pressure between water and BSA solution, hydrogel swelling in BSA solution is smaller than in distilled water and also since the molecules of BSA are larger than that of water, molecules of water diffuse more into gel pores more than that BSA solution. As swelling decreases, amorphous nature also decreases.

As a result, the SEM images of the hydrogel before and after protein adsorption (pH-5) differ. A homogeneous surface morphology in the polymer matrix with greater porous structure can be seen in Fig. 3-

HG47. When comparing the two pictures, the porous structure is no longer visible in Fig.3-47B indicating that protein molecules are adsorbing in the polymeric network.

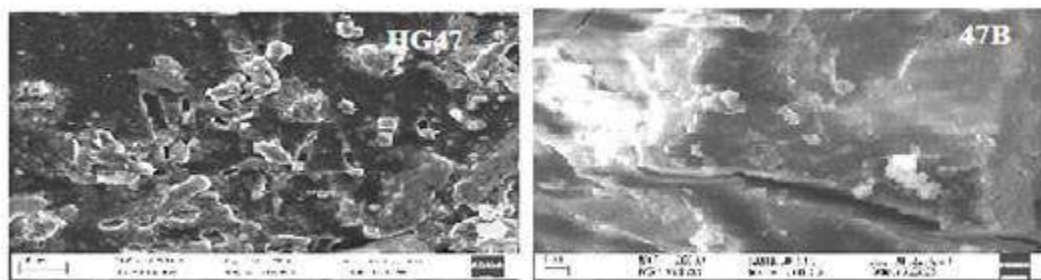


Fig.3.SEM image of:HG47-plain hydrogel :47B- BSA adsorbed hydrogel

3.2.3 XRD studies of BSA adsorption on poly(NBA-co.AM/AMPSNa)hydrogel

Since the swelling and amorphous nature decreases after BSA adsorption, the broadened peak at $2\theta=20^\circ$ (Fig.4.HG47) becomes sharpened(Fig.4.47B) due to BSA adsorption.

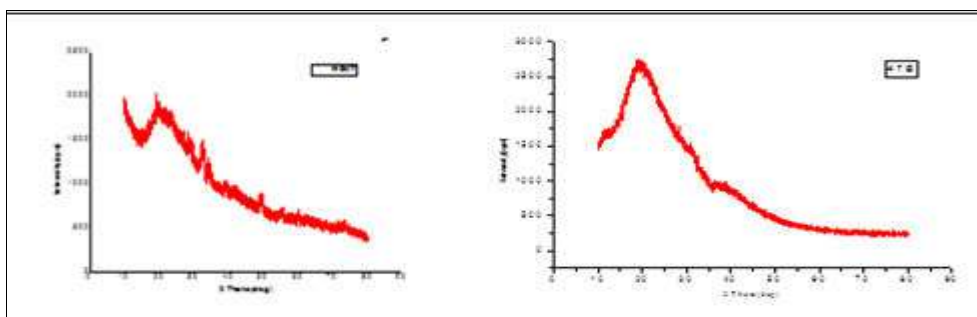


Fig.4.XRD of: HG47.plain hydrogel and 47B- BSA adsorbed hydrogel

3.2.4. Thermo gravimetric Analysis.

TGA measurements assist to the understanding of BSA adsorption characteristics. After BSA adsorption, the TGA curve exhibited alterations in the decomposition temperature. The residual weight for pure hydrogel at 800°C is 2.63% whereas after BSA adsorption it remained as 17.8% .(Fig.5)

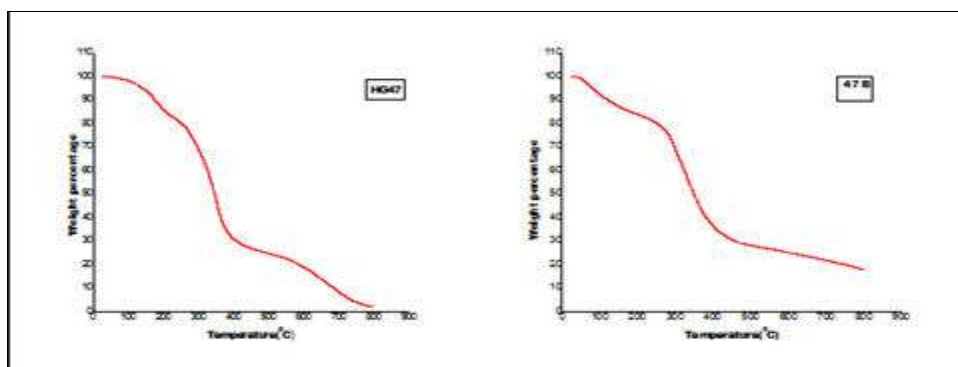


Fig.5. TGA of: HG47.plain hydrogel :47B- BSA adsorbed hydrogel

3.3. Antibiofilm (Antifouling)Effect(HG47)

3.3.1. Microtiter plate Assay

From the concentration of crystal violet stain retained by *Staphylococcus aureus* and *Pseudomonas aeruginosa* the optical density values are read from the Microtiter plate reader at 600 nm and then the percentage of inhibition are calculated. It was observed from figure .6.that as concentration of poly(NBA-co-Am/AMPSNa)hydrogel (HG47) increases from $1\mu\text{g/mL}$ to $256\mu\text{g/mL}$, CV stains by bacteria decreases and OD values (Fig.7.a. and 7.b.) also decreases and so the percentage of biofilm inhibition increase(Fig.8.a.and 8.b.) as given by the formula.

$$\% \text{ Biofilm inhibition} = \frac{\text{Control OD} - \text{Test OD}}{\text{Control OD}} \times 100$$

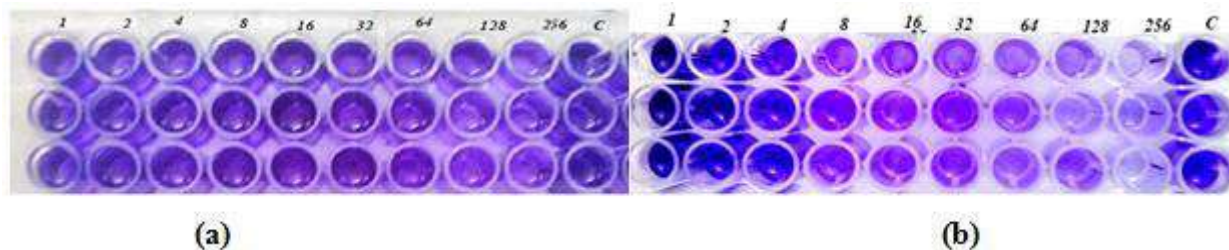


Fig.6.CV images (a) *S.aureus* (b) *P.aureginosa*

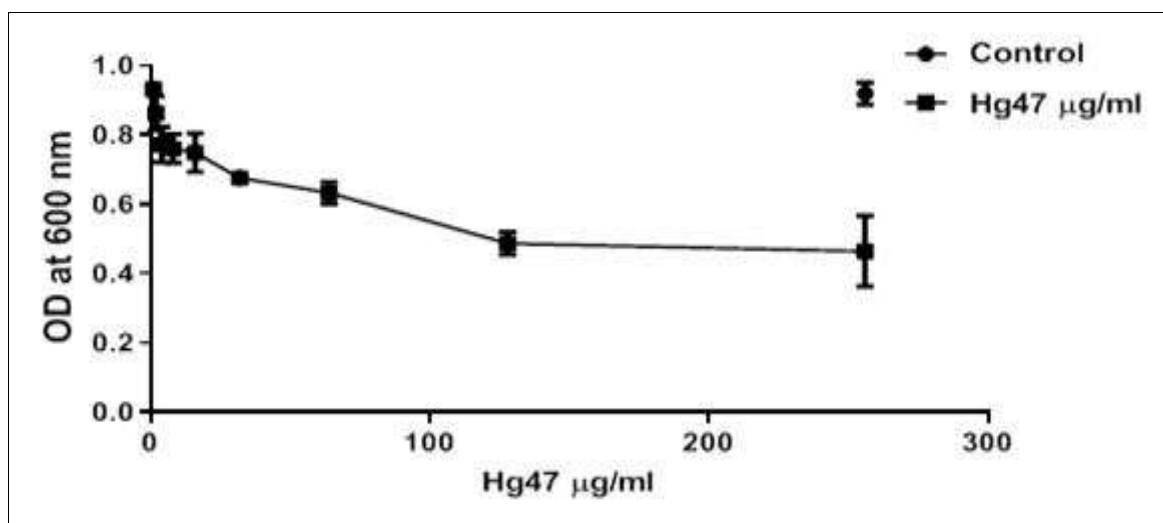


Fig.7.a.OD values for *S.aureus*

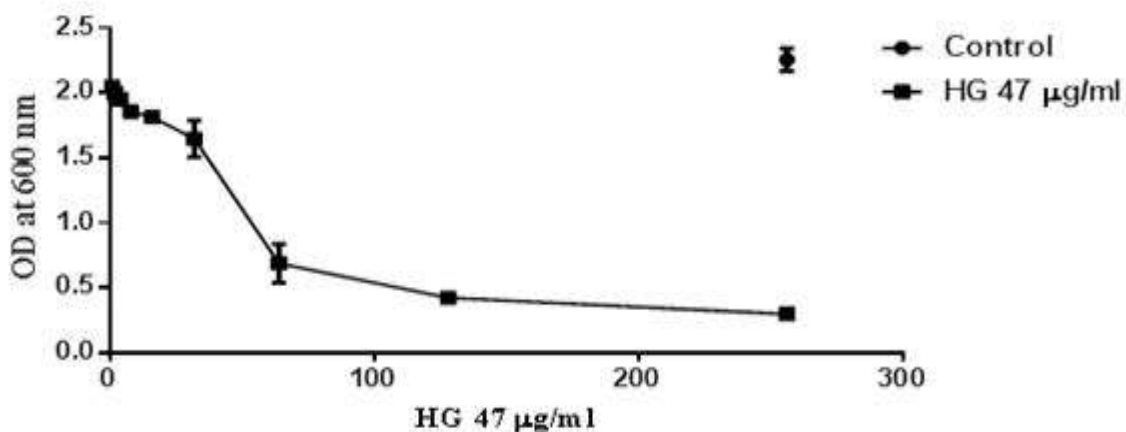


Fig.7.b.OD values for *P.aeruginosa*

Table.2.Biofilm inhibitory percentage against *S.aureus* and *P.aeruginosa*

S. No	Conc ($\mu\text{g/mL}$)	% Inhibition	
		<i>S.aureus</i>	<i>P.aeruginosa</i>
1.	256	49.41	86.74
2.	128	46.90	81.17
3.	64	31.00	69.44
4.	32	26.39	26.92

5.	16	18.4	19.53
6.	8	17.20	17.59
7.	4	15.71	13.46
8.	2	6.13	11.30
9.	1	0	9.12
10.	0	0	0

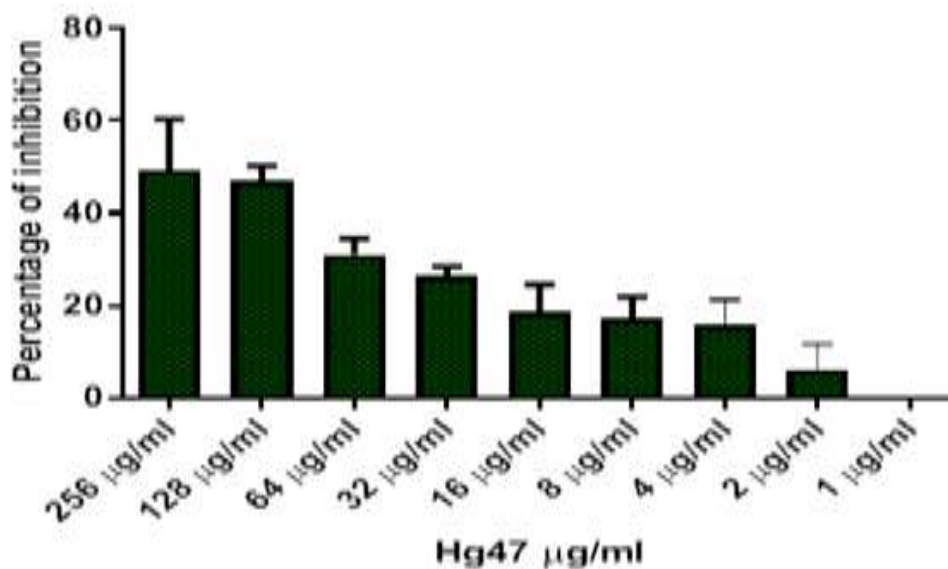


Fig.8.a.Percentage of Inhibition against *S.aureus*

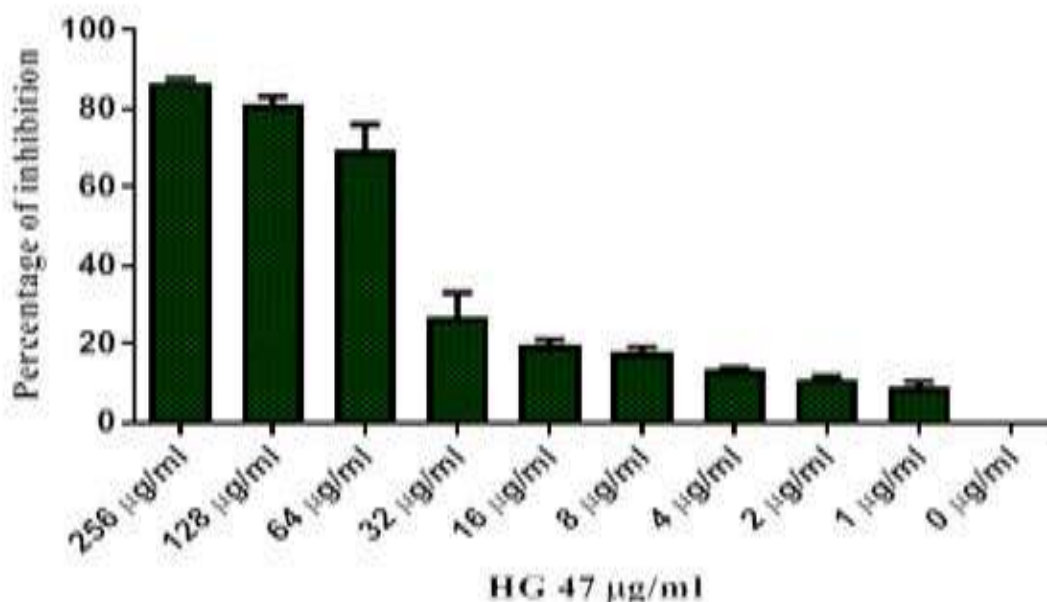


Fig.8.b.Percentage of Inhibition against *P.aeruginosa*

Graph pad prism software was used to compute the inhibitory concentration-50 IC_{50} , which was found to be **18.85 $\mu\text{g/mL}$** against *Staphylococcus aureus*(Gram positive bacteria) and **24.29 $\mu\text{g/mL}$** against *Pseudomonas aeruginosa*.(Gram negative bacteria).

3.3.2.Fluorescent Microscopy

Bacterial cells treated with poly (NBA-co-AM/AMPSNa)-**HG47'** hydrogels were examined using fluorescence microscopy.The majority of the cells (both Gram positive and Gram negative) are green in colour.(Fig.9.)The presence of a mixture of red and green cells proved HG47's antibiofilm properties.

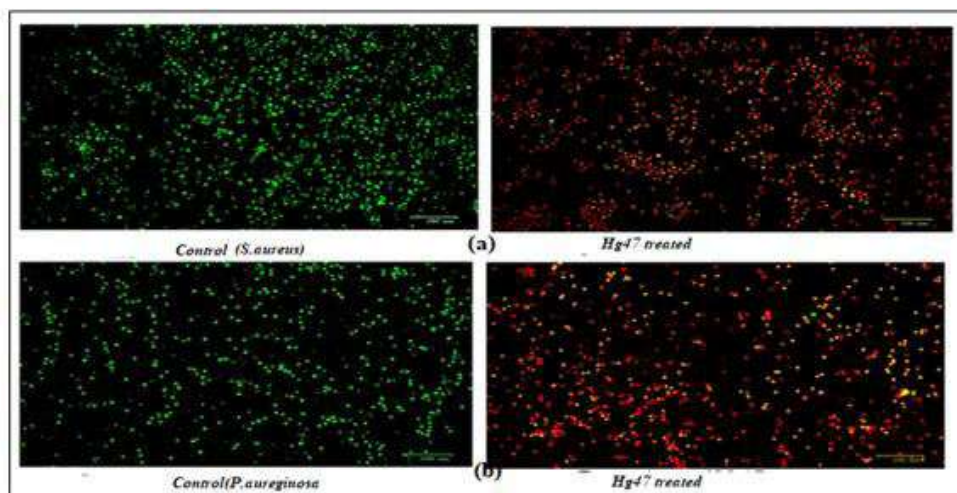


Fig.9. Fluorescent microscopic images of a) control (*S.aureus*) & HG47 treated and b) control (*P.aeruginosa*) & HG47 treated

3.3.1. Scanning Electron Microscope

The bacteria cultures without HG47 have the normal cellular shape and smooth cell surfaces. Changes in morphology occurred under the same growing conditions but in the presence of HG47, the roughness of the cell surface has increased, indicating that the cell surface has been attacked by the hydrogel. (Fig.10)

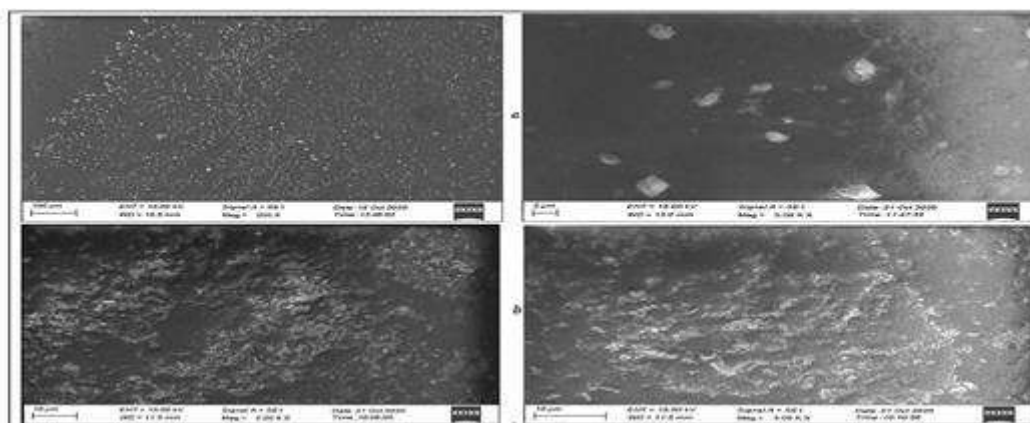


Fig.10. SEM images of a) control (*S.aureus*) & HG47 treated and b) control (*P.aeruginosa*) & HG47 treated

MECHANISM OF ACTION .

A number of approaches have been suggested to explain why some materials resist adsorption by protein and microbial adhesion on the surface. Because many antifouling compounds contain hydrophilic or zwitterionic moieties, the "water barrier" concept [24] proposes that a firmly bound water layer generated surrounding the materials behaves as a physical and energetic barrier, impeding biomolecule adsorption on the surface and hence bacterial adherence (Fig.11). Hydrophilic polymers hydrate their surfaces through hydrogen bonding, whereas zwitterionic polymers hydrate their surfaces through ionic solvation, resulting in a hydration layer that is strongly bonded at the polymer contact. Because polymer chains are flexible, "steric repulsion," which occurs when polymer chains are compressed when proteins approach the surface, is thought to have a role in protein adsorption avoidance. [25]. Water molecules must be expelled from the interface region between polymers and proteins to compensate for the loss of solvent entropy due to protein adsorption.

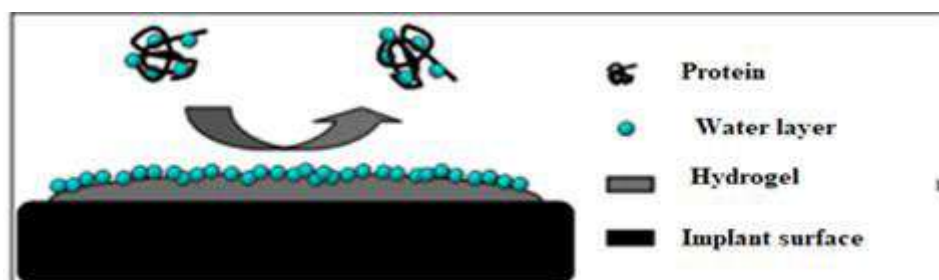


Fig.11. Resistance of protein by hydrogel

Since poly(NBA-co-A/AMPSNa) hydrogel (HG47)) is a hydrophilic polymer that can minimize microbial adhesion by the above-mentioned mechanism, and also since these are anionic, they repelled the negative charge created as a result of ionisation of carboxyl and phosphate present in bacteria's cell walls, bacterial adhesion is further reduced[26]. Strong electrostatic forces have been shown to affect the structure of adhered bacteria[27], and this feature complements the hydrophilic nature for the effective inhibition of bacterial colonization by *Staphylococcus aureus* and *Pseudomonas aeruginosa*.

4. CONCLUSION

Free radical polymerization was used to synthesize poly (NBA-co-Am/AMPSNa) hydrogels in this study. Bovine Serum Albumin adsorption was carried out on these hydrogels at pH 3, 5, 7 and 9. Maximum adsorption occurred at pH 5, near to the isoelectric point. As the amount of ionic monomer increases, the amount adsorbed also increases. The BSA adsorption was confirmed further by Scanning Electron Microscope, XRD, and gravimetry. Excellent *in-vitro* antibiofilm performance of these hydrogels has been observed, against most common organisms such as *Staphylococcus aureus* (IC₅₀-18.85 µg/mL) and *Pseudomonas aeruginosa* (IC₅₀-42.29 µg/mL) suggesting the high potential for future use of them as coatings to prevent bacterial infections in medical devices and implants.

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An Evaluative Study on E-Way Bill in India

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ABSTRACT

The introduction of the E-way bill on 1st April 2018 is a significant step taken by the Government of India for quick and easy movement of goods across the country without any hindrance. The E-Way Bill is mainly introduced to monitor the movement of goods and reduce tax evasion. It abolished all the check posts across the country. Under the E-way bill system, a taxpayer generates an electronic bill as an acknowledgment before movement of goods via conveyance and uses this acknowledgment number as a valid document accompanying the conveyance carrying goods. It would prove a vital mechanism to reduce corruption as human intervention is eliminated. It is believed that the E-way bill system would render transparency in the transit of goods and would also transform the methods of verifying and validating the authenticity of the transactions. The present paper is an attempt to understand the very purpose behind implementing E-Way Bill as a digital approach toward GST in India and also to analyse the journey of E-Way Bill in India.

Keywords: E-Way Bill, Digital approach, Vahan, FASTag, RFID, logistic industry, GST.

INTRODUCTION

On 16th December 2017, the implementation of the E-way bill was proposed at the 24th meeting of the GST Council. In the same meeting, it was propounded that the E-way bill system would be implemented nationwide for the inter-state movement by 1st February 2018. However, it was later on decided that with effect from 1st June 2018 E-way bill rules for intra-state supply would be uniformly applied to all states. The E-way bill is an electronic way bill generated online under the GST system when goods of the value of more than Rs 50,000 are shipped inter-state or intra-state. The E-way bill system is a critically designed technological framework that helps to track both inter-state and intra-state movement of goods of value exceeding Rs 50,000 under the GST regime. The primary objective of the E-way bill is to ensure that all goods which move across the country comply with the GST. Under the E-way bill system, there will be no need for transit passes for every state. Once E-way bill is generated it would be valid throughout the country for the movement of goods for a given period. Prior to the commencement of movement of goods, information regarding the movement in relation to a supply or for reasons other than supply is required to be furnished (*Under rule 138 of the CGST Rules, 2017*). An E-way bill can be generated through the E-way bill generation portal, SMS, and APP. E-way bill is considered an effective tool to check tax evasion and reduce revenue leakage. As a result, it would increase GST collection to a greater extent.

SIGNIFICANCE OF THE STUDY

The Government of India introduced the E-way bill to ensure that the goods are shipped from one place to another are in compliance with the GST law. The mechanism of the E-way bill was designed in such a way that it would prove to be an effective tool to track the movement of goods and elimination of tax evasion. So, the main purpose of the study is to analyse the effectiveness of the implementation of E-way bill during its 3-years journey in India.

RESEARCH METHODOLOGY

This study is intended to understand the very purpose of implementing E-way bill as a digital approach toward GST in India. Being reliable research, it relies upon secondary sources such as journals, articles, every day newspapers, magazines, and various online sources which focused on various aspects of the E-way bill.

OBJECTIVES OF THE STUDY

- To understand the concept of E-way Bill as a new digital approach.
- To study the status of E-way bill in India.

REVIEW OF LITERATURE

Anitha M.N (2016) in her paper titled, "Impact of Goods & Service Tax (GST) on Logistics Sector in India" attempt to analyse the possible impact of Goods and Service Tax (GST) on Logistics Sector in India with special focus on transportation, warehousing and Logistics Service Providers. The author concluded that the proper implementation of GST would be great boon for the logistics sector which leading to accelerated economic growth.

Bhiwandikar M., (2020) in his book titled, “E-Way Bill Provisions under Goods and Service Tax Act” focused on study in details the E-Way Bill Provisions under GST Act”. It covered the implementation process, problems faced by logistic industry in implementation, benefits of E-Way Bill provisions to the stakeholders and finally the future scope of E-way bill provisions.

Silpa et al., (2018) in the article titled, “An Introduction to E-Way Bill: A Game Changer of the Indian Economic System” studied the concept of introduction of E-way bill system in India. The study revealed that the mechanism of E-Way bill is an excellent step taken by the Government of India to facilitate transportation of goods and would eliminate tax evasion. The authors concluded that the proper implementation of E-Way bill would re-structure the entire logistics industry and bring a revolution in the transportation of goods throughout the country.

Vulugadam et al., (2016) in their paper titled, “Impact of GST on supply chain strategy and its effect on warehousing & transportation” mainly focused on the implication of GST on supply chain strategies, warehousing and transportation industries. The study revealed that the implementation of GST would have a positive impact in warehousing and transportation industries, but delays in the implementation of GST resulted missed opportunity for various stakeholders.

CONCEPT OF E-WAY BILL AS A NEW DIGITAL APPROACH

The introduction of the E-way bill concept is nothing but an anomaly rectification as old wine in a new bottle. During VAT and Service tax regime, VAT authorities used to issue a waybill to the businesses/dealers in case of inter-state transport of goods. It was manually issued in the form of a printed booklet only to those businesses who were regular taxpayers. The system of manual issuance of way-bill lacked transparency and boosted corruption. The business dealers were also occasionally harassed by tax authorities. In order to overcome this hindrance and to ensure easy movement of goods both inter-state and intra-state, the Government has taken step towards making the India Digital program for all the stakeholders.

GST Council approved 1st June 2018 as the deadline for both inter-state and intra-state movement of goods. With effect from 1st June 2018, the E-way bill Rules for intra-state supply was uniformly applied to all states. Karnataka is the first state to implement the system from 12th September 2017 using information and communications technology (ICT) infrastructure available with the state. It was followed by Rajasthan, Uttarakhand, and Kerala. This is how the manual way-bill has been transformed into electronic mode. As a matter of fact, around 10 states were already following the E-way bill system and is known by different names in different states. In Karnataka, it is known as e-Sugam, e-transit in Uttarakhand, e-Road Permit in Jharkhand and Bihar, Inward/outward challan in Sikkim. The E-way bill is just an anomaly rectification of the compliance around waybills which has caused restricted movement of goods across the states. This e-Governance initiative is expected to provide efficient services to the taxpayers and also result in the prevention of tax evasion. 154 items of common use, such as meat, fish, curd, vegetables, cereals, human blood, LPG for households, and kerosene for PDS, etc. are exempted from the E-way bill system. The system is not applicable in case goods are transported by non-motorized conveyance as well as where goods are transported from the port, airport, etc.

When a seller or a buyer of goods generates an E-way bill from the portal, a unique E-way bill number (EBN) is allocated and is made available to the supplier, recipient and, transporter. Though check-post has been abolished with the roll-out of the E-way bill across the country, yet the transporter has to carry the copy of E-way bill along with the invoice of goods in transit as support documents for the verification. If a taxpayer is found transporting goods without accompanying of required E-way bill as a fundamental document, a penalty of Rs 10,000 or tax sought to be evaded, whichever is greater, can be levied on the interception of consignment.

There are two parts of E-way bill. Part-A of E-way bill (EWB) consists of:

1. GSTIN of Recipient
2. Place of Delivery
3. Invoice or Challan No
4. Invoice or Challan Date
5. Value of the goods
6. HSN Code
7. Reason for Transportation

8. Transport Document Number (This indicate either one of the Goods Receipt Number, Railway Receipt Number, Airway Bill Number or Bill of Loading Number).

Part – B of E-way bill consist of:

1. Transportation details (i.e., vehicles number etc.)

INTEGRATION OF E-WAY BILL WITH FASTAG ANDRFID

FASTag is introduced in 2019 by the National Highway Authority of India (NHAI) to digitize the entire toll collection eco-system. It is a rechargeable tag that permits deduction of toll with having to stop for cash transactions. The tag uses Radio Frequency Identification (RFID). After being activated, it is attached to the windscreen of the automobile. It is mainly introduced to increase transparency, boost all toll collection and, to minimize manual intervention. Whereas, RFID is the technology that makes use of waves to read and secure information stored in a tag. Since 15th February 2021, FASTag has become mandatory for all automobiles across the country. The National Highway Authority of India (NHAI) controls and facilitates the FASTag. With the merger of the E-way bill, RFID and FASTag as giant robust technological eco-system will enable tax authorities to undertake real-time live vigilance. This would also reduce verification time at check posts. On a daily basis, an average of 25 lakh goods automobiles movement, from more than 800 tolls are recorded to the e-way bill system (Source: PTI dated 19 May 2021). The integration of the E-way bill with FASTag and RFID will assist in inhabiting loss of revenue by real time identification of cases of re-cycling and/or non-generation of E-way bills. Records on automobiles that have passed the selected tolls without E-way bills in the past few minutes are now accessible to the tax authorities. Now, through this technological eco-system any vehicle carrying critical commodities specific to the state and having passed the selected toll can easily be detected. Any suspicious vehicles and vehicles of E-way bills generated by suspicious taxpayer GSTINs, that have passed the selected toll on a near real-time basis, can also be viewed in this report. The authorities can use these reports while conducting vigilance and make the vigilance activity more effective. The tax officers of the audit and enforcement wing can also use these reports to identify fraudulent transactions like bill trading, recycling of E-way bills. Thus, integration of the E-way bill with FASTag and RFID can be considered a positive move by the Government of India to curb tax evasion.

INTEGRATION OF E-WAY BILL WITH VAHAN

With effect from 1st April, 2020, E-way bill has been integrated with the Vahan System to ease the process of transportation of goods and easy identification of the vehicle. This integration will lead to less time consumption and real-time integration of the vehicle details. The integration of E-way bill with Vahan System will makes the vehicle number identifiable on the portal and the consignor, consignee or the recipient are able to track and update the details of the bill on the portal. If the case is where vehicle number is not available/same the alert message will pop up. However, to enable the generation of E-way bill on the portal simultaneous details are required to mention in the Vahan System. Thus, the real time integration will help to track unauthorised consignments and curb the tax evasion practices.

ANALYSIS OF E-WAY BILL IN INDIA

Table No. 1 Key Statistics of E-Way Bill in India (From April 2018 – March 2021)

No of E-Way Bills generated	180 Crores
Number of vehicles	2.2 Crores
Number of users	37.6 Lakhs
Number of Consignors	35 Lakhs
Number of Consignees	77 Lakhs
Number of Transporters	.92 Lakhs
Total verification of E-Way Bill by Officers	7 Crores
Number of Officers	0.22 Lakhs

Source: GSTN 4-Year Report

Table No Year on Year Statistics of E-way bil No. in lakhs

	2018-19	2019-20	2020-21	Percentage (%) Increase/Decrease From 2018-19 to 2019-20	Percentage (%) Increase/Decrease From 2019-20 to 2020-21

Generation of E-way bills	5578.00	6288.00	6168.00	12.72	(1.91)
Verification of E-way bills	169.48	301.90	227.59	78.13	(24.61)
Intra-state E-way bills	3090.00	3694.00	3755.00	16.35	1.65
Inter-state E-way bills	2488.00	2594.00	2413.00	4.09	(6.98)
Exports E-way bills	65.46	73.97	70.43	13.00	(4.79)
Import E-way bills	63.26	70.39	59.63	11.27	(15.29)

Source: www.nic.in

INTERPRETATION

If we look at Year on Year statistics of E-way bill from 2018-19 to 2020-21 it is observed that the generation of E-way bill increased by 12.72% in 2019-20 and decreased by 1.91% in 2020-21 from previous year, verification of E-way bill increased by 78.13% in 2019-20 and decrease by 24.61% in 2020-21 from previous year, intra-state E-way bill increased by 16.35% in 2019-20 and also increased by 1.65% in 2020-21 from previous year, inter-state E-way bill increased by 4.09% in 2019-20 and decrease by 6.98% in 2020-21 from previous year, exports E-way bill increase by 13% in 2019-20 and decrease by 4.79% in 2020-21 from previous year and imports E-way bill increased by 11.27% and decrease by 15.29% in 2020-21. So, it is found that there is significant increase in E-way bill generation in all aspects in 2019-20. However, there is declination in E-way bill generation in the next year i.e., 2020-21. The main reason behind declination was due to sudden outbreak of covid-19 pandemic where the government restricted movement of non-essential goods.

Table No. Top 5 States with Inter-state E-way bil No. in lakhs

Name of States	2018 – 19	2019 – 20	2020 – 21	Total (2018 – 21)	Percentage (%) of total inter-state E-way bill generation in the country from 2018-21
Gujarat	430	449	387	1,266	16.89
Maharashtra	364	383	363	1,110	14.81
Haryana	233	266	278	777	10.37
Tamil Nadu	202	211	194	607	8.10
Karnataka	157	170	175	502	6.70
Total in the country	2,488	2,594	2,413	7,495	

Source: www.nic.in

INTERPRETATION

If we look at the statistics of inter-state E-way bill from 2018-21, Gujarat leads in the generation of inter-state E-way bill, followed by Maharashtra, Haryana, Tamil Nadu and Karnataka. Gujarat generated 16.89% of total inter-state E-Way Bills in the country from the year 2018-21. It was followed by Maharashtra – 14.81%, Haryana – 10.37%, Tamil Nadu – 8.10% and Karnataka – 6.70%.

Table No. 4 Top 5 States with Intra-state E-way bill No. in Lakhs

Name of States	2018 – 19	2019 – 20	2020 – 21	Total (2018-21)	Percentage (%) of total intra-state E-way bill generation in the country from 2018-21
Maharashtra	473	559	522	1,554	14.75
Karnataka	330	364	381	1,075	10.20
Tamil Nadu	298	394	380	1,072	10.17
Uttar Pradesh	326	351	343	1,020	9.68
Gujarat	247	358	368	973	9.23
Total in the country	3,090	3,694	3,755	10,539	

Source: www.nic.in

INTERPRETATION

If we look at the statistics of intra-state E-way bill from 2018-21, Maharashtra leads in the generation of intra-state E-way bill, followed by Karnataka, Tamil Nadu, Gujarat and Uttar Pradesh. Maharashtra generated 14.75% of total intra-state E-way bills in the country from the year 2018-21. It was followed by Karnataka – 10.20%, Tamil Nadu – 10.17%, Uttar Pradesh – 9.68% and Gujarat – 9.23%.

Table No 5 Top 5 States with Verifications No. in Lakhs

Name of States	2018 – 19	2019 – 20	2020 – 21	Total (2018-21)	Percentage (%) of total E-way bill verification in the country from 2018-21
Karnataka	48	117	102	267	38.20
Gujarat	33	52	39	124	17.73
Kerala	22	45	26	93	13.30
Uttarakhand	17	20	10	47	6.72
Jammu & Kashmir	6	10	9	25	3.57
Total verification in the country	169	302	228	699	

Source: www.nic.in

INTERPRETATION

From the above table it is observed that number of verifications of E-way Bill for top 5 states in the country increased from 2018-19 to 2019-20. However, there is a remarkable declination in the year 2020-21 due to sudden outbreak of Covid-19 pandemic which restricted the movement of certain goods by the Government. From 2018-21, Karnataka recorded 38.2% verifications, out of total verification in the country. It was followed by Gujarat – 17.73%, Kerala – 13.3%, Uttarakhand – 6.72% and Jammu & Kashmir – 3.57%.

Table No. No of E-way bill from top 5 Sector No. in Lakhs

Sectors	2018 – 19	2019 – 20	2020 – 21	Total (2018-21)	Percentage (%) of total no of E-way bill generated in the country from 2018-21
Textiles & Textile articles	713	820	647	2180	12.09
Electrical machinery & equipment	386	494	527	1407	7.80
Machinery & Mechanical appliances	435	501	517	1453	8.06
Iron, Steel & articles	509	526	508	1543	8.56
Automobiles	464	463	449	1376	7.63
Total No. of E-way bill generated in the country	5,578	6,288	6,168	18,034	

Source: www.nic.in

INTERPRETATION

If we look at sector-wise generation of E-way bills from 2018 – 2021, it is observed that highest number of E-way bills were generated from textiles & textile articles i.e., 12.09% of total E-way bill generated in India. It was followed by electrical machinery & equipment – 7.80%, machinery & mechanical appliances – 8.06%, iron steel & articles – 8.56% and, Automobiles - 7.64%. But the sudden outbreak of Covid-19 and announcement of national lockdown by the Government of India in the first quarter of 2020 has resulted declination in generation of E-way from Automobiles and Textiles & Textiles sectors significantly.

Table No. 7 Quarterly E-way bill generation from April, 2018 – March, 2021

Quarter	Intra State	Intra State E-way bill generation as	Inter State	Inter State E-way bill generation as
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		a percentage of total (%)		a percentage of total (%)
Apr 18 – Jun 18	5,08,12,546	4.63	6,11,80,323	7.81
Jul 18 – Sept 18	8,10,78,512	7.40	6,01,97,078	7.68
Oct 18 – Dec18	8,63,21,180	7.87	6,22,27,881	7.94
Jan 19 – Mar 19	9,07,73,951	8.28	6,51,87,450	8.32
Apr 19 – Jun 19	9,18,70,855	8.38	6,46,73,992	8.25
Jul 19 – Sept 19	9,11,72,433	8.32	6,46,27,260	8.25
Oct 19 – Dec19	9,50,79,871	8.67	6,65,71,123	8.49
Jan 20 – Mar 20	9,12,55,498	8.32	6,35,11,662	8.10
Apr 20 – Jun 20	9,30,86,465	8.49	6,11,01,538	7.80
Jul 20 – Sept 20	9,49,40,298	8.66	6,03,09,969	7.70
Oct 20 – Dec20	11,09,47,285	10.12	7,51,58,145	9.59
Jan 21 – Mar 21	11,90,17,295	10.86	7,89,32,761	10.07
Total	1,09,63,56,189	100.00	78,36,79,182	100.00

Source: www.nic.in

INTERPRETATION

From the above table, it is observed that the total number of intra-state E-way bills generated during the year 2018-21 is more than inter-state E-way bills. Most number of E-way bills were generated during the quarter Jan-Mar'21. Approximately, 11% of the E-way bills were generated during these period. If we look at the quarterly trend of both inter-state and intra-state E-way bill generation, it shows an increasing trend in case of intra-state E-way bill generation except during Jul-Sept'2019 and Jan –Mar'2020. On the other hand, the percentage of total inter-state E-way bill generated increased from 7.81 during Apr – Jun'2021 to 8.49 during Oct – Dec'2021. However, it constantly decline from Jan'2020 to Sept'2020. These decline are believed to be due to a national lockdown announced by the Centre owing to Covid-19 pandemic. On 15 March, 2020 when the Government of India imposed lockdown, most states stated to lock their borders. Transportation of non-essentials goods were restricted. From October 2020 onwards, it stated picking up again.

FINDINGS

1. The introduction of the E-way bill system can be considered as one of the intelligent moves by the Government of India towards E-Governance.
2. It abolished all the check posts across the country.
3. The system of issuance of E-way bills ensures transparency.
4. It would prove a vital mechanism to reduce corruption as human intervention is eliminated.
5. It would provide efficient services to the taxpayers and pave the way to a more systematic and developed logistics industry and also result in elimination of tax evasion.
6. The mandatory issuance of E-way bills through the portal would result in the elimination of tax evasion.
7. The introduction of the E-way bill provided relief to tax officers from monotonous work as they no more need to collect and match the manual way bill with the returns of the taxpayers.
8. E-way bill system would eliminate the paperwork that existed in manual waybill system. This would result in saving paper per day, in turn, the environment too.
9. The integration of E-way bill with Vahan system will reduce the entry of incorrect vehicle numbers and thereby will reduce fraudulent transactions.
10. With the introduction of E-way bill, it has restricted generation of EWB multiple times using the same invoice number or document number and thereby has increased tax compliance.
11. Based on pin codes, the E-way bill system can now auto calculate the distance between the source and destination and thereby reduced recycling of E-way bills.
12. Gujarat and Maharashtra recorded the highest enrolment of inter-state and intra-state E-Way Bill respectively.
13. Karnataka, Gujarat, and Kerala are the top three verifying states of the E-way bill.

14. Among the sector-wise generation of E-way bill, textiles and, textile articles is at the top, followed by electrical machinery & equipment, machinery & mechanical appliances, etc.

CONCLUSION

The implementation of E-way bill can be considered as a vital initiative taken by the Government to eliminate the drawbacks of the erstwhile way bill system prevailing under VAT regime in different states. Prior to the implementation of E-Way bill on 1st April, 2018, the different states used to follow their own prescribed E-way bill rules making compliance difficult. Moreover, this digital approach would most likely to facilitate faster movement of goods from one place to another place improving the turnaround time of vehicles. The E-way bill system is also bound to help logistics industry by reducing the travel time as well as costs. This would provide ample amount of opportunities for those who are looking forward for the start-ups in the logistic sectors. Hence, matter of fact is to wait and watch how Government of India progress towards the development of the logistics sector with the implementation of E-way bill.

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In Vitro Susceptibility of *Acalypha Indica* against *Malassezia* Species and their Phytochemical Characterization

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ABSTRACT

The increasing resistance on anti-microbial agents creates pave for exploring new compounds and the large amount of undiscovered bioactive compounds in herbs makes study on the anti-fungal activity of *Acalypha indica*, a valuable medicinal plant that has its origin in India, for the fungi *Malassezia*spp. The antifungal activity of leaf and flower extracts of *A. indica* was studied against *M. furfur* (1765) and *M. pachydermatis* (1369) and different phytochemicals present in those parts of the plant also examined. The extracts of flower and leaf parts of the plant were prepared using ethanol, methanol, ethyl acetate and hexane. The antifungal activity of the extracts was found by zone of inhibition using disc diffusion method. For the identification of phytochemicals present in the extracts, phytochemical analysis was done using different experiments. Ethanolic extract of leaf exhibited 12mm of zone of inhibition at its maximum against *M. pachydermatis*. The qualitative phytochemicals analysis revealed the presence of alkaloids, tannins and steroids. *A. indica* ethanolic extract of leaf has a considerable zone of inhibition which implies that it has potential antifungal activity and can be exploited against skin diseases and systematic infection caused by *M. furfur* (1765) and *M. pachydermatis* (1369).

Keywords: Dandruff, Antifungal activity, Phytochemicals, *Malassezia* species, Dermatitis, fungemia.

INTRODUCTION

Several plants are used for curing various diseases all over world from ancient culture and Asians always use plants as part of their routine health management purposes (Pan et al., 2014; ZAIKA, 1988). Nowadays, 60% of the world's population turns to herbs medicines as a first line of defence to maintain health and fight diseases (*Biodiversity and Health*, n.d.; Pan et al., 2014; Sofowora et al., 2013). Many countries also insist on traditional medicine values and incorporates on public health system that can be reflected in the increasing values of national policy on traditional and complementary medicine (T&CM) reported by WHO (*Biodiversity and Health*, n.d.; WHO GLOBAL REPORT ON TRADITIONAL AND COMPLEMENTARY MEDICINE 2019, 2019). Presently, plant derived drugs are spearheading in curing and treating countless diseases. It is worth noting that over 25% of modern medicines are directly or indirectly derived from plants (Allaie Rani Durgawati Vishwavidyalya et al., 2017; Katiyar et al., 2012; Pan et al., 2014; Veeresham, 2012).

It should be noted that Indian medicinal plants are considered a vast source of several pharmaceutical principles and compounds which are commonly used as home cures against multiple diseases (Pan et al., 2014). One among these plants is *Acalypha indica* linn, which belongs to the family of Euphorbiaceae, a traditional plant of worldwide interest that can be found as a troublesome weed in gardens, along the roads and throughout the plains of India. This plant plays a major role in the treatment of various diseases in the traditional methods that are practised in Ayurveda and Homeopathy. It is used in treating scabies, rheumatoid arthritis, syphilitic ulcer, healing wounds, as a laxative, as an anti-snake venom, and for its anti-implantation and anti-estrogenic activity (Zahidin et al., 2017).

Malassezia spp. are lipophilic fungi that is present on the skin surfaces of humans, many domestic and wild animals as both commensal and opportunistic pathogenic organisms. Recently eighteen species have been introduced in the genus *Malassezia* includes 13 anthropophilic and obligatory lipophilic species and 5 zoophilic species (Dolenc-Voljč, 2017; Honnavar et al., 2018; Sankaranarayanan et al., 2020). These species have been related with a various disease of human skin, such as pityriasis versicolor, seborrheic dermatitis, dandruff, folliculitis, atopic dermatitis, and psoriasis etc. (Allaie Rani Durgawati Vishwavidyalya et al., 2017; Dolenc-Voljč, 2017; Harada et al., 2015). Among them there were many reports with seborrheic dermatitis by anthropophilic *M. furfur* and on fungaemia cases in neonatal intensive care unit by the zoophilic species *M. pachydermatis* (Donato et al., 2020; Harada et al., 2015) (Gaitanis et al., 2012; Velegraki et al., 2015). There were many studies on anti-fungal susceptibility of these two *Malassezia* spp. against various anti-fungal drugs and also with various herbs extract (Al-Sweih et al., 2014; Cafarchia et al., 2015; Laokor & Juntachai, 2021; Mussin et al., 2019; Schlemmer et al., 2019; Velegraki et al., 2015; Vinciguerra et al., 2018). Since the resistance of the species against the agents also raised, the need of new anti-fungal chemical is

need. Accordingly, this study is aimed to determine the antifungal activity of *A. indica* against two *Malassezia* species by disc diffusion method and also to analyse the phytochemicals present.

MATERIALS AND METHODS

Plant material

Acalypha indica was collected from Tamil Nadu Agricultural University, Coimbatore, India. The aerial parts of the plant such as the leaf, flower, stem and root were separated.

Test organism

The yeast cultures *M. furfur* (1765) and *M. pachydermatis* (1369) were received from the Microbial Type Culture Collection and Gene Bank, Chandigarh, India. The cultures were revived using the standard procedures given in the MTCC catalogue. It was sub cultured and maintained on Sabouraud dextrose agar with sterile olive oil as a medium and stored in refrigerator at 4°C. Periodical subculturing was done using above medium.

Inoculum preparation

The inoculum was prepared by taking loopful of cultures from the above sabouraud dextrose agar medium and inoculated in 50 mL of sabourauds dextrose broth with few drops of olive oil and incubated at 30°C for five days and growth study was carried out. Since the log phase of both the organisms were between 20-60 hr, two days cultures were taken for further studies.

Sample Preparation

The aerial parts of the plant, *A. indica* such as leaf, flower were dried for four days at room temperature and made into fine powder. Then the powder was exhaustively extracted with ethanol, methanol, ethyl acetate and hexane in Soxhlet apparatus. Then the extract was filtered and concentrated for further evaluating the antifungal activity and phytochemical analysis.

Disc Diffusion method

The antifungal activity was determined by disc diffusion method using sterile sabouraud dextrose agar with olive oil as a lipid source. On top of the solidified media, the test cultures were swabbed and dried for 10 minutes. The discs were loaded with 10 µg/µl of various parts of extracts. To attain compound diffusion, the loaded discs were placed on the surface of the medium and left undisturbed for 30 minutes at room temperature. By using the respective solvent, the negative control is prepared. Then the plates were incubated at 37°C for 48 hours. The zone of inhibition was noted in millimeters and the experiment was repeated in triplicates.

Phytochemical Analysis

In order to check the presence of various phytochemicals such as alkaloids, tannins, saponins, steroids and proteins, the following procedure was carried out in triplicates.

Test for Alkaloids

A small amount of the extract was added with few drops of 1% hydrochloric acid and filtered. The filtrate was treated with Wagner's reagent and observed for reddish brown precipitate.

Test for Tannins

5mg of extract was dissolved in small amount of water and filtered. The filtrate was treated with few drops of concentrated nitric acid and ammonia solution. The appearance of reddish orange precipitate indicates the presence of tannins.

Test for Saponins

1mL of extract was mixed 20mL of distilled water then agitated for 15 minutes. The formation of foam indicates the presence of saponins.

Test for Steroids

2mL of extract was mixed with each 2mL of chloroform and concentrated sulphuric acid and observed for green bluish colour for the presence of steroids.

RESULTS AND DISCUSSION

The methanol, ethanol, ethyl acetate and hexane extracts of leaf and flower of *A. indica* showed considerable zone of inhibition. The results of the disc diffusion are presented in Fig 1 (Not all pictures shown) & 2. The zone of inhibition of the extract's ranges between 4 to 12mm in diameter. The results reveal that the leaf extracts showed better zone of inhibition than flower and also revealed that ethanol extract shows much better efficacy than other extracts. Our findings are similar to (Chekuri et al., 2018; Saranraj, n.d.) who reported ethanolic leaf extracts has more anti-fungal potency against *Candida* and *Aspergillus* species. Among the two different

organisms, the average values of zone of inhibition shows that *M. pachydermatis* responded more to the extracts than *M. furfur*. But there is not much differences in flower extract zone of inhibition values among the organisms. This results are contradictory to (Singh Parihar et al., 2019) reported no antifungal activity of *A. indica* extract against *M. furfur* species.

For determining the presence of phytochemicals present in the leaf and flower extracts of methanol, ethanol, hexane and ethyl acetate showed considerable zone of inhibition and the presence of tannins, saponins, alkaloids, steroids and proteins were analysed. The results for the phytochemical analysis are tabulated below in the Table 1 & 2. The antifungal activity is proved by the presence of the alkaloid berberine and the antimicrobial activity by the presence of tannins against *Malassezia* species that can be utilized to develop herbal formulations such as shampoos, hair gels and hair or skin creams for the treatment of clinical symptoms like dandruff and seborrheic dermatitis. The antimicrobial properties of tannins include inhibition of extracellular microbial enzymes, deprivation of the substrates required for microbial growth and direct action on microbial metabolism through inhibition of oxidative phosphorylation.

Acalypha indica has showed varying degree of anti-fungal activity against the given microorganism. There are many reports that plant family Euphorbiaceae has anti-microbial activity and also there are many reports on anti-fungal property of many herbs, essential oils against *Malassezia* species. In this study the leaf and flower extracts of the plant showed activity against *Malassezia* species and can be administered in medical practice.

CONCLUSION

The result of the present study suggested that the anti-fungal property of the plant extracts and the presence of bioactive compounds confirms anti-microbial property also. So the extracts of the *A. indica* confirms the medicinal activities and it can also be studied for further microbial activities which will be useful for developing new drugs against various microbes. Quantification and structural studies on the bioactive compounds can be done for future work in this herb.

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CONFLICT OF INTEREST

The authors declare that there is no competing interest.

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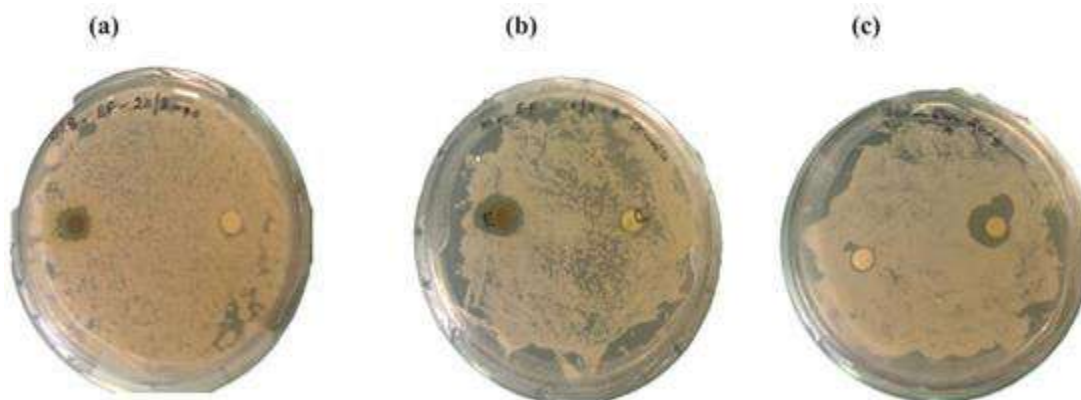


Figure 1: Zone of inhibition of (a) Ethanolic extract of flower on *M. pachydermatis* (b) Ethanolic extract of leaf on *M. pachydermatis* (c) Ethanolic extract of leaf on *M.furfur*.

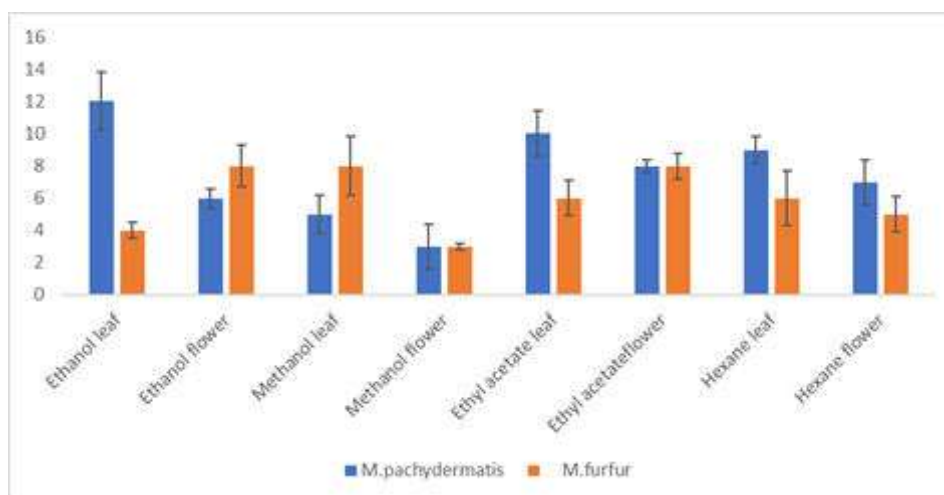


Figure 2: Zone of inhibition values of leaf and flower extract of *A.indica* against *Malassezia* spp.

Table 1: Phytochemical analysis of leaf extracts of *A.indica*

S.No	Solvent	Alkaloids	Saponins	Tannins	Steroids	Proteins
1.	Ethanol	+	-	+	-	+
2.	Methanol	+	-	+	-	+
3.	Ethyl acetate	+	-	+	+	-
4.	Hexane	+	-	+	+	-

Table 2: Phytochemical analysis of flower extracts of *A.indica*

S.No	Solvent	Alkaloids	Saponins	Tannins	Steroids	Proteins
1.	Ethanol	+	-	+	-	+
2.	Methanol	+	-	+	-	+
3.	Ethyl acetate	+	-	+	+	-
4.	Hexane	+	-	-	+	-

Design of a Mobile Phone Application for Interactive Teaching Learning in Kindergarten Education: Augmented Reality as a Digital Tool

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ABSTRACT

Education is getting transformed from traditional way of learning in the class room to virtual immersive learning through interactive technologies. Game based learning environment is found useful for the children to learn concepts easily. This paper explains the development of an Augmented Reality (AR) based mobile phone application to increase the motivation for learning and engagement of the children in the classroom. This Augmented Reality application is marker-based and was developed using Unity game engine. The application was developed to teach English and Mathematics subjects. The application consists of two modules namely learn and play. After completing the teaching and learning of any topic, the children can be tested using the play module. It is possible for the children to interact with the 3D objects and animations. Further, inclusion of audio-visual effect attracts the students to use the application.

Keywords: Augmented reality, Educational games, Interactive Learning environment, Mobile devices, Marker, Collaborative learning.

I. INTRODUCTION

Education plays an important role to cultivate various skills like observing skills, learning skills and problem-solving skills among the children. Early childhood education is one of the main factors in developing knowledge and the determining the success of the children in learning. Educating children during the early childhood is a complex task due to the internal and external factors that influence the teaching method. As the technology is developing at a higher speed, traditional way of teaching learning process is getting changed significantly. Computer technologies has a great and wonderful impact on teaching-learning process [1]. It changes a passive learner into an active learner. Alternative way of teaching process should provide a learning environment that is attractive and motivating the students. The technology enhanced learning motivate and engage the young children in the learning programme.

Augmented Reality is one of the emerging technologies that is capable of bringing out pedagogical innovations in various subject domains. It is used to superimpose virtual elements on the physical world. AR has three major features. They are; it merges real objects and virtual objects, it provides opportunities for real-time interaction, and it provides accurate registration of three-dimensional virtual objects and real objects [2]. Augmented reality is considered to lie between the real environment and virtual world as shown in Fig.1.

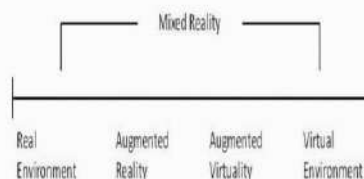


Fig.1. Milgram's Reality-Virtuality continuum [3]

Increase in the usage of electronic gadgets like smart phones, tablets, advanced projector system helps to build and use AR system for surgical training, tourism, advertisement, education, shopping and various fields of science and technology. There are three types of augmented reality. They are marker-based augmented reality, marker-less augmented reality and projection-based augmented reality. Display devices like head mounted display, spatial display and handheld display are generally used for visualising the AR system. Hand held display devices are cost efficient and are widely used.

II. LITERATURE REVIEW

A. Advantages of Game based learning

Many researches have been carried-out in the recent past to find out the effectiveness of integrating the software game with learning. The guiding principles that are very useful for the development of environment and educational games design for children was studied by Miller et al. [4]. Effectiveness of video-based instruction

and game-based instruction for learning mathematics using multimedia devices was investigated by Lin et al. [5]. It was found that learning and thinking skills were improved using game environment than video-based learning. Burguillo [6] suggested that Competition based learning increased the motivation of the users and their learning performances. Competition brought the additional challenge which attract the attention of the player. This increases collaboration of the work and students feeling of enjoyment. Many such works are reported to have positive impact on the students' learning and understanding ability. Viruvou et al. [7] found out that children who were less interested in studies may be benefitted from extra motivating environments like virtual reality educational games.

Many studies have indicated that game-based learning environment is efficient, which increases the motivation of students. Based on the review, researchers and game developers are trying to integrate educational content with game-based content with a goal to transform educational process into fun-based learning.

B. Uses of Augmented Reality

Bolestis and McCallum [8] developed a table mystery collaborative augmented reality game to teach chemistry. The results of the work indicated that students were more excited and engaged while learning in AR environment. It was recommended that AR games can be used for educational purpose. Di Serio et al. [9] compared the effects of augmented reality technology in visual art course with the traditional art course. Results found that student who uses the AR application achieved a greater level of concentration while doing various tasks. Oh and Woontack [10] developed a AR Garden application which increases the interactive experience of the user in gardening. It has simulations for applying fertilizer to plants, watering and the effect of light on plant growth. Hannes Kaufmann & Dieter Schmalstieg [11] designed Construct3D. It is a tool developed to teach geometry and mathematical concepts using AR technique at high schools. It proved that AR provides more positive experience in learning and improves the spatial skills. Thus, researches showed that use of augmented reality in education provides more opportunity for the learners to understand the subject in the easiest way. It also greatly improves the interaction between the teachers and students. It improved the learning effects and motivation in students [12].

C. Uses of Augmented Reality in childhood education

Yilmaz [13] developed an educational magic toy that has puzzles, flash cards, match cards to learn animal, fruits, colors, numbers for the children in the age group 5-6 years. Teachers had an increased positive attitude towards educational magical toys and believed them as useful. Results showed that the children prefer mostly pointing, inspecting, turning and responding behaviors while playing educational magic toys. In one of the studies, Tarnag et al. [14] developed an augmented reality ecological system by integrating virtual breeding activities with campus host plants. Students used digital tablets and smart phones to breed virtual butterflies. It improved their learning effectively and encouraged the children to acquire knowledge about butterfly ecology. The concept for making augmented reality classroom environment was developed to study the classroom usability. This research showed the design principles to be used while developing augmented learning environment [15]. Squire and Jan [16] explored the effectiveness hand held devices in engaging students with scientific thought. Results proved that it promotes the cooperation and understanding skills among the users. Research showed that AR story books increased the learning and story reading experience.

From these reviews, it is found that AR is useful in the teaching-learning process. Most of the research work in the area of VR and AR were done for science education. Availability of AR based applications related to Mathematics and English are limited. Learning objectives could be achieved in short duration of time using AR based application.

III. METHODOLOGY

This work includes three phases. First phase involves creation of the 3D models importing them to Unity in specific formats. The second phase involves development of various learning modules with animation and audio effects. The third phase involves creation of user interface, providing user interaction in learning environment using C# script and integration of appropriate learning modules.

Software used for this work is Unity and the application is made suitable to run in smart phones and digital tablets.

IV. DESIGN AND IMPLEMENTATION OF AR APPLICATION

A. Design of 3D models

3D modeling is one of the graphic techniques which is used to create a digital representation of the object. Creation of 3D models is one of the important tasks in developing AR learning environment and Maya software

is used for it. 3D models improve the visualization effect of the objects than that of 2D models. Material and texture are applied to the 3D model for more realistic appearances.

B. Conversion of file format

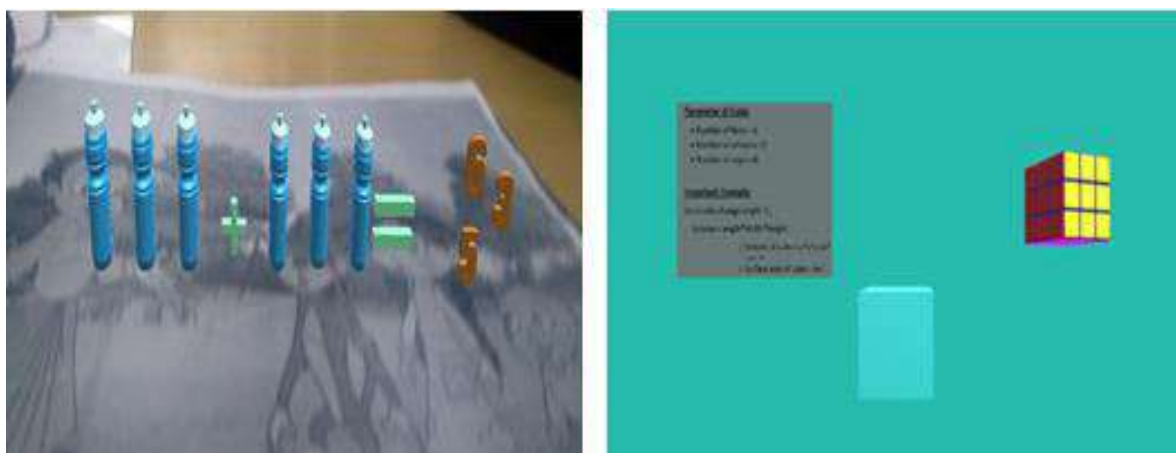
The 3D models are then saved in .mb file format and imported to Unity environment. As Unity game engine is a different platform and supports .fbx and .obj file formats only, the 3D models developed using various modelling software are generally converted into neutral file format like Initial Graphics Exchange Specification (IGES) or Standard for the Exchange of Product Data (STEP) and then converted to .fbx or .obj file format. It is important that no information of the original image is lost during the file conversion. The .fbx file format is the most efficient file exchange format and serves as the communication tool between the modelling software and unity software.

C. Development of augmented environment

The game engine is useful for developing various applications. In Unity software, there are some predefined 3D objects that can be used to design models. Materials and shaders were applied using C# scripting. The AR environment contains learning module for the courses English and Mathematics. Imported models were also used to create the AR environment. Colliders were added to all the models for interaction. Every learning module has learn and play modes. In learning mode, children are taught to learn the concepts in the easiest way by interacting with the 3D images. Play module is used to test the understanding of a particular module by the learner. Markers are developed for each module to augment the images.

D. Development of mathematics learning module

Three sections were developed in mathematics learning module. They are: numbers, measurement and shapes. Each section has learning and playing method. Number modules has four levels to learn numbers and basic arithmetic operations such as addition, subtraction. Shapes module contains learning about basic 2D, 3D shapes. Learning measurements includes various concepts such as tall, short, long, heavy and lighter. 3D models, interaction and audio-visual effects together improves immersion and learning. Fig.2 shows the various sections in mathematics learning module.



a) Addition learning module b) Shapes Learning module

Fig.2. Various section in mathematics learning module

E. Development of English learning module

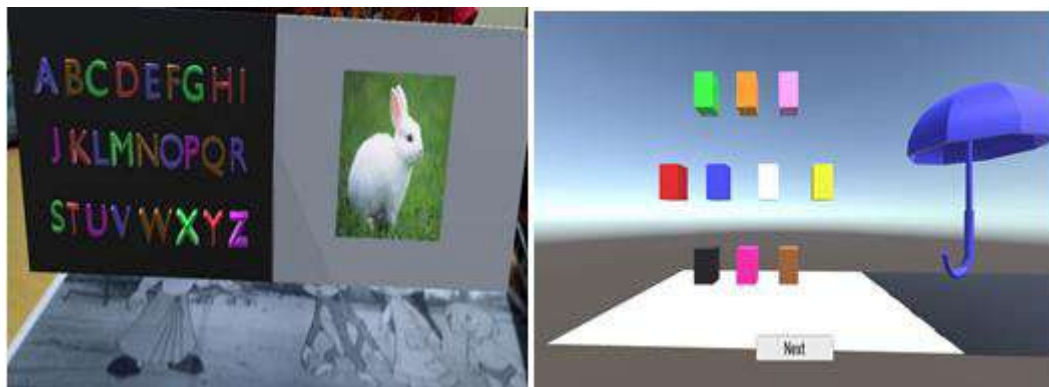
English Learning module contains four sections – alphabets, colors, preposition, and actions. Alphabets module contains two sections: capital letters, small letters. Questions are randomly generated and displayed as image. User has to find out by choosing the correct alphabet. In Colors module, user has to match the colors and remember their name. Voice command is given for correct option and it also increased the participation of the user. Better animations are used to learn the concepts easily. Fig. 3 shows the various sections in English learning module.

F. Selection of AR markers

Modules developed for learning were converted to augmented learning environment. Marker based AR is used in this application as it is mostly used by the children. For each learning module, appropriate markers were developed. Children can scan a particular marker and start learning the concepts. The 3D models will pop-up above the marker that leads to immersion and interaction of the user with the environment.

G. User Interaction

User interface attracts the user to engage in the environment. User can interact with the application by clicking the appropriate buttons in the learning environment. Interaction is done using C# scripts. Compiler converts the code into Common Intermediate Language which can be used to run the program. C# scripting is done for more immersion like when user pressed correct option, balloon animations will be played. It motivates the user.



a) Alphabets learning module b) Colours Learning mode

Fig.3. Various section in English learning module

V. CONCLUSION

Thus, the Augmented Reality learning application is developed and interaction with the 3D images are enabled to improve the participation of the user in the teaching-learning process. Inclusion of 3D models and audio-visual elements in the AR application was found to motivate the kids in learning. This kind of learning environment makes the children to learn the concepts with more fun and immersion.

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Optimization of Plant Layout in Cable Tray Manufacturing Industry

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ABSTRACT

In general, manufacturing costs of the products are mainly influenced by processing and material handling factors. The processing cost depends on the quality of the final product and the handling cost depends on the transfer time and the handling equipment. The handling costs of the product could be reduced by optimizing the plant layout. Geethanjali Engineering is involved in the manufacture of cable trays for different companies. As the layout influences the productivity significantly, there is a lag in achieving the production demand. This paper proposes an optimized plant layout for a cable tray industry using layout optimization tools (VIP PLANOPT and CRAFT) and it has been compared with the existing layout. This comparison facilitates increase of the plant productivity by redesigning the layout, using the combination of lean six sigma and the above-mentioned layout analysis tools.

Keywords: Layout optimization, handling cost, CRAFT, Lean six sigma, VIP PLANOPT

I. INTRODUCTION

Lean six sigma tools are now adapted by many industries in order to improve their productivity by eliminating waste and non-value-added activities. Lean manufacturing is a systematic approach to identify and eliminate waste through continuous improvement by following customer friendly processes at various stages of manufacturing. The concept of lean manufacturing was proposed by a Japanese automotive company, Toyota during 1950's which became famously known as Toyota production system (TPS). The first goal of TPS was to improve productivity as well as to decrease the cost by eliminating waste and non-value-added activities.

One of the main goals of a manufacturing system is the improvement of productivity. This depends upon several factors such as the type and the complexity of product, the quality of raw material the arrangement of workstations constituting the production process. Some of these parameters determined by the product for this reason are unchangeable. The challenge of determining the best arrangements of workstations is one of the elements that has a great impact on a system performance called as facility layout problem. Layout analysis aims to spatially locate interrelated units such as departments, machines and modules subject to some design criteria and area limitations with one or multiple objectives. More specifically, the facilities layout problem, which is an integral part of facilities design, aims to locate the production units within a facility. Today, the layout problem is considered in a dynamic nature. Layout generation and evaluation is often considered as time consuming and difficult.

This is because of two reasons. First, the extensive data collection process at the initial stages and second, the multiplicity of project objectives. i.e. the best layout is selected after a trade-off between a combination of actual production requirements and effort involved in data collection and analysis. The current layout of the industry has complications since the departments that are necessary to be adjacent are not adjacent and this causes transportation time and material movement to be higher. The main objectives of layout redesigning are reducing the material movement between the machines, effective utilization of plant area, improving material flow, material transportation time and cost. CRAFT and VIP PLANOPT are the major tools used in industries for the layout optimization. CRAFT is a layout improvement algorithm widely used in industries which minimizes the transportation cost by pairwise interchanging of the departments. Similarly, VIP PLANOPT is another strategy for layout optimization which incorporates the VSM (Value stream maps) which are an important tool for organizations applying Lean methods. They provide a vital means of identifying waste and improving process efficiencies in a wide range of industries. In this research work, layout optimization of a sheet metal industry has been attempted and an improved layout has been proposed. Both the existing as well as the proposed layouts are analyzed using the CRAFT and the VIP PLANOPT for the evaluation of material handling cost.

II. LITERATURE SURVEY

Filippo De Carlo In et al. (2013) studied a small scale layout redesigning is rarely deployed. The layout design depends on the current situation of the company and the better solution can be provided for the manufacturing system to maximize the productivity. To achieve those requirements, lean re-engineering becomes the option [1]. **Syedasadali et al. (2016)** have experimented the Implementation of lean manufacturing principle in

production industry to the continuous improvement for achieving global competition. Lean manufacturing maximizes efficiency reduces costs and improves product quality. Since plant layout design is directly correlated with the production systems. Facility Layout Design FLD is the arrangement of operations, machineries, spaces and the correlation between them [2]. *Vasanth Kumar et al. (2013)* studied the application of simulation software Arena and layout optimization software Plan Opt to a dynamic print and packaging company in India. Some of the problems were expressed by the company on huge quantity, unnecessary volume of shop floor material, handling cost difficulties and confusion over production planning, long processing in the production of products consumes time, resulting in losing of customers and high overhead costs because of poor layouts. These solutions are also simulated to see the impact of the change in the layout of the company. Thus, by making an optimized layout using the VIP Plan opt software we are able to reduce the material movement which increases the productivity [3]. *T. Vignesh et al. (2017)* studied the important parameters which affect the capacity in negative way. There is an increase in break time, downtime, repair time and many other minor factors. Efforts have been made to reduce the idle time in the assembly shop. The idle time in the transfer area also plays an important role in restricting productivity. Six Sigma is one of the most common and well-known methodology for problem-solving and DMAIC (Define-Measure-Analyze-Improve-Control) approach. Six sigma is a structured methodology that focuses on reducing various measuring defects and improving the quality of products in processes and services [4]. *T. Viswajit et al. (2017)* have experimented Systematic Layout Design SLD based on the resolution of the machinery which helps in enhancing the productivity was analyzed. In addition to machine arrangements essential features are utilities, labour, electrical connections and ventilation. Layout designs should consider growth and expansion of the industry in future. The unit time per product decreases, which has a positive impact on the productivity [5].

Scope of the Work

Industries are spending a lot of resources in finding and elimination of wastes and also to reduce the production costs. The layout optimization is a strategy to find an improved and optimized layout for a plant by continuous improvement. This paper aims for improvement of the productivity and reduction of production costs using improvement of the plant layout.

III. METHODOLOGY

The methodology followed for the analysis and solving the problem existing in the industry is shown in **Figure 1**.

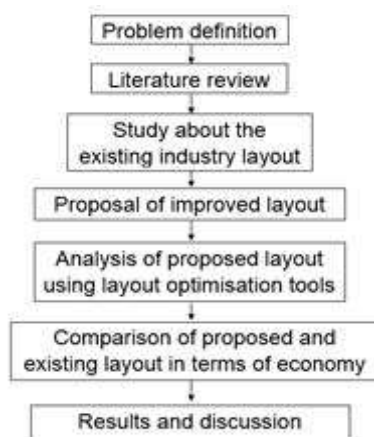


Fig1. Methodology

In the industry which was chosen, due to non-optimal plant layout, there has been a higher material handling cost and inability to achieve the production demand. Hence, this methodology has a goal of proposing a new layout with improvement in material handling and productivity. The existing layout has been studied and literatures related to the layout optimization has been reviewed. By trial and error, the existing layout has been modified and analyzed. The layouts have been analyzed using CRAFT and VIP PLANOPT. The improved layouts with better results have been proposed.

IV. EXISTING LAYOUT

The layout of the industry along with the material flow, size, production demand and productivity have been studied. The existing plant layout is shown in Figure 2. This existing layout is analyzed through CRAFT and the material handling cost is determined. The flow table, distance table, cost table are shown following the existing plant layout.

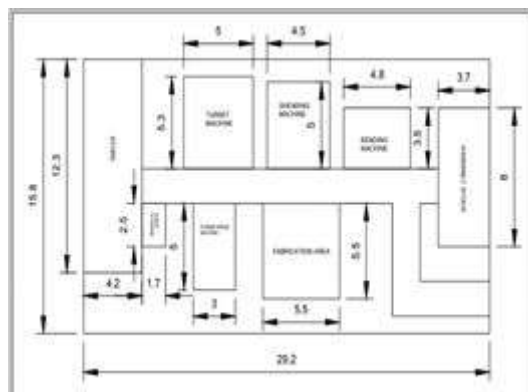


Fig2.Existing layout

Table1. Dimensions of stations

Department	X	Y	Description
1	1.7m	2.5m	SheetStorage
2	5m	5.3m	TurretMachine
3	4.5m	5m	ShearingMachine
4	3m	5m	PowerPress
5	4.8m	3.5m	Bendingmachine
6	5.5m	5.5m	FabricationArea
7	3.7m	8m	Assemblystock
8	4.2m	12.3m	Store

Table II. Distance Matrix for existing layout

To From	1	2	3	4	5	6	7
1	-	10.9	17.3	5.7	21.3	12.8	26.7
2	10.9	-	6.4	5.2	10.3	10.8	21.0
3	17.3	6.4	-	11.6	4.2	5.8	15.2
4	5.7	5.2	11.6	-	15.1	8.2	21.0
5	21.3	10.3	4.2	15.1	-	9.3	10.9
6	12.8	11.0	5.8	8.2	9.3	-	15.2
7	26.9	21.0	15.2	21.0	10.9	15.2	-

Table III .Cost Matrix

To From	1	2	3	4	5	6	7
1	-	2262					
2		-	2233				
3			-	2146			
4				-	1914		
5					-	1943	
6						-	1943
7							-

Table IV. Flow Matrix

To From	1	2	3	4	5	6	7
1	-	1					
2		-	1				
3			-	1			
4				-	1		
5					-	1	
6						-	1
7							-

The total cost of the initial layout can be calculated by the formula,

$$\text{Total cost} = \sum_{i=1}^n \sum_{j=1}^n F_{ij} * D_{ij} * C_{ij}$$

F_{ij} is the flow from the station 'i' to the station 'j'

D_{ij} is the distance from the station 'i' to the station 'j'

C_{ij} is the cost per unit distance from the station 'i' to the station 'j'

Table V. Total cost matrix

To From	1	2	3	4	5	6	7
1	-	24655					
2		-	14291				
3			-	24893			
4				-	28710		
5					-	17875	
6						-	17875
7							-

Total material handling cost per month is found to be Rs.128299 from the total cost table.

A. Modified Layout 1

The modified layout using CRAFT has been analyzed and there has been a reduction in the MH cost. In the modified layout, the stations 5 and 6 have been interchanged. The modified layout has provided a reduction in the material transfer distance between the stations, Hence the material handling cost has been reduced. The distance matrix has been shown here. Total material handling cost per month is found to be Rs.122245.

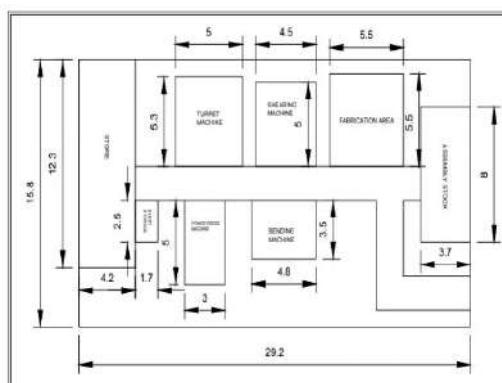


Fig3.Modified layout 1

Table VI. Distance matrix of modified layout 1

To From	1	2	3	4	5	6	7
1	-	10.9	17.3	5.7	13.4	23	26.7
2	10.9	-	6.4	5.2	11.5	12.1	21.0
3	17.3	6.4	-	11.6	6.6	6.2	15.2
4	5.7	5.2	11.6	-	8.8	17.3	21.0
5	13.4	11.5	6.6	8.8	-	12.4	10.9
6	23	12.1	6.2	17.3	12.4	-	8.8
7	26.7	21.0	15.2	21.0	10.9	8.8	-

A. ModifiedLayout2

Similarly, another layout has been developed in which the stations 3 and 4 have been interchanged. This also gave a better result in cost reduction which is less than the other two layouts. The distance matrix of the modified layout 2 is given below. Total material handling cost per month has been reduced to Rs.105998.

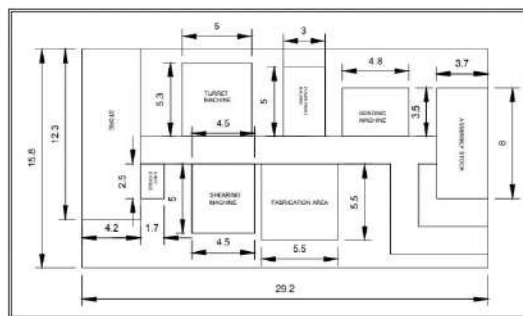


Fig 4. Modified layout2

Table VII. Distance table of the modified layout 2

To From	1	2	3	4	5	6	7
1	-	10.9	6.7	15.6	20.8	12.7	26.7
2	10.9	-	4.1	6.7	10.1	10.8	21.0
3	6.7	4.1	-	8.9	14	9.2	19.9
4	15.6	6.7	8.9	-	5.1	4.1	14.3
5	20.8	10.1	14	5.1	-	7.2	10.9
6	12.7	10.8	9.2	4.1	7.2	-	15.1
7	26.6	21	19.9	14.3	10.9	15.1	-

V.VIP PLAN OPT

VIP PLANOPT is a layout optimization tool through which the elements in a plant can be arranged in an optimized manner. It also allows the user to modify the layout manually. It also makes the user know the cost difference between the optimum and user modified layout.

A.Input required

Table VIII .Input data for VIPPLANOPT

Module	X	Y	Description
1	1.7m	2.5m	SheetStorage
2	5m	5.3m	TurretMachine
3	4.5m	5m	ShearingMachine
4	3m	5m	PowerPress
5	4.8m	3.5m	Bendingmachine
6	5.5m	5.5m	FabricationArea
7	3.7m	8m	Assemblystock
8	4.2m	12.3m	store

B. Modified layout 1

Another layout has been done and analyzed through VIP PLANOPT and modified based on feasibility of material flow.

In this layout, the elements are placed, such that distance between the elements have been maintained shorter. The station 5 and station 6 are seen to be modified when compared with the existing layout of the plant. The cost of handling analyzed for this layout through VIP PLANOPT is found as Rs.17321. The modified layout is shown in the figure below.

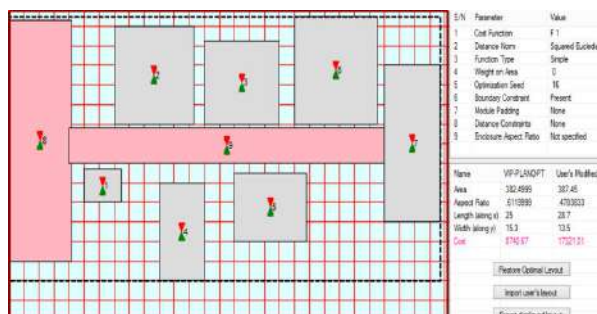


Fig.5 VIP PLAN OPT modified layout 1

An empty space is also created at the end of the material path for the feasibility of taking out the material after finishing. It will help to keep the finished parts before dispatch. This empty space can also be used for installing additional machines in future.

C. Modified Layout 2

Similarly, like the layout 1, another layout has been developed in the VIP PLANOPT which also provides reduced costs in the material handling between the stations. The stations 4 and 5 are interchange by 3 and 6 respectively.

The total material handling costs of modified layout 2 is Rs. 17532.61.

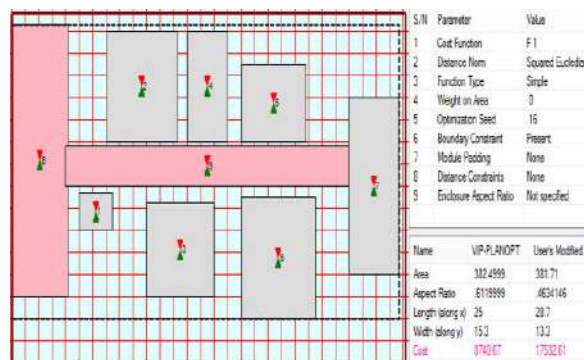


Fig6. VIPPLANOPT modified layout 2

VI. RESULTS AND DISCUSSION

On comparing the layouts analyzed and improved through CRAFT, layout 2 is found to be the cost effective on exchange of stations. On comparing the layouts improved by the VIP-PLANOPT, the cost of material handling is lower in the layout 2. On comparing the two layouts, the layout 1 is found to be the better one. But, considering material handling feasibility and space, layout 2 is found to be better on comparing with existing and other improved layouts. The VIP PLAN OPT results are influenced by the distance by minimal amount than the CRAFT. But, the layout 2 provides necessary space for the transport of the material from the unloading station to the sheet metal storage. The comparison of the material handling costs is shown in the table below.

Table IX. Comparison of cost in improved layouts.

*	CRAFT	VIP PLAN OPT
Layout 1	RS.122245	RS.17321
Layout 2	RS.105998	RS.17532

Layout 2 is considered to be the better one since the influence of the distance between the stations is considered more in CRAFT than in VIP-PLANOPT.

CONCLUSION

The better layout among the improved layouts is analyzed and proposed for modification of the existing one. The cost effectiveness of the layouts is only considered for optimizing. The costs spent for the material handling is reduced by the layout optimization. Also, the distance between the stations highly influences the material handling costs. In the proposed layout the distance between the stations is reduced, in order to reduce the material handling cost and it has provided significant effect in the simulation. For further validation of real time results, the model with better improvement has been proposed. The results in the cost reduction of the plant for material handling would be seen only after the real time implementation.

A.Future work

The layouts which are found to be better will be simulated using ARENA, and the best among the improved layouts will be determined. Present and future state Value stream mapping is to be done in order to compare the benefits and achieve the production demand of the plant.

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VIII. ACKNOWLEDGEMENT

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Cities 4.0

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ABSTRACT

In comparison to that of yesteryears, today's world continuously poses several newer and newer challenges. Increasing population trends, especially in the third world countries amplifies these challenges. There is a marked trend of development (often to the point of being over-development) and gradual transformation of undeveloped countryside into sprawling cities, and of already existing cities into larger and larger hubs spawning high-rise buildings and increasing the demand on resources multi-fold. Against this backdrop of growth, cities must find ways and means of innovating in order to avoid choking, and to meet the various challenges imposed on them. In parallel fashion, manufacturing has transformed itself over the years from very basic to digital and smart factories, with current buzzwords like Industry 4.0. This paper presents an approach using various aspects of Industry 4.0 drawn from manufacturing and their application to the urban cities of today in order to better manage their demands and problems.

Keywords: Development, smart cities, transformation, manufacturing, Industry 4.0, smart factories, digital manufacturing.

1. INTRODUCTION

At the turn of the nineteenth century, only about 3% of the world's population was urbanized i.e. living in cities. The United Nations has estimated that currently 55% of the world's population lives in cities, a number expected to grow to 68% by 2050 [1]. Interestingly, the total area of cities is less than 5% of the land area, necessitating vertical growth of large cities. This spiraling demand for more urban space renders it absolutely essential for cities to be managed effectively and efficiently. While it is true that more and more cities have emerged from agglomerations of smaller towns and villages as part of the natural growth, such growth has more often than not been "knee-jerk" to suit the immediate and short-term needs. This haphazard growth has spawned cities that are bursting at the seams, or have just learnt to live with problems with seemingly no solution.

In sharp contrast, the growth of the manufacturing industry, right from the days of primitive implements and tools to present day Smart Manufacturing, has been more structured – so much so that the growth of the Manufacturing Industry has been segmented into "bands" across different eras, working backwards from the current Industry 4.0 revolution that is sweeping the manufacturing world – Industry 1.0 used primitive tools to assist manual labour, 2.0 adopted basic electrification like motors and prime movers, 3.0 with electronification ushering in the CNC era, and Industry 4.0 that heralds the coming to age of the digital revolution and Smart Manufacturing.

This paper draws a parallel and extrapolates some of the tools and methods within the structured growth pattern of Industry 4.0 into the domain of Cities and their management – can the Industry 4.0 wave be replicated into a fourth generation of Smart Cities? By definition, a "smart city" is expected to possess the elements shown in Figure 1 at a bare minimum in order to qualify for the tag of "smart city".



FIGURE 1. Smart City components

The number of smart cities worldwide is currently estimated as under 50, a number expected to grow to 100 by 2025 as shown in Figure 2.



FIGURE 2. Growth of Smart Cities worldwide

2. AUGMENTED AND VIRTUAL REALITY

A smart city is “an urban area that uses different types of electronic Internet of things (IoT) sensors to collect data and then use these data to manage assets and resources efficiently” [2]. AR and VR are key emerging technologies being used in a wide range of manufacturing applications. VR is broadly defined as a feasible and possible real-life situation being virtualized, while AR uses the same technology to add fictitious elements to the situation, making it impractical or something that does not occur in real life. Using these technologies in the management of cities, especially smart cities opens up an array of interesting application areas, some of which are discussed below.

VR in city management is a useful tool for city management in some of the representative areas mentioned below.

1. Checking the water, effluent and drainage system in cities, and determining low-lying areas likely to be flooded during heavy rains; as an extension, planning effluent and drainage lines for new extensions as part of a city's growth.
2. Designing evacuation routes for *en masse* exodus of vehicular traffic and inhabitants in the event of an emergency – the city of New Orleans in the USA has implemented this approach, and both the 8-lane in and 8-lane out freeways were used as 16-lane evacuation routes when Hurricane Rita and Katrina struck in 2005.
3. Preparation of Disaster Management plans in the event of natural catastrophes like earthquakes. Virtualizing the effects of an earthquake can also help in determining weak spots (buildings and water bodies) that are prone to damage, and which need to be strengthened.

Likewise, AR in city management can provide various immersive experiences in the following areas.

1. Management of public services like streetlight control, parking and vehicular control, solid waste segregation and disposal.
2. Smart data management and city-wide sensors with streaming capability linking various devices – for example, water level monitoring using sensors in all the storage and distribution points, linked to a central pumping station to switch on when the lower level limit is sensed.

Figure 3 shows the application of AR in Traffic Management.



FIGURE 3. AR in Smart City Traffic Management

3. DATA AND RECORDS MANAGEMENT - CLOUD COMPUTING AND BIG DATA ANALYTICS

As smaller towns morph into large cities over a period of decades and centuries, a huge amount of data is generated and needs to be effectively managed. Bettencourt opines that “under general conditions, new sources

of data coordinated with urban policy can be applied following fundamental principles of engineering to achieve new solutions to important age-old urban problems” [3]. These urban problems span multiple areas right from weather records to safety and accident statistics to seismic data in earthquake prone cities. In short, a city is a continuous source of data generation, and effective city management must include an effective streaming, capture and analysis mechanism to tap into these data streams, and ensure that all decisions are taken in accordance with the nature of the data generated.

While the effective management of data, especially in large volumes, is key to the progress of cities, there are issues of data security and privacy norms that need to be fulfilled and addressed. According to Elmashraby *et al*, “the world is experiencing an evolution of Smart Cities. These emerge from innovations in information technology that, while they create new economic and social opportunities, pose challenges to our security and expectations of privacy.” [4]

Any application handling data necessitates appropriate storage and retrieval, along with backup measures not just to prevent data loss, but also to build up trends and patterns over a period of time. Smart cities need to have mechanisms of storing their data on the cloud, thus obviating the need to have elaborate hardware and storage systems as part of their data management. Agarwal states that “with the help of cloud computing various services can be available on clouds and citizens of smart city can use these services very easily via the internet on their smart phones, laptops, PCs and tablets.” [5]

Figure 4 shows the various stages of smart data management, capturing the steps in converting raw data into meaningful decision points and data analytics measures of monitoring and measurement.

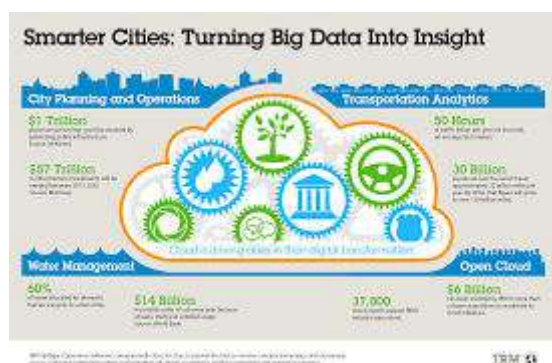


FIGURE 4. Data Analytics in Smart City Management

4. SIMULATION

Many of the areas relating to smart cities and their management as mentioned in this report are complex and require elaborate analysis. They are difficult to replicate in the real world sense – for example, the impact of earthquakes on a city, with earthquakes not a frequent occurrence. Hence all smart cities need to use simulation tools to virtually replicate such events.

Simulation in smart city management can start right from city planning, and evaluating various models and layouts before finally deciding on the best one. Starting from the basic city planning, simulation continues to be a powerful tool in all the subsequent stages of city planning and development. Over a span of time, simulation can also be used to extrapolate various parameters into the future space, and assess various aspects – for example, population growth and demands of a city.

The concept of simulation has been effectively used across all the stages of city management, right from city layout and planning to planning for future growth. With an array of simulation tools and technologies to choose from, it is no wonder that it is possible today to design and manage a SimCity (simulated city) from start to finish of the city’s design, development and expansion cycle.

5. AUTONOMOUS SYSTEMS AND INTERNET OF THINGS

Management of a smart city involves dealing with an array of infrastructure and specialized equipment to carry out various related tasks. These tasks can range from pumping out the water in storm water drains to huge generators and transformers used in the city’s main electrical power station.

Present day equipment and infrastructure is generally modular and maintenance-free to a large extent. The concept of Autonomous Maintenance adds a self-diagnostic layer to the equipment and adds a basic level of maintenance capability to the equipment, generally through embedded systems and microprocessor controls.

Autonomous systems are ideally used in city management in equipment that is inaccessible (underground pumping stations), hazardous (septic tanks) or high-cost (involving scarce or specialized labour).

These systems are connected to each other as well as to a centralized control hub via IOT protocols and circuits. Many cities use the ANYmal robot shown in Figure 5 to carry out a wide range of city management jobs.



FIGURE 5. ANYmal robot used in Smart City Management

6. SMART CITIES – THE INDIAN CONTEXT

With the objective of streamlining the development of cities, the Government of India has launched the Smart Cities Mission in June 2015. By the year 2030, nearly 40% of India's population (currently 31%) is expected to live in urban cities, contributing to 75% (currently 63%) of India's GDP. [6]

According to this initiative, the following factors are defined as key indicators of the extent to which cities can be classified as smart.

- i.) adequate water supply,
- ii.) assured electricity supply,
- iii.) sanitation, including solid waste management
- iv.) efficient urban mobility and public transport
- v.) affordable housing, especially for the poor
- vi.) robust IT connectivity and digitalization
- vii.) good governance, especially e-Governance and citizen participation
- viii.) sustainable environment
- ix.) safety and security of citizens, particularly women, children and the elderly
- x.) health and education.

It is significant to note that all of the methods, tools and techniques mentioned in this paper have a big part to play in the effective administration of the above Smart City parameters. As a measure of monitoring and administering the Smart Cities Mission, the Government of India has set up a Command and Control Centre in Surat, shown in Figure 6.



Figure 6. Smart Cities Mission Integrated Command and Control Centre

7. NEXT STEPS

As an amalgamation of the various methods described in this paper with the factors outlined in the Government of India initiative, the following are the suggested future action points that need to be planned and executed for cities in general, and Indian cities in particular, in their journey to becoming smart cities.

- i) Defining acceptable norms and standards for classification of smart cities.

- ii) A scale of measurement for tracking progress and setting targets across the various parameters of smart cities.
- iii) Customization of the Smart cities initiative and measures to meet the requirements of the vast (and primarily agrarian) hinterland of India that plays a significant part in the nation's economy.
- iv) Including Smart Cities content into the nation's education system right from schools in order to inculcate a sense of responsibility and societal awareness into the future generation who would ultimately pick up ownership of these schemes.

8. CONCLUSION

Keeping in mind the rate at which progress is happening, and more and more semi-urban or rural towns and villages are growing into inevitably large cities and hence on to smart cities, the use of technology and tools mentioned in this paper is bound to proportionately increase.

While the advantages of these technological tools seem fairly obvious, these tools also come with their own inherent disadvantages and risks. The human judgement factor sometimes uses a "sixth sense" or gut feeling that overrules all logic and rational thinking, and that ultimately turns out to be right.

It is therefore important to strike the right balance between the tried and tested conventional methods and the new-fangled methods mentioned in this paper. It is this balance which will finally determine the effectiveness of these tools in smart cities and their management.

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Cost Effective Energy Saving Method in Chillers Using Impeller Trimming

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ABSTRACT

A chiller plant consists of chiller, cooling tower, and pump subsystems. The study was conducted to estimate the potential energy savings made possible by trimming the pump's impeller to match the actual system head requirements. Pump impeller trimming is an attractive energy conservation opportunity because it is easy to implement, and the work can be carried out without disruption to the building's normal operation. Seven pumps were evaluated for energy savings from impeller trimming. Energy calculations was to plot the field measurements onto the pump's factory-verified pump curve data. The flow rate at the operating point is read from the horizontal axis and is compared with the design and nameplate flow rate to determine if the pump is over-sized. The savings from the condenser pumps and the chilled water pumps are calculated separately. Other Energy saving opportunities like condensate recovery also implemented at the Cooling tower.

Index Terms: Energy saving, Impeller Trimming, Condensate recovery

I. INTRODUCTION

Reduction of energy consumption by centrifugal pumps will, make a substantial contribution toward any energy conservation effort in a factory or building. It is a standard practice to specify an oversized pump during the design stage to allow for either future expansion or unforeseen losses. An oversized pump may deliver too much flow rate, and necessitate the use of a throttle valve to reduce flow rate. Such a practice results in energy inefficiency. A more energy efficient way to reduce flow rate is by using variable-speed control [1 - 3]. However, this method requires a large investment. An alternative and cheaper method is reducing the impeller diameter or impeller trimming [4, 5]. There has been suggestion that pump power varies with the cube of impeller diameter, and flow rate varies with impeller diameter [6]. This implies that pump power varies with the cube of flow rate.

Centrifugal pumps increase the pressure of fluid using rotational power input from a motor or an engine. The fluid flows axially into the pump impeller, which consists of many blades, and centrifugal forces of the rotating blades force the radial outflow of the fluid. Centrifugal pumps come in a wide variety of sizes, designs, and capacities. The performance of each pump is characterized by the increase in fluid energy or pump head, the power required to operate the pump, and the pump efficiency. These three parameters vary with the fluid flow rate. Testing of the pump will reveal how pump head, power, and efficiency vary with flow rate. Test results are usually used to draw pump performance curves. The main objective of this paper is to show how much cost and energy can be saved by using impeller trimming and condensate recovery.

II. Energy Analysis

Energy audit is conducted in a Chiller system of an automobile company to find the major energy consuming systems and to identify potential areas of energy saving. The Energy consumption details of the automobile company is given in the table below.

Table 1 Energy consumption details of the automobile company

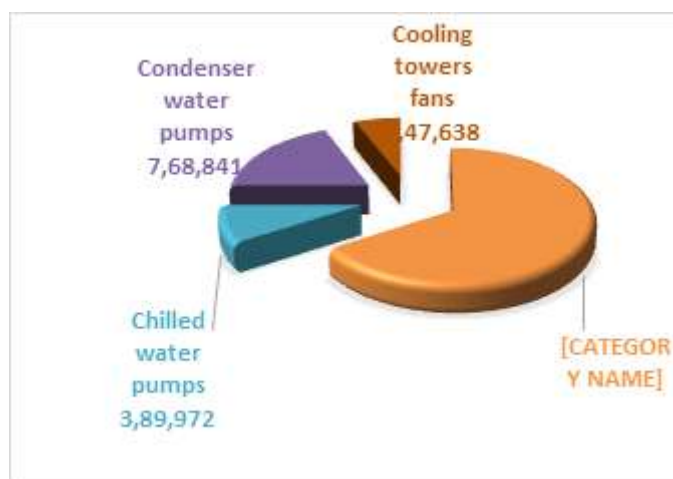
S No	Observations	Parameter (kWhr)
1	Average per day consumption for 16 hour per day production	9,948
2	Extrapolated per day consumption based on 24 hour per day production	14,922
3	Annual consumption based on 277 production days	41,33,560

This includes the consumption of chillers, chilled water pumps, condenser water pumps and cooling tower fans.

Table 2 Energy consumption details of chiller

S No	Description	Consumption kWhr	Percentage %
1	Chilled water system	27,27,109	66%
2	Chilled water pumps	3,89,972	9%
3	Condenser water pumps	7,68,841	19%
4	Cooling towers fans	2,47,638	6%
5	Total	41,33,560	100%

The various chiller system consumption proportion is given in the table above.



The energy consumption various chiller subsystem are represented by a pie chart below.

Fig. 1 Energy Consumption of various chiller subsystem

The Chilled water system consumes the maximum proportion of 66% of total energy. This is mainly due to the compressors which consumes more power for refrigerant compression than pumps which pumps condenser water and chiller water.

III. Chiller Plant Performance Analysis

The chiller system consists of three 356 TR chiller, 3 Chilled water pumps and 4 condenser water pumps. The details of chiller is given in the table.

Table 3 chiller design details

S No	Design Parameters	Units	Design Details
1	Capacity	TR	356
2	Connected load	kW	261
3	No of chiller	No	3
4	Chilled water inlet	°C	12
5	Chilled water outlet	°C	6
6	Condenser water inlet	°C	32
7	Condenser water outlet	°C	37
8	Evaporator flow	m ³ /hr	180
9	Condenser water flow	m ³ /hr	260

Present Operating Condition of Chiller

Three chillers are installed to provide the chilled water to ASUs out of which two are working & one is standby. The chilled water circulating system is configured as primary constant volume to maintain the flow across the air supply units. Four condenser water pumps are installed to maintain the flow across the chillers and cooling towers.

Chiller operation sequence is based on the paint shop requirement as well as ambient conditions. Most of the time two chillers are running & third chiller is operated as per the requirement.

Chilled water pump operating condition

- One chiller : Two chilled water pumps
- Two chiller : Two chilled water pumps
- Three chiller: Two chilled water pumps

Condenser water pump operating condition:

- One chiller : Three condenser water pumps
- Two chillers : Three condenser water pumps
- Three chillers: Three condenser water pumps

The present condition of chiller and comparison of operating chiller performance with design condition is given done and tabulated in the table below.

Table 4 chiller performance with design condition

S.No	Description	Units	Design Value	Chiller 1	Chiller 2	Chiller 3
1	Delta T (chilled water)	°C	6	4.05	3.8	4.05
2	Delta T (Condenser water)	°C	5	4.1	7.3	7.3
3	Power consumption	kW	242.73			
4	TR generation	TR	356	174	201	198
5	Specific consumption of the chiller	kW/TR	0.68	1.09	1.11	1.06
6	C.O.P of the chiller	COP	5.16	3	3	3.1

The condenser water pumps are always running. Available data indicates that operational chilled water delta't' does not match with designed delta't'. There is no automation and all chillers are operated manually. No motorized isolation valves installed on chilled water piping & condenser water piping for each chiller. All valves are manually operated. The COP of the chiller does not match with the design COP.

IV. Chilled water pumps performance analysis

Three chilled water pumps are installed for maintaining the flow across the chiller. There is common header for chilled water circulation. The chilled water pumps operation does not depend on the number of chillers in operation. Two pumps are running continuously irrespective of the number of chillers in operation

Table 5 performance of chilled water pump

S.No	Description	Units	Pump 1	Pump 2
1	Suction pressure	kg/cm ²	2.8	2.8
2	Discharge pressure	kg/cm ²	5.5	5.5
3	measured flow	m ³ /hr	250	256
4	Actual head	m	27	27
5	Pump power	kW	27	31.66
6	Hydraulic power (Ph)	kW	18	19
7	Pump shaft power (Ps)	kW	22	23
8	Pump efficiency	%	68%	59%

The individual pump design flow and chiller flow does not match. Chiller design flow is 180 m³/hr and pump design flow is 270 m³/hr. Two pumps are designed for three chillers. No motorized valves installed on the chilled water circulation line across the chiller. No balancing valve on the chilled water line. All chilled water valves are fully opened. Sometimes the combination of one chiller with two pumps & three chiller with two pumps is operated. The overall performance of the pump is less; the actual efficiency of the pump does not match with design efficiency. Actual head of the pump is less than the design head. This increases the power consumption of the pump and decreases the performance of the pump

A. CHILLER WATERPUMP PRESSURE PROFILE

Table 6 Chiller Waterpump Pressure Profile

S No	Observation	Units	Parameter
Chilled water pumps suction	Pumps 1	kg/cm ²	Standby

	Pumps 2	kg/cm ²	2.8
	Pumps 3	kg/cm ²	2.8
Chilled water pumps discharge	Pumps 1	kg/cm ²	Standby
	Pumps 2	kg/cm ²	5.5
	Pumps 3	kg/cm ²	5.5
Common header pressure	Chiller inlet		
	Chiller No 1	kg/cm ²	5.4
	Chiller No 2	kg/cm ²	5.4
	Chiller No 3	kg/cm ²	5.5
Common header pressure	Chiller outlet		
	Chiller No 1	kg/cm ²	5
	Chiller No 2	kg/cm ²	5.1
	Chiller No 3	kg/cm ²	5
Pressure drop across the chillers		kg/cm ²	0.4
ASU (Air supply unit) supply	ASU No 1	kg/cm ²	1.5
	ASU No 2	kg/cm ²	1.5
ASU (Air supply unit) return	ASU No 1	kg/cm ²	1
	ASU No 2	kg/cm ²	1
Pressure drop across the ASU		kg/cm ²	0.5
Pump actual Head			kg/cm ²
			Meter

The design head of the pump is 35 m but the actual required head of the pump is 27 m. The oversized pump increases the power consumption and reduces the efficiency of the pump.

V. Condenser Water Pump Performance

The pump design as one pump for one chiller. The design flow & pump head is much higher than the design. Three pumps are running continuously. There is no motorized valve in the condenser water circulation line. All valves are fully open. Required head is less as compared to the design head. Due to the low head power consumption of the pump is increased.

Table 7: performance of Condenser water pump

Pump performance			Pump 1	Pump 2	Pump 3	Pump 4
1	Suction pressure	kg/cm ²	0.2	0.2	Standby	0.2
2	Discharge pressure	kg/cm ²	2.4	2.4	Standby	2.5
3	Measured flow	m ³ /hr	684			
4	Actual head	m	22	22	Standby	23
5	Pump power	kW	36.75	41.2	Standby	37.7
6	Pump efficiency	%	36			

The overall combine pump efficiency is less as compared to the design efficiency.

A. CONDENSER WATER PUMP PRESSURE PROFILE

Table 8: Condenser Water pump Pressure Profile

S No	Observation	Units	Parameter
1	Condenser water pump suction		
A	Pumps 1	kg/cm ²	0.2
B	Pumps 2	kg/cm ²	0.2
C	Pumps 3	kg/cm ²	0.2
D	Pumps 4	kg/cm ²	0.2
2	Condenser water pump discharge		
A	Pumps 1	kg/cm ²	2.5
B	Pumps 2	kg/cm ²	2.4

C	Pumps 3	kg/cm ²	Stand by
D	Pumps 4	kg/cm ²	2.5
	Common header pressure	kg/cm ²	2.5
3	Chiller inlet		
A	Chiller No 1	kg/cm ²	2.3
B	Chiller No 2	kg/cm ²	2.3
C	Chiller No 3	kg/cm ²	2.3
4	Chiller outlet		
A	Chiller No 1	kg/cm ²	1.6
B	Chiller No 2	kg/cm ²	1.7
C	Chiller No 3	kg/cm ²	1.7
	Common outlet header pressure	kg/cm ²	1.7
	Pressure drops across the chiller	kg/cm ²	0.6
	Actual head of the pump	kg/cm ²	2.3
		Meter	23

Three condenser water pumps are running continuously irrespective of the number of chillers in operation. From the analysis of the condenser, it was found that the actual head and designed head are not matching. From the above pressure profile it is clear that required head of the pump is 23 m, against the design head of 35 m.

VI. Impeller Trimming

Oversized and throttled pumps that produce excess pressure are excellent candidates for impeller replacement or “trimming,” to save energy and reduce costs. Trimming involves machining the impeller to reduce its diameter. Trimming should be limited to about 75% of a pump’s maximum impeller diameter, because excessive trimming can result in a mismatched impeller and casing. As the impeller diameter decreases, added clearance between the impeller and the fixed pump casing increases internal flow recirculation, causes head loss, and lowers pumping efficiency.

Trimming reduces the impeller’s tip speed, which in turn reduces the amount of energy imparted to the pumped fluid; as a result, the pump’s flow rate and pressure both decrease. A smaller or trimmed impeller can thus be used efficiently in applications in which the current impeller is producing excessive head. Pump and system curves can provide the efficiency or shaft power for a trimmed impeller.

1) Affinity Laws for Impeller Trimming

Affinity laws can be used to predict the variations in pumping performance with changes in the impeller diameter:

$$Q_2/Q_1 = D_2/D_1 \quad (1)$$

$$H_2/H_1 = (D_2/D_1)^2 \quad (2)$$

$$bhp_2/bhp_1 = (H_2Q_2)/(H_1Q_1) \quad (3)$$

$$bhp_2/bhp_1 = (D_2/D_1)^3 \quad (4)$$

Where

Q - Pump flow rate, in gallons per minute gpm

H-Head, in feet (H1 is head for the original impeller;

H2, for a trimmed impeller)

Bhp- brake horsepower impeller diameter, in inches

From the above laws, impeller diameter for required head and flow rate for both chilled water and condenser water pump is calculated. The impeller is trimmed for required head and flow rate.

2) Chilled water pump design

Table 9: Chilled water pump design

Description		
Speed of rotation	1478 rpm	1482 rpm
Flow rate	270.04 m ³ /h	180 m ³ /h
Total developed head	30.01 m	23.01 m
Requested developed head	35.00 m	27.00 m
Efficiency	68 %, 59 %	80.10%
MEI (Minimum Efficiency Index)	≥ 0.50	≥ 0.50
Power absorbed	27 kW	10 kW
NPSH required	2.77 m	2.77 m
Effective impeller diameter	329 mm	313 mm

For chilled water pump, the effective impeller diameter is calculated as 286 mm. This reduces the power input to the pump from 27 kW to 10 kW. The required head for the pump is 27 m but the pump was designed for 35 m. Now after trimming, the pump serves the exact requirement. Thus reduces power consumption and results in energy saving in pumps.

3) Condenser water pump design

Table10: Condenser water pump design

Description	Actual	Modified
Speed of rotation	1478 rpm	1482 rpm
Flow rate	270.04 m ³ /h	270.06 m ³ /h
Requested flow rate	270.00 m ³ /h	270.00 m ³ /h
Total developed head	30.01 m	23.01 m
Requested developed head	35.00 m	23.00 m
Efficiency	36 %	80.1 %
MEI (Minimum Efficiency Index)	≥ 0.50	≥ 0.50
Power absorbed	36, 41, 37.7 kW	21.10 kW
NPSH required	2.77 m	2.77 m
Effective impeller diameter	329 mm	286.0 mm

For chilled water pump, the effective impeller diameter is calculated as 286 mm. This reduces the power input to the pump from 36 kW to 21 kW. The required head for the pump is 23 m but the pump was designed for 35 m. Now after trimming, the pump serves the exact requirement. Thus reduces power consumption and results in energy saving in pumps.

VII. CONCLUSION

After the installation of trimmed impeller, energy and cost saved in both chilled water pump and condenser water pump. The energy saved per annum in chilled water pump is calculated as 2,65,151kWhr which is 6.45% of total energy consumption when two pumps are running. Likewise when three condenser pumps are running, it is calculated to be 4,66,819kWhr which is 11.3% of total energy consumption. So 17.75% of energy is saved by this method.

APPENDIX

1. ENERGY METER READING

Date	Forenoon(kWhr)	Afternoon(kWhr)	Total(kWhr)
04.12.2017	7938	8683	16621
05.12.2017	7382	6684	14066
06.12.2017	4444	6112	10550
07.12.2017	7611	7568	15179
09.12.2017	6948	7388	14336
10.12.2017	4150	5088	9238
11.12.2017	6651	12680	19331
12.12.2017	3840	6650	10490

13.12.2017	3612	5587	9193
14.12.2017	5093	6621	11714
16.12.2017	3256	5218	8474
17.12.2017	8330	8169	16499
18.12.2017	2354	4609	6963
19.12.2017	1645	3755	5400
20.12.2017	4160	5830	9990
21.12.2017	3040	4980	8020
23.12.2017	4360	5780	10140
24.12.2017	6080	6770	12850
25.12.2017	3239	4638	7877
26.12.2017	5414	6228	11642
27.12.2017	6184	7018	13202
01.12.2018	5766	6567	12333
02.12.2018	4937	6112	11049
03.12.2018	1727	5859	7586
04.12.2018	5270	6760	12030
05.12.2018	5440	6060	11500
06.12.2018	7540	8030	15570
08.12.2018	4930	5840	10770
09.12.2018	4090	5560	9650
10.12.2018	2905	4694	7599
11.12.2018	2127	3882	5959
12.12.2018	1635	3778	5413
14.12.2018	2469	4529	6998
15.12.2018	2134	3951	6085
16.12.2018	2909	4777	7686
17.12.2018	3962	4951	8913
18.12.2018	3903	4980	8883
19.12.2018	1780	3930	5710
21.12.2018	5260	6440	11700
22.12.2018	2080	4220	6300
23.12.2018	1560	3570	5130
24.12.2018	2893	4515	7408
25.12.2018	1818	3484	5302
26.12.2018	4016	5375	9391
29.12.2018	5247	6233	11480
30.12.2018	2518	4190	6708
31.12.2018	3665	4960	8625

2. CHILLED WATER PUMP DETAILS

S No	Design Parameter	Units	Chiller No 1	Chiller No 2	Chiller No 3
1	Pump make	Make	KSB	KSB	KSB
2	Pump type	Type	Centrifugal	Centrifugal	Centrifugal
3	Model	No	Etanorm G125-315	Etanorm G125-316	Etanorm G125-317
4	Design head	m	35	35	35

5	Design flow	³ m /hr	270	270	270
6	Design efficiency	%	82	82	82

3. CONDENSER WATER PUMP DETAILS

S No	Design Parameters	Units	Design Details
1	Make		KSB
2	Type		Centrifugal
3	Model		Etanorm G125-315
4	Head	m	35
5	Flow	m ³ /hr	270
+6	Efficiency	%	82
7	No of Pumps		4

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Productivity Improvement in Fixed Layout Assembly Shop

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ABSTRACT

Housekeeping plays a vital role in assembly shop productivity. To produce and deliver the products on time housekeeping is inevitable. Material flow and information flow directly influences assembly. 5S housekeeping policies ensures place for everything, everything should be kept in right place and it should be sustained. Sustaining the place for everything is a tedious process, when tools and parts were in large variety. The current papers objective is to aid the workers in identifying, locating, storing, retrieving the tools and products. To minimize the tool and material searching time and improve the information flow among the workers a java program with GUI (Graphical User Interface) is developed using Net Beans Integrated Development Environment (IDE). To utilize the shop floor in efficient manner layout optimization is done using layout optimization software.

Keywords: House Keeping, 5S, Material Tagging, Java Program, Net Beans, Layout Optimization

I. INTRODUCTION

Assembly shop consists of men, material, and machine. To organize material and machine housekeeping policies plays a vital role. 5S provides systematic way to keep and maintain the housekeeping policies. When the shop floor is vast and sustaining the house keeping is harder due to a large variety of components need to be addressed. Workers lacks in decision making while ensuring the place for everything. There should not be any misconceptions and collisions while allocating the location. In an assembly shop there are varieties of equipment's and tools that are needed to assemble which comes out as a product. Once the assembly process is over, tools need to be returned to the allocated storing location. When the assembly process is started by one person or a team and completed by another person or another team, the information flow on storing the tools in the right place becomes unavailable. When the second team places the tools or equipment in an unallocated space, the other person and team may search for it. Information flow between the teams should be improved, when the large variety of tools needs to be addressed the worker may find it difficult to locate as well as retrieve the tool.

In this paper it is considered that the information flow between the workers and adding the location labeling to the sub-assemblies. Layout has been drawn using commercial drafting software in order to understand the material and worker movement. Relationship between the products and work location need to be considered while allocating the space for the tools and equipment. The program developed in java consists of part location matrix, searching methodologies, part classification methods.

Part location matrix consist the details of the tools, equipment's and where they need to be stored. Location details stored in tables, search algorithm works with the key word provided by the user. When the user request to search, algorithm finds location and shows it in the user interface. When program fails to find the location or location is not allotted shows a pop up dialogue box will be displayed in the monitor to the user.

Net Beans is an integrated development environment for programmers, and it is commonly used for developing programs, software's and algorithms in versatile fields, Net Beans is free and open source and reliable IDE.

Java swing is used to design the front end of the program. Java swing makes the work easier to design front end such as scroll bars, search windows, buttons, toggles and file pick windows.

VIP-Planopt is commercial layout optimization software used to optimize the plant layout. Assembly shop floor has been optimized. Information required for optimization namely, distance, machine size, gangway dimensions are considered before optimizing the layout.

II. LITERATURE REVIEW

Adoption of Lean-Kaizen approach to process improvement by the largest manufacturer of steering systems for passenger car and utility vehicle market in India. The company was facing severe liquidity crunch due to falling customer demand (25 percent lower than forecasted), rising cost of raw material and bank borrowing rates. In order to survive in such stiff scenario, the company systematically deployed Kaizen events and drastically improved their internal efficiency [1]. KAIZEN principles presumes a practical approach and low costs of

improvement. The Kaizen management system is based on the continuous loss reduction by means of methods that do not rely on investments, but on the improvement of the processes and the employees' performance [2].

Hypothesis test and alternative hypothesis conducted and proved there is a relationship between the 5S level and productivity. And the results are statistically proved. The need of having 5S method implemented represent one of the first step taken in the Lean Management strategy and it determines, as a result, the increase of the productivity of the organization. Moreover, due to 5S, the factory is a cleaner place, the safety at workplace and the product quality is increased, the problems are easy to detect and prevent, waste and costs are reduced, the product or service fulfils the customer needs in the most efficient manner [3].

5S implementation and highlights the achievements realized from deployment of 5S initiatives for sustainable performance of organizations. And found 5S is an outstanding Japanese philosophy for the development of any type organization all over the world. This study bring out the concept of 5S, requirements for its holistic implementation, relationship with other lean tools, benefits, success factors and obstacles in 5S implementation. The significant contributions through 5S initiatives in the organization like production, quality, safety and effective utilization of workspace for the sustained organizational improvement have also been highlighted in the study [4]. Overall improvement of the organization by implementing 5S in systematic way. Kaizen suggestion and implementation considered shop floor layout and travelling of person and movement of material [5].

III. TOOL DEVELOPMENT

Problem Description

Assembly shop floors with three different products were considered for the current study. Each product varies by dimension and selling price. Each product needs variety of sub-assemblies. Sub-assemblies are assembled separately in the same shop floor. Assembling of sub assembly parts needs variety of tools and machines to manufacture and assemble the sub assembly components.

Sub-assemblies are assembled by dedicated workers and stored in random racks. There is no specific methodology to allocate the storage racks for the sub-assemblies, when the main product requires sub-assembly, Main product assembly persons call the sub assembly team persons to retrieve the sub-assemblies, if they are not available or engaged in the work they randomly search the storage racks for the sub-assemblies. Information between sub assembly team and main product assembly team need to be improved. Information on sub assembly stock is much essential to aid the main product assembly team to find how many sub-assemblies are required.

Workers search for sub-assemblies when they need to assemble it in the machine and if they are not able to find the sub-assemblies again they start to assemble the new sub assembly as required. This causes delay in delivering the product. This in turn leads to material build up in the inventory at the end of financial year with lot of materials which are found under unidentifiable label. Money spent on this material becomes waste, when the material is not converted into finished good on time, to take care of unidentifiable parts workers and storekeeper need to be so conscious, if they missed to track the materials, parts become unusable due to ageing and loses its physical properties.

During Enterprise Resource Planning, un finished sub-assemblies are considered as finished and parts required for the sub-assemblies are consumed but in real time parts are not consumed, it may still in the inventory. While raising the purchase order industry orders more than required quantity this is due to stock quantity difference between ERP software and the actual stock available in the inventory.

B. Tool Development

Front end of the java program consist of search dialogue box and list of sub-assemblies and their part code and tagging methods. Workers can search on the tool by using part name and part code details. Fig. 1 shows the graphical use interface the developed program. Search dialogue passes the search key words to search algorithm. Algorithm searches in the part location table. Figure 3 represents how the information flow and command has been passed when the user request is raised inside java program.

Part location table is created while coding the program, the corresponding table can be modified and updated from admin login other users are prohibited to change the information in the part location table.

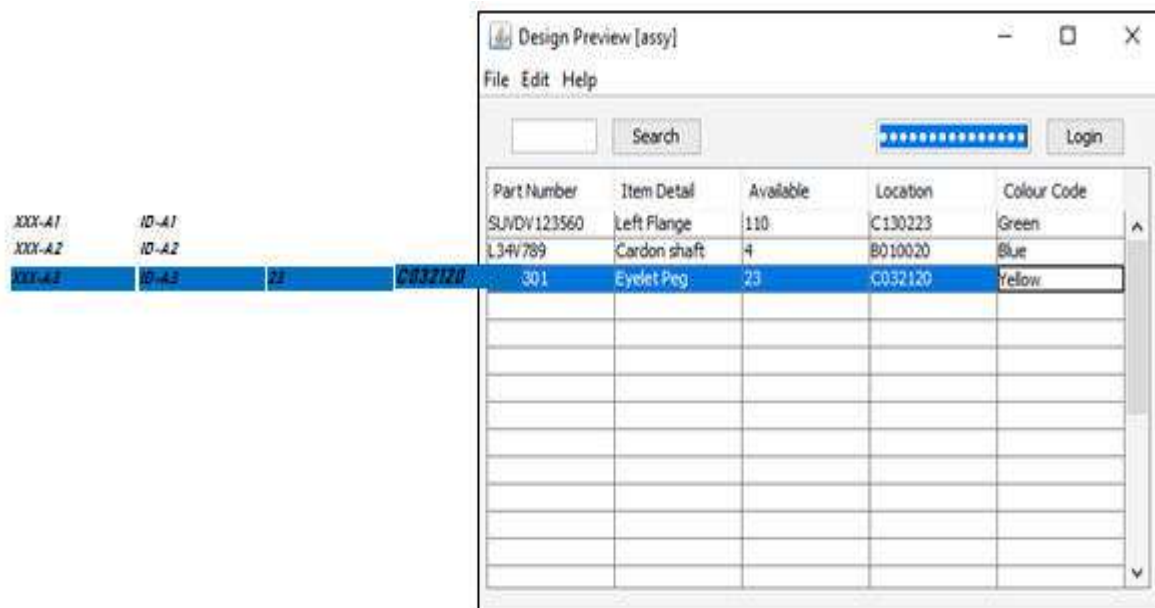


Fig.1 Front End of the House keeping Tool

Front end of the Java program is easily accessible with keyboard as well as common pointing devices. Further to this front end graphical user interface work instruction tool is attached. Worker who has doubt in assembly procedure can view the Standard work instruction document to resolve the doubts. This ensures dynamic learning environment rather than periodical training. Standard work instruction document can be picture; wording can be video, which depends on the organization decision.

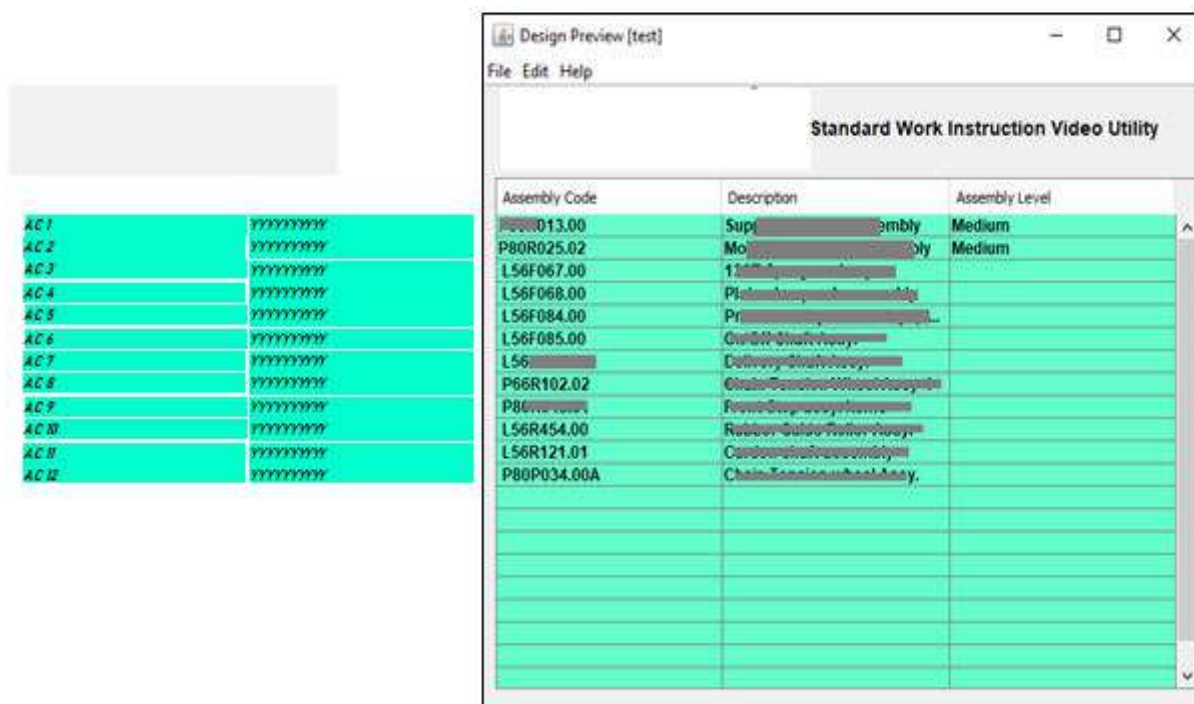


Fig.2 Front End of Standard work instruction utility

Standard work instruction utility consists of assembly code, description and assembly level (Easy,Medium,and Hard). Fig. 2 represents the front end view of the work instruction utility home page. This tool consists of play button and built in video player using VLCJ player. Both tools are platform independent; java framework is the minimum requirement.

During assembly process workers keep the drill bits, reamers, and allen keys in a single tool box which in turn consume more time while looking for a specific size which result in delay in assembly process. To prevent this scenario, tool bit organizer has been designed and developed shown in Fig. 4; which can hold drill bits, reamers and allen keys. Once the assembly is over workers are instructed to keep their tools in the organizer.

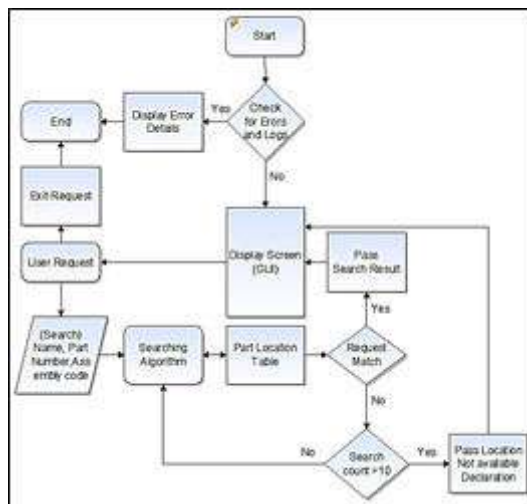


Fig.3 Flow chart of Java program for House Keeping

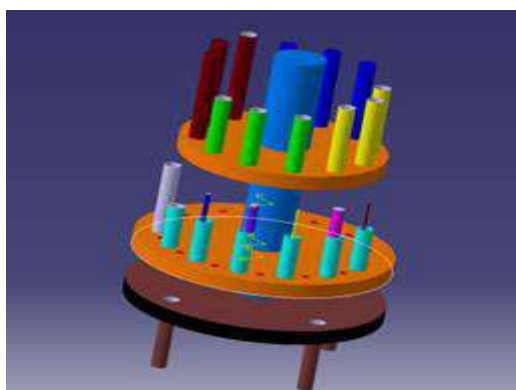


Fig.4 Drill bit and Allen Key Organizer

To represent different size of drill bit holders, different colour has been used. Red holes indicated holder for Allen keys. Normal tool organizers occupy much space and does not allows the workers to build their organizer as they want. Each workstation needs different kinds of tools, this tool holder can be modified with various combinations.

C. LAYOUT OPTIMIZATION.

VIP-Planopt2010 is utilized to optimize the assembly area layout. Three different machines are assembled in the shop floor. Information and Data required for optimization has been collected such as material flow details, dimension. To optimize the shop floor layout in VIP-Planopt minimum one of the following matrix details are required such as flow matrix, cost matrix and unit cost matrix. In the current case study flow matrix is considered for optimizing the layout rather than cost required for the flow because cost for three different products varies with each other and cost varies with the type of part and material moved in the shop floor All the three machines are considered for the assembly. Dimensions of the products, shop floor dimensions were measured and drafted in AutoCAD as shown in Fig. 5. Gangway, Shop floor boundaries are considered, these acts as constraints along with flow matrix information. Fig. 8 shows Flow matrix details which show the relationship between shop floor entities.

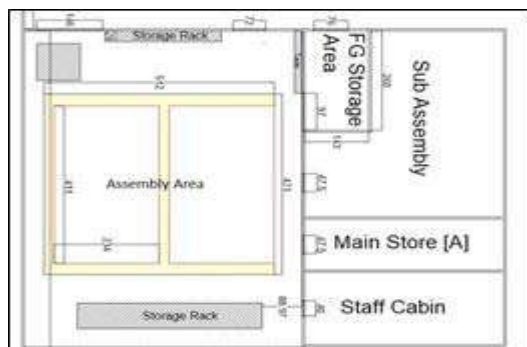


Fig. 5 Assembly area Zoom –IN

Optimized layout figure 7 shows that the floor can be utilized better than present Scenario. Currently methodology followed by the industry can be improved by this method. Distance between each machine varies with type. For Machine A 2.5 feet distance available. For Machine B there is 4 feet space is available between two machines. Distance between Dryer and Machine B 1.5 space is allotted. Optimized assembly area layout showed in figure 7 and entity details in the optimized layout are shown in figure 8.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0	1	0	1	0	0	0	0	0	0	0	1	1
2	1	0	0	1	0	0	0	0	0	0	0	0	0
3	0	0	0	1	0	0	0	0	0	0	0	0	0
4	1	1	1	0	1	0	0	0	0	0	0	1	1
5	0	0	0	1	0	0	0	0	1	0	0	0	0
6	0	0	0	0	0	0	1	0	0	0	0	0	0
7	0	0	0	0	0	1	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	1	0	0	0	0
9	0	0	0	0	1	0	0	1	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	0	0	1	0	0	0	0	0	0	0	0	0
13	1	0	0	1	0	0	0	0	0	0	0	0	0

Fig. 6 Material Flow Matrix in VIP-Planopt

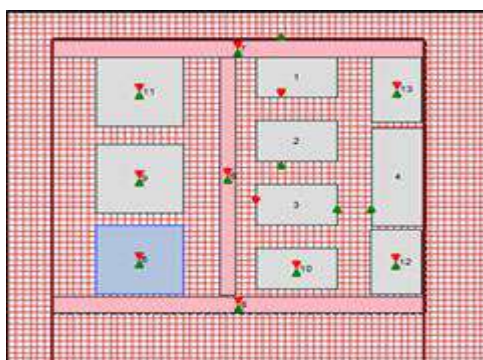


Fig. 7 Optimized Assembly Area Layout

Dimensions showed in figure 8 represent the entities in optimization module in the VIP-Planopt. Gangway and Pavements should not be moved, entities for gangway and pavements are anchored in the optimization module.

Relationship between the assembly area, machines, reachability of hoist, forklift gangways are considered in the flow matrix for the optimization.

Dimensions	
Machine A	= 112 x 70
Dryer	= 75 x 212
Machine B	= 20 x 120
Pavement 6	= 22 x 441
Gangway 7	= 512 x 29
Gangway 9	= 512 x 29
Boundry	= 512 x 731
Entity Detail	
Machine A	- 1,2,3,10,12,13
Dryer	- 4
Machine B	- 5,9,11
Gangway	- 7,8
Pavement	- 6

All dimensions in inches.
 1 grid = 10sq.inches

Fig. 8 VIP-PlanoptEntity Dimension Details

IV. RESULTS AND DISCUSSION

Java tool helped the worker to search and locate the tools quicker, which reduced 0.5 man hours in every work shift. Work instruction tool helped the new trainees and apprentice person to learn quicker. Training period is reduced from 90 days to 45 days. Drill bit organizer reduced the searching time for the tool.

V. CONCLUSIONS AND FUTURE SCOPE

Java program helps the worker to quickly retrieve and locate the equipment from the allocated work location. This improves the information flow between the workers. Unwanted movement between workstation and searching made by the workers is reduced.

This increases the time spent by the worker on the assembly by 12.5 % man hours per shift. However, this is an initial step to improve better sustainable assembly shop. Developed java tool can aid the worker to locate and retrieve the tool from the allocated work space. But space allocation algorithms are not implemented in the present java program. In future, development of allocation algorithm with relationship matrix with space constraints can be developed. This will be much beneficial and helpful to industrial engineers, store keepers and facility planners while allocating space for the new tool or equipment's.

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Investigation of Anisotropic Friction in Snake Skin Sheds Based on Method of Locomotion

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ABSTRACT

The surface of snake skin is known to exhibit anisotropic frictional properties. Snakes use this property extensively in order to propel forward using various locomotion techniques. The ability to exhibit dissimilar coefficient of friction (COF) along different directions can prove to be very useful in engineering systems. The aim of this research is to correlate the anisotropic frictional behavior with the locomotion technique using the skin of two indigenous snake species – the Russell's viper and Indian rock python. Towards this, friction studies were conducted in four sliding directions on the two snake skin sheds. The results indicated a variation in COF with the sliding direction with lowest values being recorded in the forward direction. This affirms that, the locomotion technique influences the COF. The research outcomes substantiate the anisotropy in friction and have potential in creating bio-inspired engineering surfaces.

Index terms: Snake skin, anisotropic friction, bioinspired design, biomimicry, adaptive surfaces

I. INTRODUCTION

Friction is a vital constituent of engineering systems in relative motion. However, it is also the primary source of energy losses. A significant amount of input energy may be wasted due to friction. Frictional losses tend to manifest in diverse forms like heat and sound emissions. Anisotropic friction is commonly exhibited in nature such as in the tongues of felid animals, claws of insects and fascicle of female mosquito [1]. The engineering community has evinced interest in mimicking the anisotropic frictional properties of snake skin. The skin is wear resistant and enables the snake to move swiftly across dry, dusty or sandy terrains. Snake skin inspired laser textured surfaces were found to reduce frictional forces by more than 40% [2], [3].

Surfaces with reduced friction in desired directions can be manufactured by varying the surface topology [4] as friction anisotropy depends on topographic orientation [5], [6]. Adaptive tribological systems can thus be developed by taking inspiration from nature. In this context, limbless locomotion exhibited by snakes has been investigated and reported extensively in literature. Snakes use diverse ways of terrestrial locomotion like simple and lateral undulation, slide-pushing, side winding, rectilinear locomotion and concertina locomotion [7]. Several studies have been conducted on snakes such as Boa constrictor, Python regius, Morelia spilotes, Naja nigricollis and Crotalus atrox [8]–[10]. These studies have clearly revealed that the ventral scales surface of snakes exhibit direction dependent frictional behavior. In this paper, the skin of two indigenous species namely, Russell's viper (*Daboia russelii*) and Indian rock python (*Python molurus*) have been investigated and a comparative study of their COF is presented.

A. Locomotion of snakes

For this research, the two native snakes have been chosen based on their locomotion technique. Russell's viper exhibits lateral undulation as shown in Figure 1(a) and the Indian rock python exhibits rectilinear motion as shown in Figure 2(a).

B. Lateral Undulation

Lateral undulation is a locomotion technique which involves local deformation of the snake body around objects (peg) in contact. As the snake bends around multiple obstacles, it exerts a force simultaneously on them. The lateral force vectors thus produced, cancel out each other leading to a resultant force. The resultant force propels the snake forward. Sliding friction plays a major role in lateral undulatory motion. This is one of the most common methods of locomotion observed in snakes for fast terrestrial motion [11].

C. Rectilinear Motion

Rectilinear motion is a simple locomotion method observed in large snakes like boas and pythons. Unlike sidewinding and undulatory techniques, rectilinear motion takes place along a straight line. Here, the ventral muscle fibres are arranged in a horizontal, longitudinal fashion. During motion, successive waves of contraction and relaxation of muscles results in forward propulsion of the snake at a relatively constant speed [12]. Static friction is the critical component of rectilinear locomotion.

D. Description of SnakeSpecies

Russell’s viper (*Daboia russelii*) is a venomous snake commonly found throughout South Asia. It inhabits in grasslands, scrub and open forests. It can grow to an average length of 4 feet. The Indian rock python (*Python molurus*) is a non-venomous snake. It is a rare species and listed as ‘endangered’ under Indian law. This snake grows to an average length of 10feetandcanbefoundinforests,scrubandmangroves.

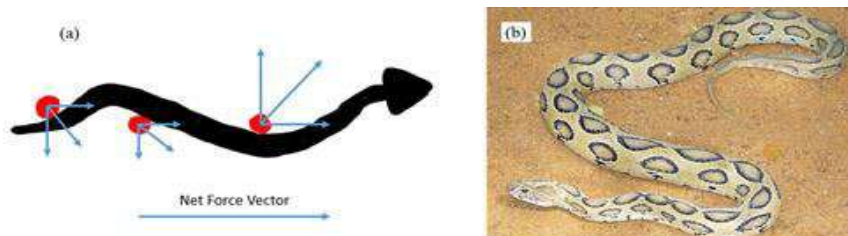


Fig. 1. (a) Lateral Undulation (b) Russell’s viper (*Daboia russelii*)

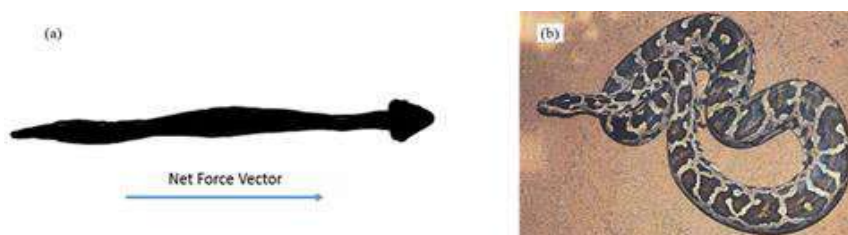


Fig. 2. (a) Rectilinear Motion (b) Indian rock python (*Python molurus*)

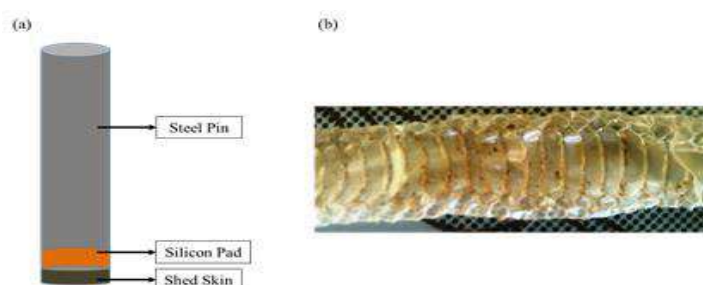


Fig. 3. (a) Schematic of Test Pin (b) Snake skin sample of Russell’s viper

TABLE I: COEFFICIENT OF FRICTION FOR RUSSELL’SVIPER

Sliding Direction	Percentage Comparison	Normal Force(F_n)	Frictional Force(F_f)	Coefficient ofFriction(COF)
Forward	4.905	2.6	0.530071356	100
Right	4.905	3.1	0.632008155	119.23
Reverse	4.905	4	0.815494393	153.85
Left	4.905	3.5	0.713557594	134.62

TABLE II: COEFFICIENT OF FRICTION FOR INDIAN ROCK PYTHON

Sliding Direction	Normal Force (N)	Frictional Force (N)	Coefficient of Friction (COF)	Percentage Comparison
Forward	4.905	1.5	0.305810398	100.00
Right	4.905	1.18	0.240570846	78.67
Reverse	4.905	1.8	0.366972477	120.00
Left	4.905	1.1	0.224260958	73.33

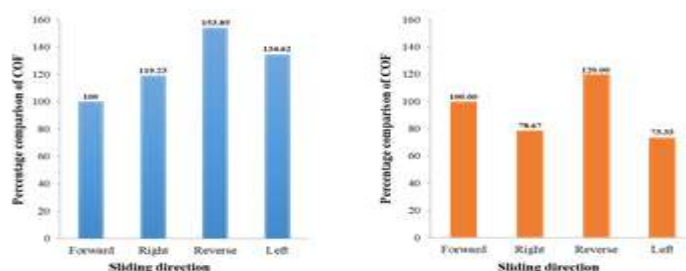


Fig. 4. COF distribution for (a) Russell’s Viper (b) Indian rock python

II. MATERIALS AND METHODS

The first step in the research involved selection of the species. The species were selected on the basis of existing literature on them, their locomotion techniques and their size. Snake skin sheds for Russell's viper and Indian Python were obtained from Chennai Snake Park Trust (CSPT), Chennai. The second step involved the selection of appropriate zones in the skin sheds which exhibit the desired tribological properties that are of research interest. In accordance with prior research [4], the skin samples were taken from the ventral scales in the mid-trunk section. They were then carefully analyzed in a pin-on-disc tribometer (Make: Ducom). Steel pins of 8 mm diameter were used to hold the sample as shown in Figure 3(a). The skin sheds were relatively thin as shown in Figure 3(b) and hence, a thin layer of silicon pad was fixed to the end of the steel pin. A section of the selected skin sample was then bonded to the bottom of the pin. Adhesive was applied on the sides to hold the sample in place and prevent any interference with the skin and its properties being tested.

III. RESULTS

A constant normal force (F_n) of 4.905 N was applied by the tribometer and the frictional force (F_f) for four sliding directions of the snake skin (forward, right, reverse and left) was measured. Three trials were conducted to obtain each value of F_f . The COF was estimated using Equation (1).

$$COF = F_f / F_n \quad (1)$$

To investigate anisotropy in friction, the percentages of the COF in other directions were compared with that in the forward direction. The COF in the forward direction was regarded as the base value for comparison with other directions as shown in Table I and Table II. For percentage comparisons, the primary direction of sliding namely, the forward direction was taken as 100%.

Table I and Table II depict the measurements of the frictional force and calculation of the COF for Russell's viper and Indian rock python respectively. The variation in the COF with sliding direction for both the snakes is shown in Figure 4(a) and (b).

IV. DISCUSSION

The anisotropy in frictional behavior of the skin samples for both the snake species is evident from Figure 4(a) and (b). When the forward direction is taken as the base COF, it is observed that both snakes show a higher COF in the reverse (backward) direction with a relative percentage change of up to 53.85% in case of Russell's Viper and 41.33% in case of Indian python. This suggests that lower resistance is offered when moving in the forward direction (tail to head) as compared to the backward direction (head to tail).

As can be seen in Figure 4(b), for the Indian python, the COF in the sinistral (left – 73.33%) and dextral (right – 78.67%) direction shows only a minuscule variation of 5.34%. It is to be noted that, in this case though the individual values of COF are small, frictional anisotropy exists. This is consistent with the findings for snakes exhibiting rectilinear motion [4].

It can be inferred from Table 1 and Table 2 that, the COF value for Russell's viper varies from 0.53 - 0.81 and that for Indian python from 0.22 - 0.36. This variation in COF can be correlated with the locomotion technique of the snakes.

As indicated before, the Russell's viper follows lateral undulation. In this locomotion pattern, the contact forces required to propel the snake forward are applied laterally to specific points on the body of the snake rather than to the entire body [13]. An increase in the number of contact points leads to an increase in both - the laterally directed forces and friction [14]. Furthermore, prior research suggests that for terrestrial lateral undulatory motion, snakes require a minimum of three points of simultaneous contact, as illustrated in Figure 1(a), for the lateral force vectors to cancel out each other [7]. This allows the snake to propel forward with higher speed and less lateral slippage [11]. The higher COF values of the viper can thus be attributed to the lateral undulatory motion of the snake.

In contrast, the Indian python being a heavy bodied snake employs rectilinear motion. Here, belly scales act as static pivot points. Next, the costocutaneous muscles present in between the ribs and skin pull the vertebral column forward. This action results in the whole body of the snake being pulled forward over the pivoted scales. Unlike in lateral undulation, the motion of the snake is nearly linear and precise. For rectilinear motion, flexibility of the snake's skin is of utmost importance than friction [14]. Hence, the lower COF values of Indian python correspond with rectilinear motion.

It is interesting to note from Figure 4 that, for the viper, COF of the left differs from the right by approximately 15%. In lateral undulation, contact with the ground is established throughout the entire length of the snake.

However, the weight distribution of the snake is non-uniform. The weights are loaded at well-defined points where belly scales push against the ground. Additionally, at these points, the body curvature is zero. Increased sideways friction is also essential for forward motion on smooth surfaces due to the absence of push points on such terrains[15]. Due to the hefty build of the snake and the non-uniform distribution of weight per unit length of the reptile during undulation, a variation in COF between the left and right directions is essential to maintain frictional traction. These preliminary results concur with observations on other species like ball python reported in literature[4]. In order to conclusively state the same, further studies on the morphology, micro-fibril structure and metrology of snake skin have to be performed.

V. CONCLUSION

In this work, frictional studies were performed on the ventral side skin of two indigenous snakes namely, the Russel's Viper and Indian rock python exhibiting lateral undulation and rectilinear motion respectively. The variation of COF with respect to the sliding direction was studied. As reported in numerous studies, the results confirmed the anisotropy in friction.

The intensity of variation was found to depend on the locomotion technique of the snake. The overall variation in COF for rectilinear motion of python was found to be less than that of viper. The direction dependent variation of COF was high in the case of viper as higher frictional forces are involved in undulatory motion.

Preliminary results also indicated that undulation coupled with the non-uniform weight distribution of the viper necessitated a significant change in COF between the left and the right directions. This permitted the reptile to reliably slither across various surfaces. The findings support the theory that physical forces involved in locomotion contribute to frictional anisotropy of snake skin.

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Evaluating Profile Error of Freeform Surface Using CMM and Computer Vision

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ABSTRACT

Freeform profiles are widely employed in various engineering applications starting from the manufacturing of aerospace parts to the biomedical instrumentations. Designers use the B-spline, Bezier and NURBS curves to represent the freeform profiles in the CAD model. Due to the complexity in profile, measurement of the freeform profile is a tedious process and consumes more time. Therefore, selection of the best measuring strategy is important for evaluating the profile errors. In this study, NACA 4412 profile is selected for representing the freeform profile. The CAD model of the freeform profile is developed from the point clouds and the freeform profile is machined using a 5-axis vertical milling centre. The three different measurement strategies such as parametric space, dominant points and curve length are used to sample the measuring points of the freeform profile. The point clouds of the profile are scanned using coordinate measuring machine and computer vision system. The profile error is calculated by comparing the actual and design profiles with the substitute profile. Metrological aspects such as time required for measurement, number of measurement points and profile error are analyzed.

Keywords: freeform surface, NACA 4412, coordinate measuring machine, measurement strategies, profile error, machine vision system

I. INTRODUCTION

A freeform profile is employed in many engineering fields such as automobiles, aerospace and medical industries. Analysing and measuring the freeform profile is important for maintaining its quality [1]. The common measuring strategy used for measuring the freeform profile is distribution of the sampling points in a uniform pattern. This strategy is simple and time required for measuring the freeform profile is less. But, this strategy will often result in an inadequate sampling of the region that has more curvature and edge detection is undesirable [2]. A measurement strategy is considered to be best if the strategy determines the maximum form deviation with minimum number of sampling points [3]. So, an optimum measurement strategy is to be selected for evaluating the freeform profiles.

Various studies carried out to measure the freeform profiles are discussed in this section. Rajamohan et al. [4] proposed two new measurement strategies for evaluating freeform profile deviations. The freeform profile is measured using Coordinate Measuring Machine (CMM) and form deviation from the design profile is assessed using measurement strategies based on curve length and dominant point. The study shows that a measurement strategy based on the dominant point is more suitable for evaluating the form deviations of freeform profiles.

Cho et al. [5] and Pahk et al. [6] suggested various sampling methodology based on the surface mean curvature, uniform distribution and hybrid distribution to reduce the number of the measurement points. Rajamohan et al. [7] recommended new measurement strategies based on scanning of isoparametric lines. Mansour et al. [8] and Sang et al. [9] recommended sequential quadratic algorithm and heuristic algorithms for equi-parameter sampling and Gaussian curvature based sampling for distribution of the points along with uniform u and v parametric direction.

Lang et al. [10], Gaiyun et al. [11] and Zhou et al. [12] have presented an economical sweep scan strategy for efficient and accurate profile error evaluation to obtain the accurate result of the points that are scanned for inspection. Eun-Young et al. [13] and Hui-Chin et al. [14] suggested a computer-aided measurement planning for effective gauging and inspection of freeform profile. The profiles have been computed based on the lower positional deviation strategy. The point, normal vector and curve constrain are considered as the important parameters. Yicun Sang et al. [15] introduced a star-shaped mode based sampling strategy to measure the form error of freeform surfaces. Zhongyue et al. [16] proposed a new method, Improved Whale Optimization Algorithm, for inspecting freeform surfaces of optics.

The above literature shows that the measurement of freeform profiles is tedious, time consuming and a large number of sampling points are required for accurate evaluation of profile error. Therefore, in this study three different measurement strategies are considered for measuring profile error of freeform surface that is

represented NURBS curves. Finally, the profile deviation between the design profile created using the CAD software, substitute profile obtained from 3-axis CMM and the actual profile scanned using a machine vision system are analysed. Optimum measurement strategy for measuring the profile of freeform surfaces is recommended based on the profile error, measurement time and number of measurement points.

II. FREEFORM PROFILE - NACA 4412

An aerofoil profile NACA 4412 is considered in this study which offers a wide range of applications in aerospace applications. The measurement of profile deviation is very important because a slight variation of the profile will affect the performance to a greater extent. NACA 4412 has low drag and the lift coefficient. Thus, it is very suitable for sport planes. The measurement of the aerofoil profile is time consuming and sampling points that are required for measuring the profile are also large so it is important to select optimized measurement strategy for the measurement of freeform profiles. The parameter affecting aerodynamic characteristic of the aerofoil profile is shown in figure 1. The parameters include maximum thickness, maximum chamber, mean chamber line, chord line and chord.

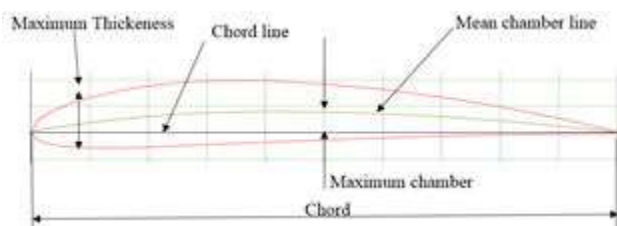


Fig.1. Influencing parameters of NACA 4412 profile

A. CAD model and Machining of Profile

The coordinate points for the NACA 4412 aerofoil profile are extracted from a reliable source [17]. The coordinate points are stored in the Microsoft excel 2015 in CSV format. The CAD model of the profile is generated by importing the CSV file into the Autodesk fusion 360 version 2020 software. The coordinate points extracted for the freeform profile is shown in figure 2.



Fig. 2. Coordinate points extracted for NACA 4412 profile

The CNC code is generated using Autodesk fusion 360 (Version 2020). Al6063 is considered as a work material and carbide end mill cutter of size 8mm is selected. The spatial dimensions of the workpiece are 160mm×60mm×60mm. Finally, the NACA 4412 profile is machined using FANUC Oi-Mate MD a 5-axis machine. The machined profile is shown in figure 3.

III. MEASURING STRATEGY

The freeform profile is measured using three different measurement strategies namely parametric space, dominant points and curve length. The best strategy based on the measuring time and number of measuring points for measuring the aerofoil profile representing NURBS curves is recommended. Measurement points are the data points required for measuring the profile. These measurement points are used to construct the substitute profile and actual profile.

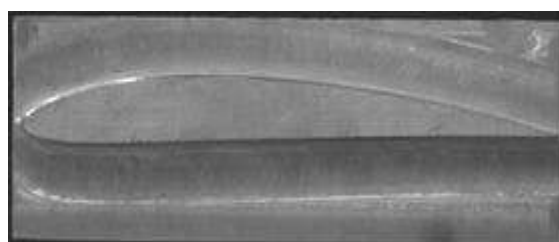


Fig .3. Workpiece with NACA 4412 profile

The substitute profile is constructed using the point clouds scanned using a Mitutoyo CRYSTA Apex S544 CMM (MiCAT software) equipped with Renishaw TP200 probe and probe diameter of 2 mm. The actual profile is constructed using the point clouds obtained from a computer vision system. The CMM used for measurement of freeform profile is shown in figure 4.



Fig. 4. Coordinate Measuring Machine

The methodology adopted for profile error measurement is shown in figure 5. The computer vision system used in this work is shown in figure 6. The vision system consists of UNIQ vision camera (UM-201) with a resolution of 752 x 582 pixels, 50 mm lens and PC2 vision frame grabber card with image processing software Sherlock 6.3. The profiles of a freeform surface are extracted using edge detection techniques and measuring points are captured using different sampling strategies.

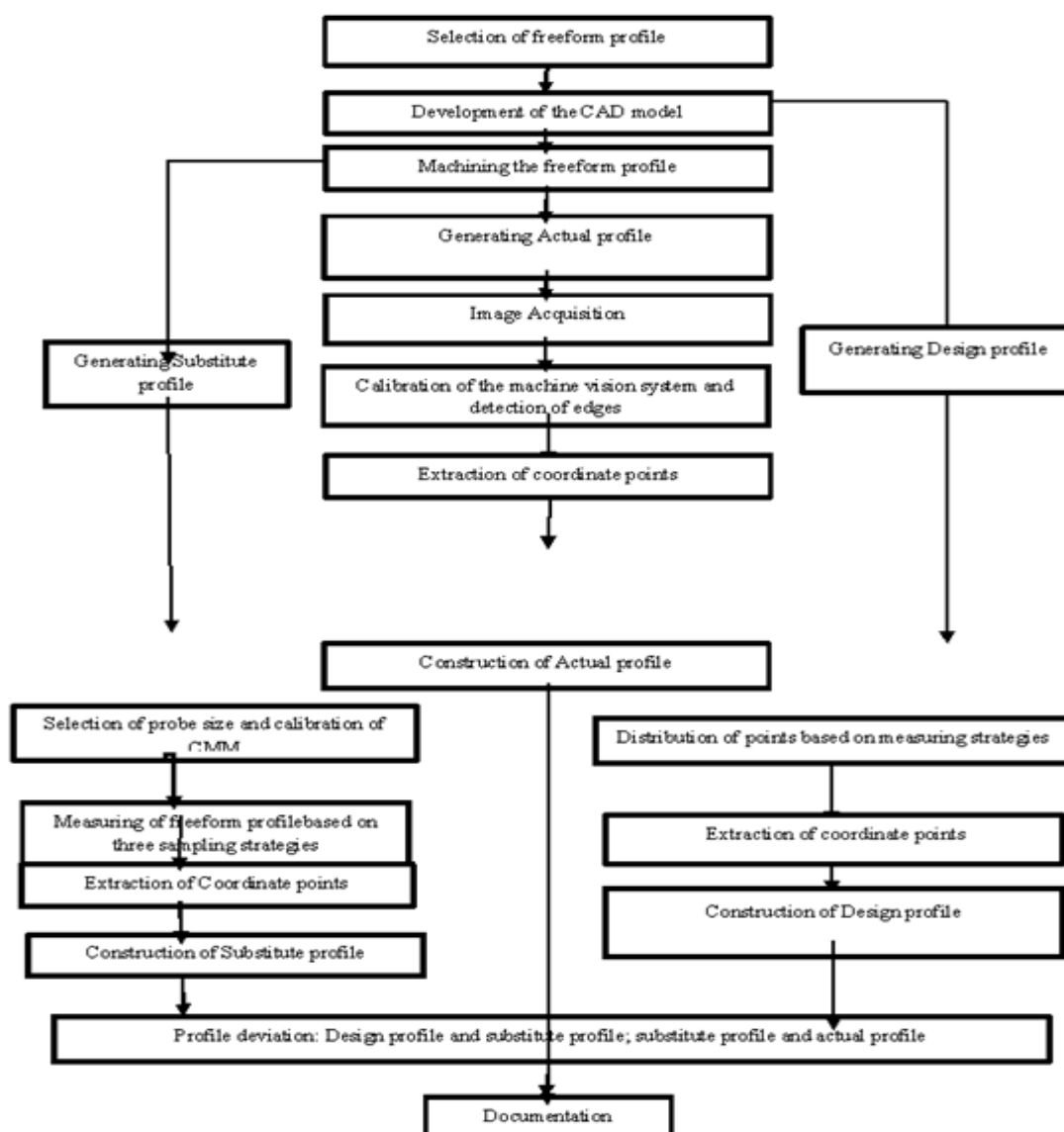


Fig. 5. Methodology flowchart



Fig. 6. computer vision system

The substitute profile is considered as a reference profile and deviations of design and actual profiles from the substitute profile are measured using three measurement strategies. In all the three methods the chord line is taken as a guideline in order to distribute the measurement points.

3.1 Distribution of measuring points based on parametric space

In this strategy, the airfoil model is divided along both the x and y-axis, x along the center of the contour, and y along the side of the curve which has a higher curve length. This contour is classified into patches in which the measuring points are distributed equally, the spacing between the points depends upon the overall length of the patch, range of the parameter and number of measuring points. The position of the sampling points is decided based on the equation of parametric space given in (1).

$$U_i = U_{min} + (i-1) \frac{U_{max} - U_{min}}{(N_s - 1)} \dots i=1,2,3 \dots N_s \quad (1)$$

Where U_i is the data points that is required for measurement of the profile, N_s is the number of sample points, U_{min} and U_{max} is the lower and upper point of the profile which varies based on the patch selected for measurement. Distribution of measuring points in parametric space for the sample points of 10 is shown in figure 7. The value of U_i for different value of N_s is calculated using the python program. The substitute profile and actual profile obtained by this strategy is shown in figures 8 and 9.

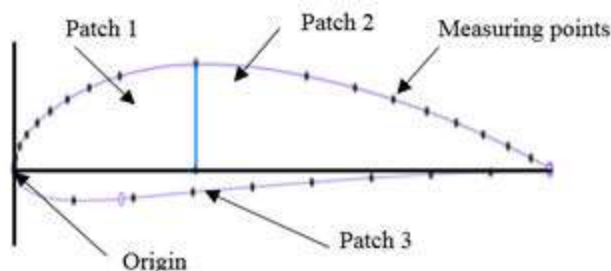


Fig. 7. Distribution of measuring points based on parametric space - Design profile

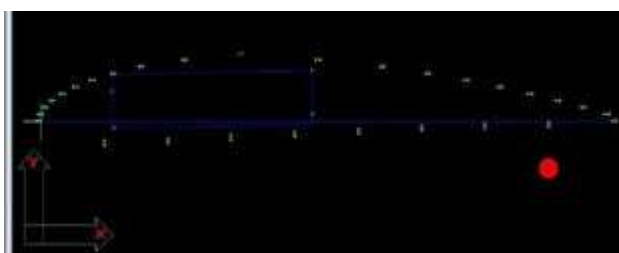


Fig.8. Distribution of measuring points based on parametric space- Substitute profile

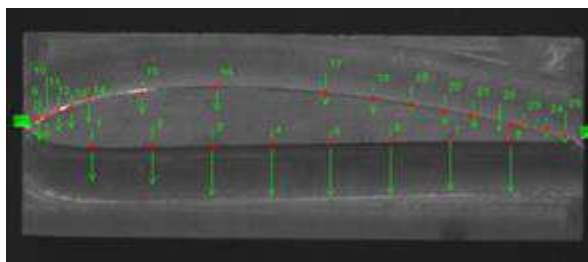


Fig.9. Distribution of measuring points based on parametric space- Actual profile

3.2 Distribution of measuring points based on dominant points

In this strategy, the airfoil model is constructed based on the number of key points called dominant points, these key points control the geometry of the profile. These dominant points are used in the NURBS curve, where the fit point curve is used to construct the NACA 4412 model. These key points provide data for the measurement of the whole profile. The distribution of measuring points along the profile obtained by this strategy is shown in figure 10.

3.3 Distribution of the measuring point based on curve length

In this method, the guideline is considering as a parameter for the distribution of the points. The overall length of the airfoil model L_t is calculated using (2),

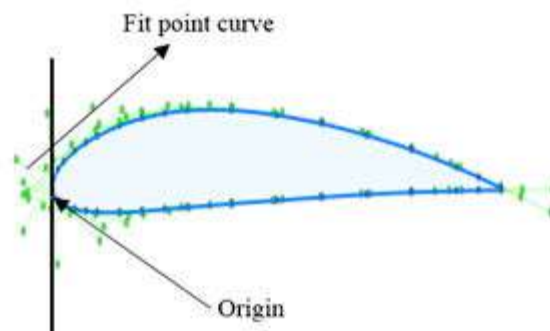


Fig. 10. Distribution of measuring points based on dominant points - Design Profile

$$L_t = [(X_{i+1} - X_i)^2 + (Y_{i+1} - Y_i)^2]^{1/2} (2)$$

The value of X_{i+1} , X_i , and Y_{i+1} , Y_i is determined using the coordinate points obtained from the value of the key points used for the construction of the airfoil model. The value of L_t is calculated using the python program. The point L_t is taken as a data points and distributed the point equally on the guideline. The distribution of measuring point along the profile obtained by this strategy is shown in figure 11.

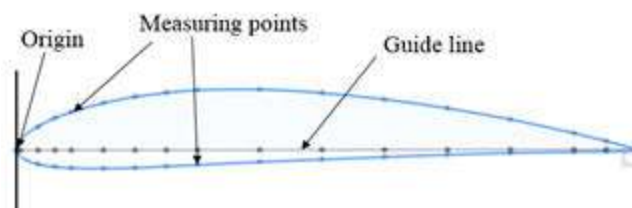


Fig. 11. Distribution of measuring points based on curve length - Design Profile

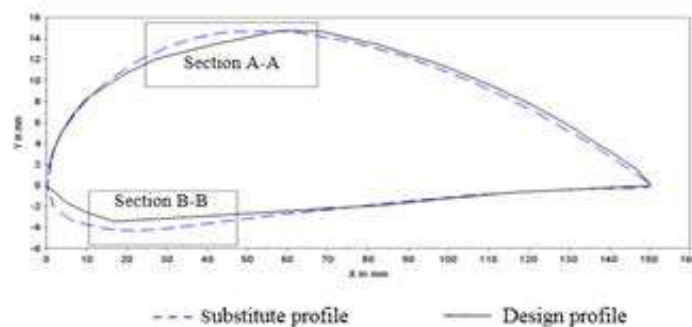
4. RESULTS AND DISCUSSIONS

In this work, NACA 4412 aerofoil profile is considered as a design profile and the profile is measured based on parametric space, dominant point and curve length strategies. The measurement of profile deviation of the freeform profile is carried out by taking the substitute profile as a benchmark and computed the profile deviation of design and actual profiles from the substitute profile. The freeform profile is constructed and the profile deviation is computed using Scilab version 6.0.2, an open source software. Finally, the strategy which reduces the measurement time, number of sampling points and provides minimum profile error is considered as an optimized strategy for the measurement of freeform profile considered in this study.

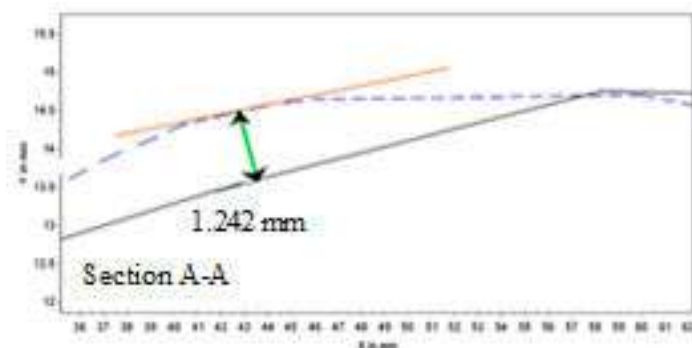
4.1 Deviation based on Parametric space strategy

In this strategy, the sampling points of the profile is measured based on parametric space and all the measuring points are gathered as point clouds. The substitute, design, and actual profile are constructed using these point

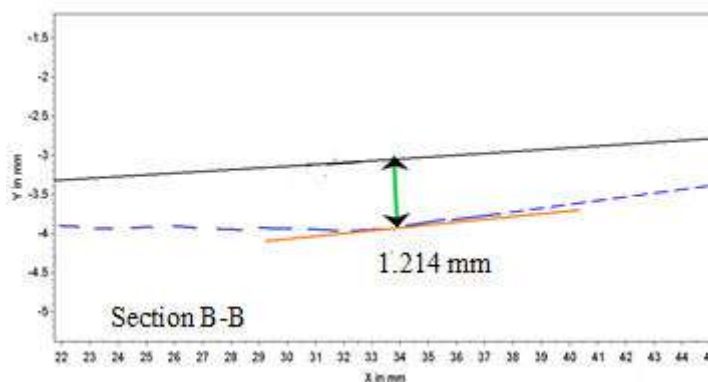
clouds. The deviation between design and substitute profile is shown in figure 12 (a) and the magnitude of profile deviations obtained along the upper and lower bounds of the profile are shown in figures 12(b) and (c). The maximum profile deviation along the upper bound and lower bounds are 1.242 mm and 1.214 mm respectively.



(a)



(b)



(c)

Fig. 12. Profile deviation by parametric space based measurement strategy (a) Substitute profile vs Design profile (b) Maximum profile deviation along the upper bound and (c) Maximum profile deviation along the lower bounds of the profile

The comparison of substitute and actual profiles is shown in figure 13. The maximum profile deviation between substitute and actual profile along the upper bound and lower bound are 1.100 mm and 0.921 mm respectively. In this measurement strategy, 29 measuring points are captured and time taken by the CMM to record the measuring points is 19.5 seconds.

4.2 Deviation based on Dominant point strategy

In this method, the NACA 4412 profile is measured based on dominant point strategy, the measuring points are gathered as the coordinate points and the substitute, design and actual profile are constructed using Scilab 6.0.2 software. The substitute and design profiles are compared in figure 14 and, substitute and actual profiles are compared in figure 15.

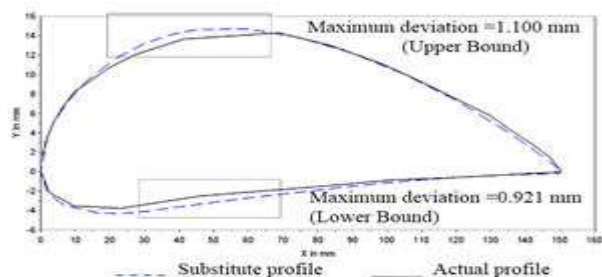


Fig. 13. Profile deviation by parametric space based measurement strategy- Substitute profile vs Actual profile

The maximum profile deviation between substitute and design profile is 0.7407 mm along the upper bound and 0.9101 mm along the lower bound. Similarly, the maximum profile deviation obtained between substitute and actual profile along the upper and lower bounds are 0.5943 mm and 0.3071 mm respectively. In this measurement strategy, 35 measuring points are captured and time taken by the CMM to record the measuring points is 25.6 seconds.

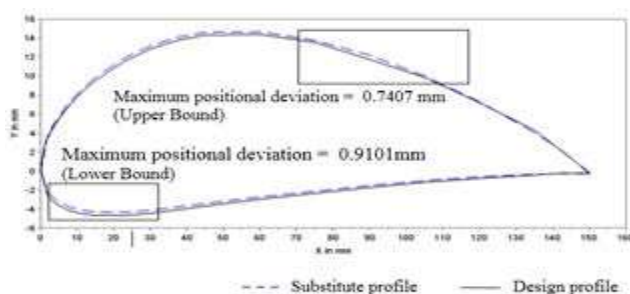


Fig. 14. Profile deviation by dominant space based measurement strategy - Substitute profile vs Design profile

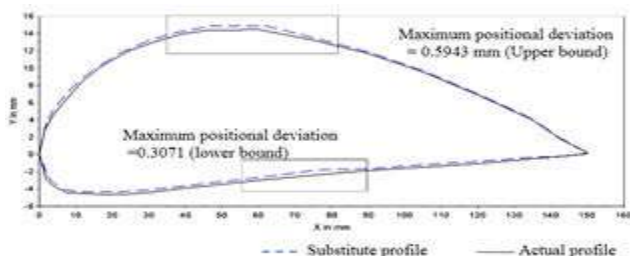


Fig. 15. Profile deviation by dominant space based measurement strategy - Substitute profile vs Actual profile

4.3 Deviation based on curve length strategy

The measuring points of the substitute, design and actual profile are captured based on curve length measurement strategy. The profiles are constructed and profile deviation between the substitute and design profile and, substitute and actual profile are computed. Figure 16 compares the profile of substitute and design profiles. The maximum profile deviation along the upper and the lower bounds are 0.1149 mm and 0.1778 mm respectively. The substitute and actual profiles are compared in figure 17. The maximum positional deviation along the upper and the lower bounds are 0.1166 mm and 0.211 mm respectively. In this measurement strategy, 31 measuring points are captured and time taken by the CMM to record the measuring points is 21.6 seconds.

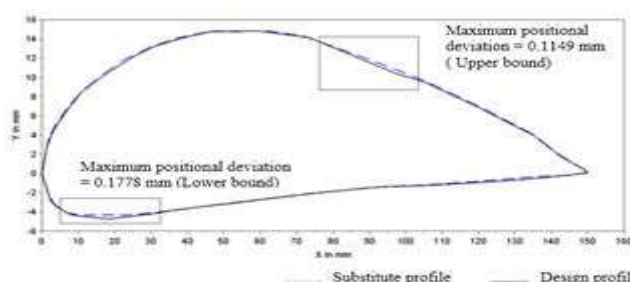


Fig. 16. Profile deviation by Curve length based measurement strategy - Substitute profile vs Design profile

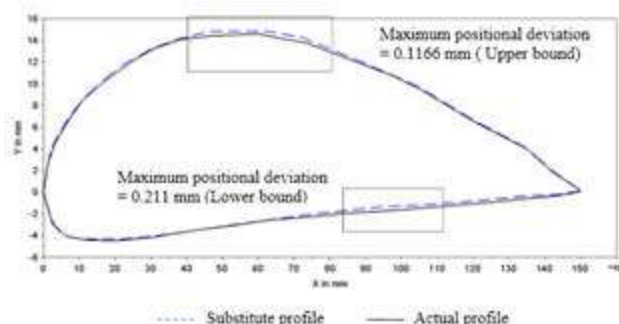


Fig. 17. Profile deviation by Curve length based measurement strategy - Substitute profile vs Actual profile

The deviations of actual and design profiles from the substitute profile are measured using three different measuring strategies and the results are listed in Table 1.

TABLE 1. PROFILE DEVIATIONS

Strategies Position	Parametric space	Dominant point	Curve length
Substitute profile vs Design profile			
Upper Bound (mm)	1.242	0.7407	0.1149
Lower bound (mm)	1.214	0.9101	0.1778
Substitute profile vs Actual profile			
Upper Bound (mm)	1.100	0.5943	0.1166
Lower bound (mm)	0.921	0.3071	0.2110
Measurement Time (Sec)	19.5	25.6	21.6

It is observed that, the measurement strategy based on dominant point and curve length gives less positional deviation compared to the parametric space based measurement strategy. But the time and number of measuring points selected for measuring the freeform profile using dominant point based strategy is more compared to the parametric space and curve length based strategies. Also, it is noticed that, the strategy based on curve length gives less profile deviation in compared to other measurement strategies. Therefore, the measurement strategy based on curve length is recommended for measuring the profiles of freeform surfaces considered in this study.

VI. CONCLUSION

In this work, the three different measurement strategies namely parametric space, dominant points and curve length are considered for evaluating the profile deviation of freeform surfaces. The results of measurement strategies are discussed based on the three aspects such as measurement time, the number of measurement points and profile deviations. The strategy based on parametric space satisfies the time and number of measuring points criteria but it fails to satisfy the third aspect by providing more profile deviations. The strategy based on the dominant point provides less positional deviation between design and substitute profile. But, the profile deviation between actual and substitute profile, time, and number of points required for measuring freeform profile are more.

Therefore, the measurement strategy based on curve length provides the optimum result with respect to measurement time and number of measuring points compared to the dominant point based measurement strategy. But the measurement time and number of measuring points are a bit more when compared to parametric space and the profile deviation is less compared to both dominant and parametric space based strategies. As a result, the strategy based on curve length is considered as a suitable strategy for measuring the aerofoil model considered in this study. Further, the optimum measurement strategy recommended from this analysis can be extended to assess the profile deviation of other type of freeform surfaces represented by B-spline and Bezier curves.

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Formability Assessment and Process Parameter Optimization in Single Point Incremental Forming of Aa2024

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ABSTRACT

Incremental forming is a novel forming process that provides a clear advantage in complex multi-feature final products. This decade's desire for new goods, facelifts, and strategic product implementations tends to increase customisation and flexibility. With incremental depth, tool rotation, and traverse speed, this article's objective issue is formability assessment. A superior profile precision and supportive action are enhanced by numerical optimization technique. The output response was thinning, average surface roughness, and geometric precision. Based on these findings, the meridional influence of rotational tool speed on marginal forming limit propagates localised streamline fracture initiation was studied in a series of studies. So as to gain relevant ideas to further research aspirant, correlation between all components of analysis established with relation and validated.

Keywords—Incremental Forming, Process parameter investigation, Mathematical modelling, Deformation analysis

I. INTRODUCTION

Metal-forming technologies that can match market demands and flexible for new product development have been increasingly important in recent decades. The most common sheet metal forming processes are die moulding, drawing, and roll bending. These processes were created for mass production. The design of punches and dies is critical here. The industrial growth is transforming mass production into quality production based on small batch manufacture. Conventional forming procedures are inadequate for producing bespoke pieces. Designing unique punches and dies for prototyping and low volume component production takes effort. With the exception of material and time consumed for die and punch fabrication, ISMF was developed. Incremental forming (IF) is a modern manufacturing technology used to build complicated three-dimensional items. Through a sequence of minor incremental deformations, a sheet is used to make the final component. Formed components are then fed into CNC Vertical Machining Centers to be machined using forming tools. As a result of a pre-defined CNC programme, the sheet metal is clamped tightly in an ISMF fixture. With this method, simple generic tools are used to generate localised deformation in the sheet, allowing it to form a broad range of shapes. Its adaptability improves forecasting and planning. Aviation, automotive, bio-medical, architectural, customisation, and research and development are a few engineering areas that invest in incremental form. Contact sites, hybrid techniques, and physical variables all affect incremental formation. The graphic below depicted incremental forming classifications.

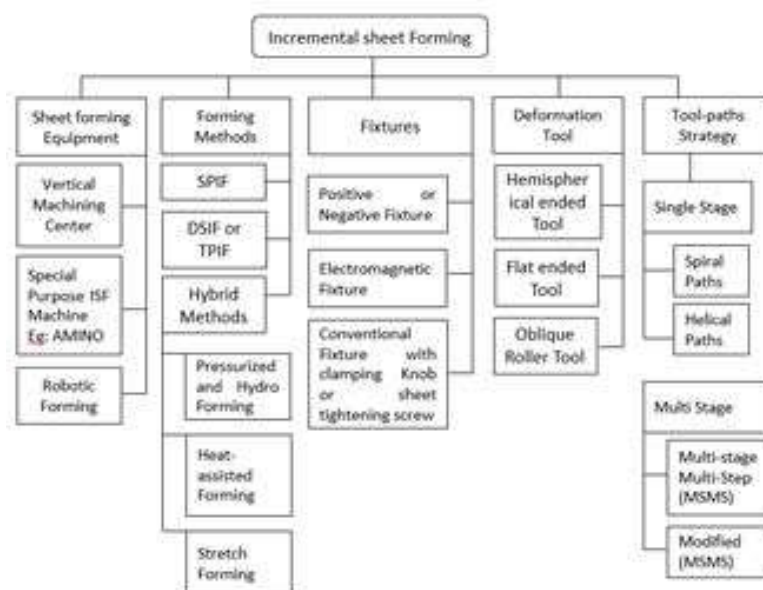


Fig. 1. Classification of incremental forming

During its initial prior decades, traditional ISMF comprises a tool and sheet with predefined contact points with specified toolpaths able to form the sheet to desired geometry. Last two decades, ISMF revolutionized with different strategies to overwhelm the complexities in incremental forming such as SPIF with hydro-forming, ISMF with positive or negative fixtures and ISMF with desired wooden or metallic support. These strategies have significant advantages over initial ISMF techniques like geometrical accuracy, formability, sophisticated thinning characteristics, flexibility in implementation and reduction in forming force. This paper illustrates the effect of infeed force and process parameter and Harish K. Nirala, AnupamAgrawal[1] et al., SPIF has a wide range of complex applicability for the industries. Here, the author mainly contributed over the fixture and forming force, the fracture initiation is compared with simulation and experimental approach. The material chosen here is SS 430 and deforms the sheet metal incrementally by D-shell and frustum of a square pyramid has the forming depth of 7 and 25 mm respectively. The sheet material is annealed for better formable. A newly developed novel electromagnetic clamping has significantly reduced the forming force about 20% for D-shell components and for frustum of a square pyramid is observed forming force reduced to be 16.67% and increased the machining lead time the compared fracture initiation result shows the experimental approach fracture initiated at 15 mm but in simulation resulting failure occurs at 22 mm.

Sheng A, Hui Long [2] et al., conducted a review on fracture mechanism in incremental sheet metal forming. This paper is mainly reviewed on various formability enhancement techniques in ISF and proposes the different type fracture behaviour occurring in the experimental investigation. In fracture mechanism, the empirical way of fracture analysis is forming limit curve that is mainly discussed with plane strain condition; the progressive tool paths on ISF mainly form the non-linear loading strain paths. The sine law is approximately related to the sheet thickness distribution and helps to measure the thickness with various forming angles. The two different fractures like fracture initiated and necking initiated failure are more observed in SPIF and are challenging. The DSIF has very limited in occurring fracture but expected is more in-depth analysis of fracture behaviour occurring in the material. There is a need for a damage model with more focusing on complicated loading conditions to predict the ISF material fracture. Sirichai Torsakul, Natha Kuptasthien[3] et al., this paper is mainly focused on the effect of process parameters including material type, forming angle and revolution speed for SPIF. All these parameters have various aspects resulting over the influence of forming force. As the results show more favour to brass sheet, the high tool revolution speed resulting in low forming force and low wall inclination angle resulting in high forming force with replication of high coefficient of friction. The experimental values revealed that the influence of resultant force involved in different sheet material from the value brass had the maximum force of 165.155N. The optimized value shows the high wall inclination angle and tool revolution speed indicate the reduction in forming force. Ankush Bansal, Rakesh Lingam, Sateesh Kumar Yadav, N. Venkata Reddy[4] et al., this paper based on the prediction of thickness, forming forces and contact area during the single and multi-stage toolpaths for deformation of sheet metal. Utilizing the literature strategies to modify the analytical model able to predict the parameter with more accuracy and decrease the computational resources. The experimental investigation and analytical model are compared and the result shows maximum error for predicting the forming force is decreased from 18.1% to 7.8% at 60° wall inclination angle and for thickness distribution about maximum error is 3.85% without bended region. J. Diabb, C.A. Rodríguez, N. Mamidi, J.A. Sandoval, J. Taha-Tijerina, O. Martínez-Romero, A. Elías-Zúñiga [5] et al., this paper illustrated the experimental study of lubrication and wear characteristics in single point incremental forming for AA 6061 in addition with lubrication as sunflower and corn oils with weight percent of 0.0125, 0.025, 0.05 and 0.1 % of SiO_2 nanoparticles prepared as the nanofluids. The experimental results show the 0.025% weighs concentration of nanofluids has better lubrication and low surface roughness. The stribeck curves help for friction effect, the curve shows before SPIF has hydrodynamic fluid film lubrication and during the process is mixed fluid film lubrication. The normal forces decrease with the bending moment also decreases only with magnitude. Massimo Durantea, Antonio Formisanoa, Francesco Lambiase [6] et al., this paper reported the experimental investigation of tool-polycarbonate sheet interface and toolpaths strategies. The variation in toolpaths increases the formability and minimum twisting as compared to unidirectional toolpaths. The alternate toolpaths with twisting angle of 0.5° has the high geometrical accuracy and elastic springback is not influenced by toolpaths. The thickness measured from sample and prediction of thickness using cosine law in good agreement, the value of prediction is 0.95mm and measured sample with mean value of 0.978mm. Pranav Gupta, Jacob Jeswiet[7] et al., this article conducted the research on the effect of temperature variation on formability for new geometry using a flat ended tool using an AA5754-H32 sheet. The high relative motion between the tool-sheet interface does not affect the surface roughness but the generated temperature distribute the shear stress throughout the sheet wall thickness. Geometrical error occurs at bending near to the backing plate and lobe interaction due to the lack of support and unavailability of die when tool passes at high wall angle. Higher

feed rate and tool rotation resulting in friction stir heating in sheet metal forming. A continuous zig-zag fracture occurs at 9.6 mm deformation depth. Yogesh Kumar, Santosh Kumar [8] et al., this paper conducted the hybrid process by combining the ISF and SHF process to achieve the higher wall angle and reduce the failure of the component. The MSMS forming strategy is able to form the component upto 78.75° and the primary issue of MSMS is the failure of components due to the thinning of sheet. The modified MSMS forming strategy and hydroforming technique enable higher forming angles of even 90° . The analytical model is developed and based on the principle of constant volume; this analytical model is able to predict the thickness up to forming angle at 90° . The developed model has the two cases to predict the vertical thinning and bottom bend thickness. Pranav Gupta, Alexander Szekeres, Jacob Jeswiet [9] et al., illustrated the vertical wall component was subjected to multiple passes causing a residual strain distribution and decrease in failure with high material strain. Here the sheet metal is deformed to C-channel for aerospace fuselage application with deployment of SPIF. The sheet metal was annealed for reducing the geometrical issue and has no constraints on the backing plate. The results show the maximum under forming and over-forming occurs at the corner and base respectively. The sheet metal underwent multiple passes in plastic deformation and was clearly visible in microstructure as high as variation in orientation, grain size and fragmentation between the locations. This variation in plastic deformation might cause the inconsistency in material properties at different locations can be avoided through the post material processing of annealing. Ajay Kumar, Vishal Gulati, Parveen Kumar, Hari Singh [10] et al., the detailed review on limitation of forming force, process capability and influence of forming temperature, sheet thickness and tool shape. Here the elevated temperature achieves through three strategies like laser assisted, induction assisted and electric hot assisted ISF processes. In laser assisted, the sheet metal was heated on strategic location of sheet and tool interface, the result observed for forming force was decreased with increase in the temperature. In case of electrically assisted, the current flowing through the tool to sheet increases the ductility of material at contact face. When the sheet thickness increases proportionally axial peak forces increase. The roller and oblique roller ball tool were improving the surface quality but maximum wall angle is expected one parameter. The hemispherical and flat end tool was deployment of deform the sheet metal results in lower peak force achieved over the hemispherical end tool. In simulation the adaptive re-meshing technique improves with near finished component utmost result achieved without compromising the accuracy of parameters and quality of mesh. Najafabady, Ghae [11] et al., performed the EHIF process with titanium alloy sheet material to deform the different profile strategies. For investigation of geometrical accuracy and surface roughness. Moreover, three different geometries are preferred such as CWACF, VWACF and PF. In the EHIF process, it has a lack of heat transfer and high friction affects the surface quality. For that molybdenum di-sulphide powder was sprayed over the sheet metal before the sheet and tool interface. These powders act as a self-lubricant and result shows nearly 64% reduction in average Ra value. Then the components are scanned and extracted into cloud points for deviation analysis. Pacheco, Silveira [12] et al., justified the relation between EHISF and EHISF with pre-heating through numerical simulation with Johnson-Cook's material modelling and simplified CAD model for reducing the simulation time. The investigation is based on plastic strain and von-mises stress to identify the thermal stress and heat distribution on sheet and tool. Further data analysis for the above two processes compared with original CAD data to obtain the geometric error. EHISF with preheating shows good geometric accuracy with an average value of 4.7%. After performing the process, there is unlikely to observe the residual stress grows due to room temperature cooling and there need to be concentrate. Further, it was claimed that above 45° wall angle and proportionally geometrical error increases. Vivek Kumar Barnwal, Shanta Chakrabarty, Asim Tewari, K. Narasimhan, Sushil K. Mishra [13] et al., illustrated for AA 6061 on behalf of behavior of forming characteristics and evaluating the microstructural deformation on SPIF experimentation. Before experimentation all mechanical properties were examined and determined the tensile test data acquisition under ASTM-E8 standard and r-bar test were conducted and then experimentation performed with lesser spindle rotation to ensure lesser tool wear, constraints etc. Digital-image-correlation was done after post forming to evaluate surface strains. The three main constituents such as major together with minor strain and thickness strain are illustrated from DIC surface strains techniques. Where major-true strain ranging from 0.30 to 0.35 observed on deformed sheets. Nevertheless, deformed wall region has appropriate constant thickness together absence of strain localization. In FE simulation, coarse-fine mesh with 1mm utilized for constraints and overcoming the computational difficulties. However, both the test data acquisition shows better correlation in agreement. Due to maximal Taylor factor causes maximum resistance on deformation throughout ID direction. Texture analysis determines goss together with S components follows stable and significant changes found on cube together with brass texture-components. Zhidong Chang, Jun Chen [14] et al., developed the predicting model for average-surface roughness and validated with various sheets for effective output responses while investigating the surface morphologies. The developed analytical model has derived based upon localized-plastic deformation

and elastically deflected and tendency to describes effect on tool diameter, vertical angle, sheet-metal thickness, incremental depth, etc. Two consecutive paths i.e scallop height constitutes to uneven sheet thinning distribution over meridional direction. The ratio of Ra and Rz ends-up with 0.268 ratio through experiments series and reveals the critical effectual parameters are spindle tool speed, friction mode and transverse speed. Unappropriated spindle speed together with feed rate and unsuitable lubricating condition resulted in plough grooves.

ISMF is a free-form forming technique to manufacture the complex contour end products. The conventional press-forming technique demands for capital and dedicated die and control systems, while ISMF is exceptions of dedication dies. Numerous researchers pointed out formability and overwhelming technique, but still, it researches progress despite of highest industrial requirements and norms. Only a few studies have been done on aircraft components with sophisticated profile geometry. The mathematical model has been constructed, but acquiring the coefficient and parameters is difficult. Lack of optimal process variable for demanding sheet metal applications.

The sheet-metal has capabilities to deform the complex contour geometry without intending to geometrical inaccuracies known as formability. Formability is associated with secondary attributes like vertical angle, twisting angle, positive and negative deviation due to bending, tool deflection, and higher axial force etc. The traditional ISF process does not meet the feasible solution for minimizing the error in desired sheet components. Then, achieving the precision contour of hard to deform materials such as titanium alloy, Inconel and stainless steel are more complicated and result in adverse effects. This effect can resolve with optimized physical variables and compensation methods. In the SPIF process, the sheet undergoes localized straining and incremental contact area causing the geometrical inaccuracies. By optimizing the incremental pitch and toolpaths result in higher plane strain mode and maximum vertical angle. The current study aimed to improve the formability and geometric accuracy of AA2024 sheet material.

II. EXPERIMENTAL METHODOLOGY AND METHODS

The flowchart below represents the process of the incremental forming and overview of the current research work. This includes findings of various output responses and inference of output responses. Finally, comparative validation determined between such as analytical theoretical and numerical simulation to establish the appropriate suggestions.

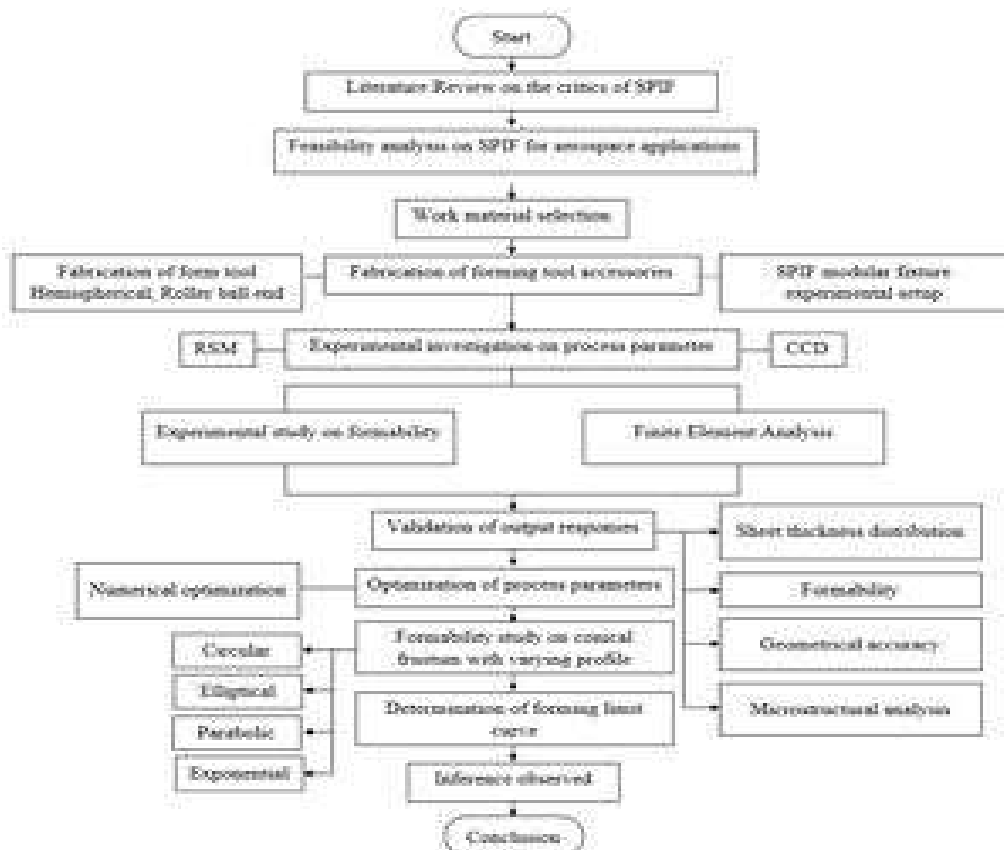


Fig.2. Flow chart of the process

A. CNC Vertical Machining Centre

The ISF experimentation was carried on a vertical machining centre as described on figure. The CNC machine has a spindle speed of 8000 rpm and power output of 7.5 KW. The experimental work area or guideway travel is constrained over 550 mm × 400 mm × 350mm in x, y, z directions. The helical toolpaths were constructed using the MASTERCAM package and interface with the CNC machine.



Fig.3. SPIF-Experimental setup

B. Fabrication of Tool shape and Type

The hemispherical-ended forming tool of 10 mm diameter was fabricated. In order to maintain optimum responses, forming tool has tendency to withstand the forming force and load together with adhesive wear and well-polished chrome alloy steel 52100 (65 HRC) is used as form tool material and servo 68 lubricant oil (kinematic viscosity at 40°C, 68 mm²/s) is employed to reduce friction between tool-sheet interface.

C. Applications of Sheet metal components

Aluminium Alloy 2024 – Aircraft structural applications

Pre-processing of sheet metal: Sheet metal has high hardness and relatively low ductility and toughness, which tends to consume more energy, higher forming force, tool adhesion and wear. Therefore, the heat treatment has required more elongation, ductility and also toughness to enhance the required formability. However, with reference to literature to process the sheet metal with annealing at 450°C and soaked for 120 minutes and furnace cooling to obtain the respective factors.

D. Modelling of desired design

The experiment will use a 130 mm main diameter and 90 mm depth variable wall angle frustum cone as a geometric profile. Modeled in PTC Creo Parametric 3.0.

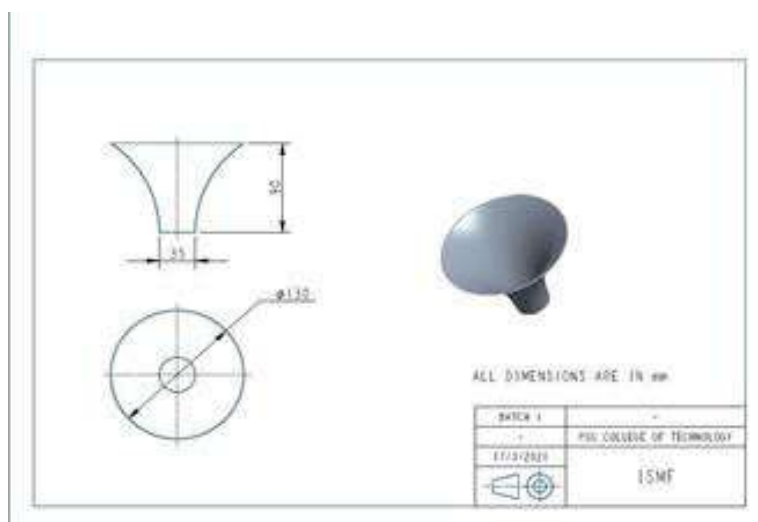


Fig. 4. Component design

E. Toolpaths generation

Tool path influences component dimensional accuracy, processing time, and surface quality. The CNC programme determines and controls tool path trajectory. The CAD model is transferred into the CAM software to create NC data. The final stage is to pick the machine type, tool diameter, tool path generation, surface parameter, and rough contour parameter. An inter-spiral tool route has been built to lower the circle diameter for the developed model.

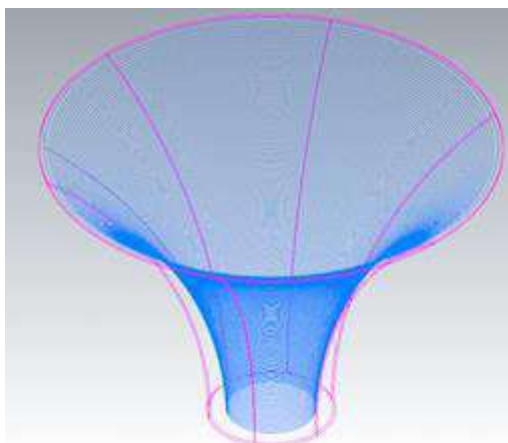


Fig. 5. Toolpaths generated with MasterCAM package

III. RESULTS AND DISCUSSION

The experiments were performed as per the run order of the design matrix and the corresponding output responses such as average-surface roughness (R_a), thinning (t_f), maximum height formed without failure (h_{max}) and forming force (F_a) were measured. The research objectivity is to explore the best combination of forming parameters to form the sheet-metal without any defects and with excellent surface finish.

TABLE 1: CENTRAL COMPOSITE DESIGN LAYOUT AND OUTPUT RESPONSES

Experimental Run	Feed rate	Spindle speed	Incremental depth	Maximum Height	Final thickness	Surface roughness	Forming Force	Temperature
1	3000	300	0.6	13.935	0.503	1.4	3319.58	60.1
2	1000	100	0.3	12.886	0.507	2.64	2903.78	52.7
3	1000	300	0.6	15.36	0.5034	2.11	2913.57	54
4	2000	300	0.6	11.5	0.515	2.43	2766.42	55.8
5	2000	300	0.6	11.5	0.515	2.43	2766.42	55.8
6	3000	100	0.9	10.246	0.5159	1.91	3570.84	58.9
7	1000	500	0.6	19.848	0.4776	1.49	3050.91	60.4
8	2000	300	0.6	11.5	0.515	2.43	2766.42	55.8
9	3000	100	0.6	11.55	0.5098	1.36	3404.07	60.2
10	2000	500	0.6	10.358	0.5042	1.77	2217.06	56.4
11	2000	300	0.3	10.389	0.511	2.52	2336.88	53.2
12	2000	300	0.9	13.596	0.4964	1.91	3384.45	60.8
13	2000	300	0.6	11.5	0.515	2.43	2766.42	55.8
14	3000	500	0.3	14.5	0.5019	1.33	2401.33	57.5
15	2000	300	0.6	11.5	0.515	2.43	2766.42	55.8

The quadratic model explains the empirical relationship well since it incorporates all major components determining the output responses. So RSM is necessary on this pivot job. The design matrix considered two input elements, tool transverse and rotational speed, on three levels, and one category factor, tool geometry, on five levels.

A. Mathematical modelling

Instantaneous thickness

The given equation is derived from Jun Chen [14] et al, the equation which validate the end thickness of wall region under the plane strain compression and bi-axial stretching condition.

$$T_f = t_i (\cos\alpha + (1 - \cos\alpha)) \frac{2\gamma}{\alpha + \beta} \quad (1)$$

$$\gamma = \frac{\Delta Z - \text{Scallop height}}{\Delta Z} \cdot \sin \frac{\Delta Z}{2tr \sin\alpha} \quad (2)$$

$$\text{Scallop height} = \frac{2 * \Delta Z}{4d \sin\alpha} \quad (3)$$

$$\beta = \cos \left(\frac{tr - \text{scallop height}}{tr} \right) \quad (4)$$

were, t_i – initial thickness, α - wall angle, tr -tool radius, d - tool diameter, ΔZ - incremental depth

Height of wall

$$H = R(\cos\theta_1 - \cos\theta_2) \quad (5)$$

H = Total height of varying wall angle

R = Radius of wall quarter curvature

θ_1, θ_2 – Two different wall angle

Forming depth up to Fracture Limit

The given equation is derived from Nirala[1] et al, this equal established under the relation between cosine law and modified Niralafor asymmetric component thickness prediction equation.

$$(H-H_f) = (u_d - t_i \cdot \cos\alpha \cdot t_r) \quad (6)$$

Flow Stress

The given equation is derived from power hardening law.

$$\sigma = \frac{K(\epsilon_p^{n+1})}{n+1} \cdot (u_d - t_i \cdot \cos\alpha \cdot t_r) \quad (7)$$

$$\text{Effective plastic strain } \epsilon_p = \frac{2}{\sqrt{3}} \ln \left(\frac{t_i (\cos\alpha + (1-\cos\alpha)^{\frac{\gamma}{\alpha+\beta}})}{t_r \cos\alpha} \right) \quad (8)$$

Were, K- strength coefficient

n-strain hardening exponent

Axial forming force

$$= - \frac{2}{\sqrt{3}} \frac{p \cdot u_d}{4d \sin\alpha} \cdot \left(\frac{t_i}{t_r + t_i} \right) \cdot \cos \left(\frac{\alpha - \gamma}{2} \right) \quad (9)$$

B. Influence of ease-to-form material with concerning output responses

The interaction between feed rate and spindle speed has been plotted on 2D surfaces in Figure6 and illustrates the role of output responses under insignificance or stabilized manner. Forming height is majorly influential on feed rate, thereby describing that excessive strain at permissible limit throughout the meridional together with forming direction. Final thickness has higher contribution toward rise in feed rate and minimal tool rotation. Each iterative successive path has maximal contact-region, this intends to localize plastic-strain and elastically deflect at each deformation cycle resulting in a superlative threshold. The average-surface roughness perceived low degree of peak and valley with manifested wall surface and substantiates minimal distance of scallop height with enough material deformation, where both spindle speed along with feed rate should be higher as far. Forming force has substantial effect on the higher feed rate and little influence towards lower spindle speed and these effects clearly governed by flow stress and stretching mode effect. Forming temperature has increased by both factors.

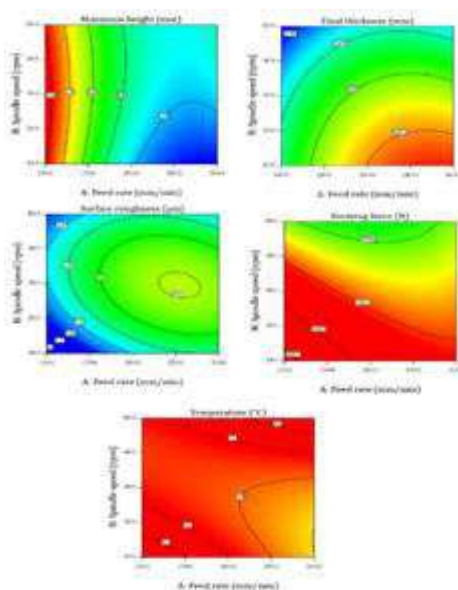


Fig.6. Influence of ease-to-form material with concerning output responses (a) maximum height, (b) final thickness, (c) surface roughness, (d) forming force, (e) temperature

C. Numerical optimization of process parameters

Optimization is a minimal or maximal set of data-driven variables with limiting the factors based upon DOE. Numerical or analytical optimization is a multiple segment of variables optimized with optimization technique

through regression equations, which can express the predicted appropriate combination of factors that intend to propagate the final output responses. Wall-inclination angle has been described as vertical angle far from nominal geometrical-profile, thus resulting in geometrical inaccuracies. This effect could dominate based upon region where might deviate on positive or negative springback because of bending, meridional stretching and twisting angle and compensated through closed loop or iterative compensating with inline optimal process variables. Average-surface roughness is the effect of the deepest of two consecutive traced step paths or scallop height, tool-sheet contact region, variation in rotational spindle speed together feed rate impact texture of vertical surface, normally Ra value should be minimal as to best fitted factor. For that minimum value is considered an optimized variable. Final thickness and maximum height intend to be maximum and avoid forming fracture. Forming force has inherently constituted many factors such as contact pressure distribution, energy consumption, rigid-body displacement and forming strategy and therefore much literature concentrate on minimizing the force component; probably minimal force is an optimal parameter. Temperature has to be marginally minimal and therefore geometrical accuracy with maximum sheet thinning could be constraints on numerical optimization. From that limitations of six output responses, better fitted combination of output factors extracted data in Figure 7 and nominal factors achieved through 2.03719 μm , 0.498224 mm, 14.4102 mm, 2252.4 N, and 53.1528 $^{\circ}\text{C}$ along with feed rate of 1000 mm/min, spindle speed 500 rpm and step depth of 0.662768 mm. Three data sets of experiments with optimal process parameters progressed, and results showed better agreement of 98% as regards predicting the output responses.

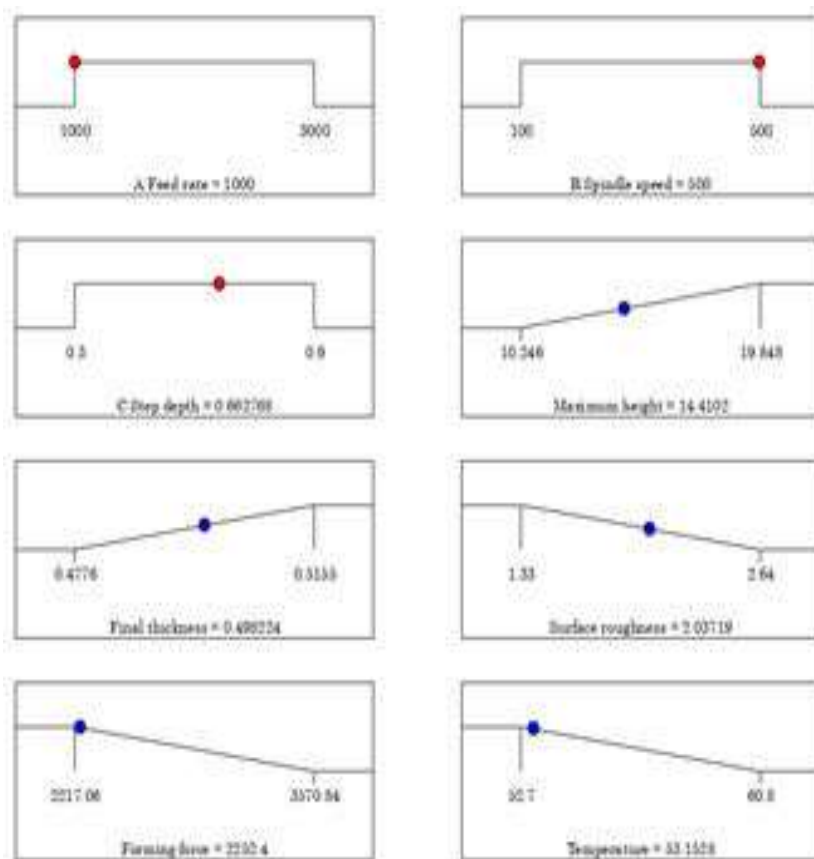


Fig. 7. Numerically optimized parameters and output responses

IV. CONCLUSION

This article expressed for Aluminium alloy 2024, this selected sheet has wide-range of automotive and aerospace applications concerning cold or hot forming as major advantages and ISMF has relatively dependent upon material stretching these aspects examined with both the experimental and analytical way-off analysis. The central composite design is considered for DOE with 15 experimental runs with three sets of process parameters to examine the tool geometry contributing towards various output responses and optimistic process parameters observation. The numerically optimized process parameter has validated and brings out important consideration of better fitted combination of output factors achieved through 2.03719 μm , 0.498224 mm, 14.4102 mm, 2252.4 N, and 53.1528 $^{\circ}\text{C}$ along with feed rate of 1000 mm/min, spindle speed 500 rpm and step depth of 0.662768 mm. The mathematical modelling is evaluated with input parameters to meet the appropriate

output responses, both the data comparatively examined observed that better agreement in predicting the output responses.

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Material Modeling of Polymer Concrete Using Numerical Technique

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ABSTRACT

Precision in machining process is influenced by stiffness, long term thermal stability and damping properties of structural materials used in machine tools. Vibration significantly affects the surface finish of the component and in order to improve the surface finish, alternative materials like epoxy granite could be used to enhance damping and dynamic stiffness of machine tools. Epoxy granite (EG) is a particle reinforced polymer matrix composite which exhibits higher damping ratio and lesser density, resulting in lower weight. Unit cell approach is adopted to predict the compression modulus and Poisson's ratio of EG material. Modeling and prediction of the overall elastic-plastic response in composite materials, in particular, particle-reinforced composites, is a very complex problem. This is because micro-structural aspects of the composite, such as particle size, shape, and distribution play important roles in the deformation behavior. In this paper, Representative Volume Element (RVE) approach is adopted to simplify the complexity involved and the mechanical behavior of the composite was simulated using finite element method. Granite particles of three different sizes were modeled and their random distribution within the RVE was enforced with the aid of MATLAB R2010a code. The properties of EG estimated by numerical simulation using the proposed approach were compared with that obtained by rule of mixtures and Halpin-Tsai model and found to be in close agreement with experimental values.

Keywords: Epoxy granite; Halpin-Tsai model; Randi function; Representative Volume Element (RVE); Unit cell.

1. INTRODUCTION

The most common materials used for machine tool structural components are steel and cast iron. While steel is commonly used in welded structures, cast iron structures are used in machine tool structures for damping vibration and thereby providing better surface finish on the component. Some parts such as headstock housings are also made of cast steel. The main advantages of these conventional materials are their low cost and ease of fabrication. Moreover, steel excels in terms of its high elasticity modulus and excellent mass to stiffness ratio and cast iron also has a high material damping ratio. But, traditional structural materials are not very effective in damping vibration and this affects the surface finish of the parts produced. This can be minimized by providing stiffer structures having thicker sections. The longer manufacturing time and higher cost of traditional materials increase the cost of machine tool. Hence, an alternative material which provides higher damping is preferable for machine tool structures.

Epoxy granite is a polymer composite which is obtained by mixing granite particles of various sizes with epoxy resin. It has properties like high damping ratio, good scratch resistance, low thermal conductivity, low density, etc. as shown in Table 1.

Table.5. Comparison of material properties

Material	Density (kg/m ³)	Damping ratio
Steel	7850	0.0001-0.0002
Cast Iron	7100	0.001
Epoxy Granite	2064	0.01-0.02

D Saraev et al. applied periodic micro-field approach to model the behavior of composites reinforced with ceramic particles using assumptions like spherical particles, periodic distribution, etc. [1]. Periodic arrangement of the fibres tends to over-estimate the load carrying capacity of the composite. Hence, an alternative approach was used to model the distribution of particles inside the unit cell [2]. Random distribution of particles aids in modeling the micro-mechanical behavior of ceramic reinforced composites with high accuracy [3]. Hence, the multiscale modeling approach incorporating the random distribution of properties was elucidated and it was found that the properties would not change drastically for every trial of randomly generated particles inside the RVE [4]. Three dimensional unit cell models were used to characterize the original microstructure of metal matrix composites and the uni-axial stress strain response derived from numerical analysis were found to be in strong agreement with experimental results [5]. The effect of random nature of particle distribution on

composites was investigated and the influence of parameters like particle size and volume fraction on strength of composites was discussed [6]. Simple multi particle models based on unit cell approach can be used to characterize the behavior of composite materials.

In order to obtain the random distribution of particles, the algorithm within MATLAB can be used with appropriate boundary conditions to meet real time situations [7]. Random sequence algorithm was used to model the random distribution of fibres in fiber reinforced composites and the accuracy of the algorithm was tested by comparing the results of numerical simulation with experimental results [8]. In numerical analysis of RVE, some assumptions were necessary to simplify the model. It was found that under extreme loading conditions, the behavior of granite was found to be isotropic and could be modeled as linear elastic in numerical analysis [9]. Experimentally determined stress strain response of epoxy resin was investigated under different loading rates and the effect of loading rate on the mechanical behavior of materials is discussed [10]. Analytical models are quite common in determining the mechanical properties like compression modulus and Poisson's ratio. The advantages of using the finite element model over a simplified analytical model to model the micromechanical properties of composites were investigated [11]. Analytical models have certain assumptions and thus provide inaccurate results due to over-simplification and thus cannot be used in all scenarios.

Among all the mathematical relations, the rule of mixtures has the simplest mathematical relations. In order to apply the above rule, the modulus of elasticity of the matrix (E_m) and that of the fibre (E_f) should be known and then the modulus of elasticity of the composite (E_c) can be calculated for any volume fraction of the fibre in the composition. But in most cases, this model does not predict the modulus of elasticity of the composites satisfactorily [12]. In this work, the process to reproduce, visualize and model the three-dimensional (3D) microstructure of particle-reinforced polymer matrix composites is described. The 3D microstructure-based FEM accurately represents the alignment, aspect ratio and distribution of the particles. But, due to the vast number of elements present in the finite element model, obtaining solution for the 3D micro structural problem becomes difficult. Hence, the unit cell approach is used to model the micro-mechanical response of polymer matrix composite.

2. MATERIALS AND METHODS

In the present study, finite element method is used to determine the elastic properties of polymer reinforced composite. The reinforcement is assumed to be macroscopically homogeneous, linearly elastic, macroscopically transversely isotropic and initially stress free implying no thermal stress. The matrix is assumed to be macroscopically homogeneous and initially stress free.

Deciding the RVE size is the most important step for modeling the micro structural properties by numerical technique. Considering different sizes of RVE, the mechanical properties do not converge to a particular value. Hence, by using the reaction force technique, the values of compression modulus can be determined for different sizes of RVE. In order to obtain this value, the following relations (1-5) are used.

$$\sigma = \frac{R_F}{A} \quad (1)$$

$$\varepsilon = \frac{dL}{L} \quad (2)$$

$$E = \frac{\sigma}{\varepsilon} \quad (3)$$

$$\gamma = -\varepsilon_t/\varepsilon_l \quad (4)$$

R_F , A , dL , L , σ , ε , ε_t and ε_l represent the reaction force in N, cross sectional area in mm^2 , displacement in mm, original length of RVE in mm, equivalent stress in GPa, equivalent strain, compression modulus in GPa, strain in the transverse direction and strain in the longitudinal direction respectively. Different RVE sizes were taken to perform test for convergence in finite element simulation. The size of RVE should be taken above 0.6 mm as the maximum size of particles lies within that value. The above size was increased in steps of 0.1 mm and for 1 mm, convergence in mechanical properties was obtained. Using equation (5), the necessary volume fraction for the corresponding weight fraction was obtained.

$$\frac{1}{\rho_c} = \frac{W_f}{\rho_f} + \frac{W_m}{\rho_m} \quad (5)$$

where, ρ_f is density of granite particles, ρ_m is density of epoxy resin, ρ_c is density of composite in kg/m^3 , W_f is weight fraction of granite particles and W_m is weight fraction of epoxy resin. The required number of particles was determined for a mass fraction of 70% of granite particles.

3. RANDOM GENERATION OF PARTICLES

3.1 Generation and modeling of particles

During manufacturing, the homogeneity in components varies from time to time based on the various parameters influencing it. Epoxy granite being discontinuous, the phenomenon of randomness needs to be taken into consideration during modeling. The RVE is generated using particles by unit cell approach. The MATLAB coding is executed based on the requirement of particles and their random distribution with the aid of co-ordinates obtained through Randi function. In this study, coding is developed to generate the RVE containing randomly distributed non-overlapping spherical particles of different sizes. Multi-particle spheres were found to be simulating the mechanical response of metal matrix composites accurately [5]. The particle distribution is obtained by evaluating the distance between neighboring particles (d_{ij}) [7]. The clearance condition was incorporated in such a way that the centre distance d_{ij} between particle i ($i = 1, 2, 3, \dots, n$) and all other previously accepted particles j ($j = 1, 2, \dots, i-1$) need to be minimum and is given by,

$$d_{ij} \geq r_i + r_j \quad (6)$$

where, r_i represents the radius of particle i and r_j represents the radii of particles j . The required numbers of particles in each size category are generated using a MATLAB program and Fig. 2 shows the particles generated through randi function. The detailed flowchart used to generate particles in random distribution inside of RVE is shown in Fig. 3.

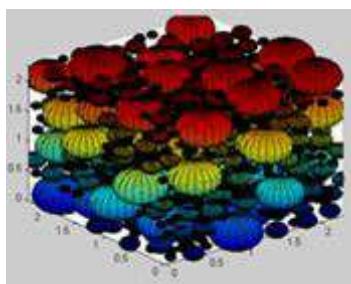


Fig. 2 Particles generated through randi function

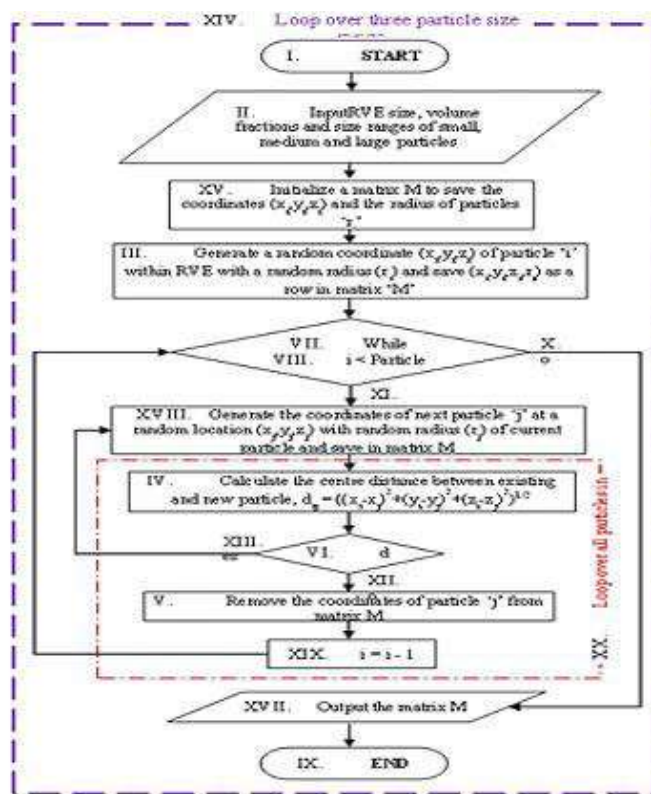


Fig. 3. Flow chart for random particle generation

Two size ranges, viz., 106 μm - 600 μm and 212 μm – 600 μm are considered for material modeling. Particles in each of the above two size ranges were further categorized into fine, medium and coarse particles. The particles are approximated as spheres and incorporated in the RVE. The coordinates are given as input to the modeling software and the particles generated are shown in Fig. 4.

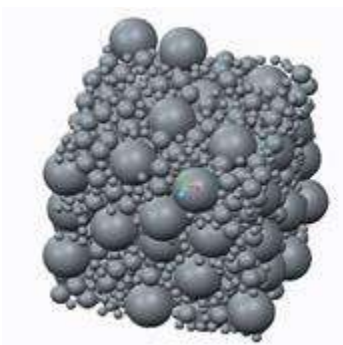


Fig.4 Particle generation

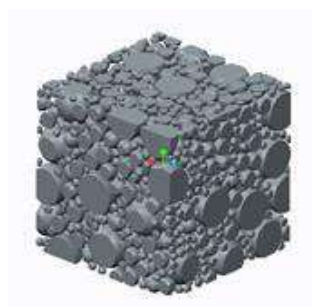


Fig.5 RVE geometric model - Granite particles

Then the generated particles were trimmed to fit within the RVE size as shown in

Fig. 5. The geometric model was converted into a finite element model comprising epoxy as matrix and granite as reinforcement.

3.2 Numerical analysis of RVE

The RVE was modeled and imported to FEA software ANSYS 15.0 to generate finite element mesh. Boolean operation was performed to model the epoxy resin as separate entity as shown in Fig. 6. The granite particles and epoxy resin matrix were modeled as linear elastic and elastic-plastic respectively by incorporating the experimentally determined stress strain value as input to the matrix [10].

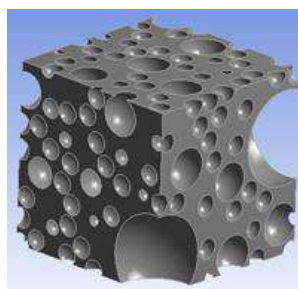


Fig.6. RVE geometric model – epoxy

The material properties of the constituent materials are given in Table 2. The bonding was assumed to be perfect. Porosity associated with polymer matrix composite was not considered during modeling and quantifying this parameter proved to be tedious.

Table.2. Properties of constituent materials

Material	Compression modulus (E), GPa	Poisson's ratio(γ)
Epoxy	3	0.3
Granite	50	0.25

The boundary conditions were applied to the finite element model by constraining the bottom face and enforcing displacement at the top face as shown in Fig. 7.

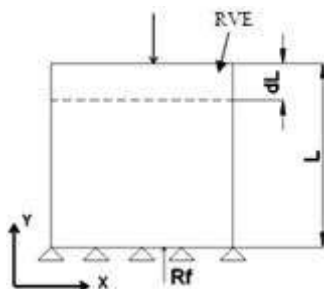


Fig.7. Loading and Boundary conditions

$$U_y(x, 0, z) = 0$$

$$U_y(x, y, z) = dL = - 0.001$$

The negative sign was used to simulate compression and displacement is initially given as 0.1% of strain. The same procedure is repeated for different values of strain. Loading rate was maintained at 6 mm/min as per the test procedure ASTM C 579[14] to simulate the exact testing conditions.

It is evident from Fig. 8 that beyond 6% of strain, the RVE attains failure and Fig. 9 gives the directional deformation value. The compression modulus and Poisson’s ratio were then obtained using relations (3-4).

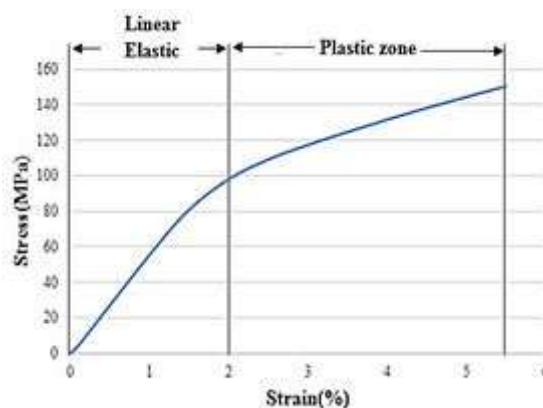


Fig.8 Stress- strain plot from numerical simulation

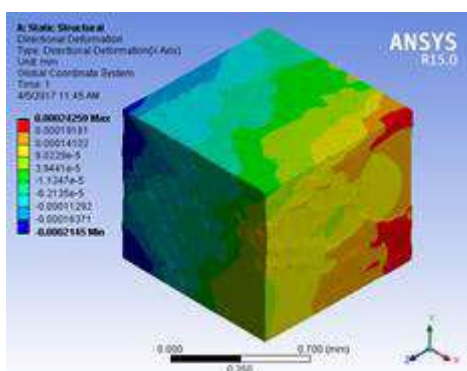


Fig.9 Directional deformation plot from numerical analysis

It is inferred from Table 3 that despite using different sizes of particles, similar results of stress strain response were observed during numerical analysis. It is found that the compression modulus and Poisson’s ratio depended only on mass fraction of reinforcement.

Table.3. Comparison of numerical results for varying particle size range

Particle size range in μm	Compression modulus (GPa)	Poisson’s ratio
106 to 600	5.088	0.242
212 to 600	5.088	0.242

4. EXPERIMENTAL PROCEDURE

Epoxy granite polymer specimen was made by using permanent mould casting. Granite stones were initially crushed and sieved to required sizes. Specimens were prepared for the granite particle size ranges highlighted in

Section 3. Required quantities of particles with the specified size ranges were mixed to form a homogeneous mixture whose weight fraction is 70%. Epoxy resin is mixed with hardener and added to the granite particles to form a semi-solid composition. They were mixed and poured into a steel die of dimensions 50 x 50 x 50 mm. Compaction was done by using a vibrating platform operating at room temperature. Then the mixture was allowed to cure for 24 hours at room temperature. The specimen was removed carefully without causing any damage to the component. A typical fabricated test specimen is shown in Fig.10.



Fig.10 Fabricated compression test specimen

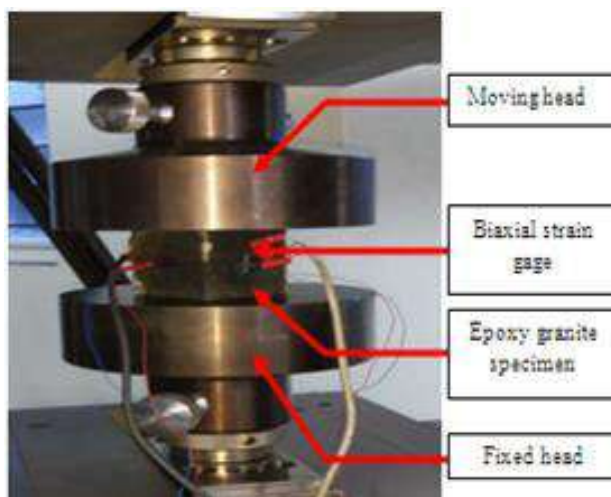


Fig.11. Experimental setup for compression test

In order to determine the compression modulus and Poisson's ratio of epoxy granite, ASTM C579 standard^[14] was followed. The specimen was subjected to compression test at a load rate of 6 mm/min at room temperature as shown in Fig.11 and the specimen after testing is shown in Fig.12.



Fig.12. Specimen after testing

A typical stress strain curve obtained is shown in Fig.13, from which the compression modulus is determined by calculating the slope of the curve at the linear region. Strain gages were used for measuring strain in a particular direction when the specimen was loaded. By measuring strain in two different directions, the Poisson's ratio can

be determined using equation (4). By using biaxial strain gage and LabVIEW software, Poisson's ratio was determined during compression test itself.

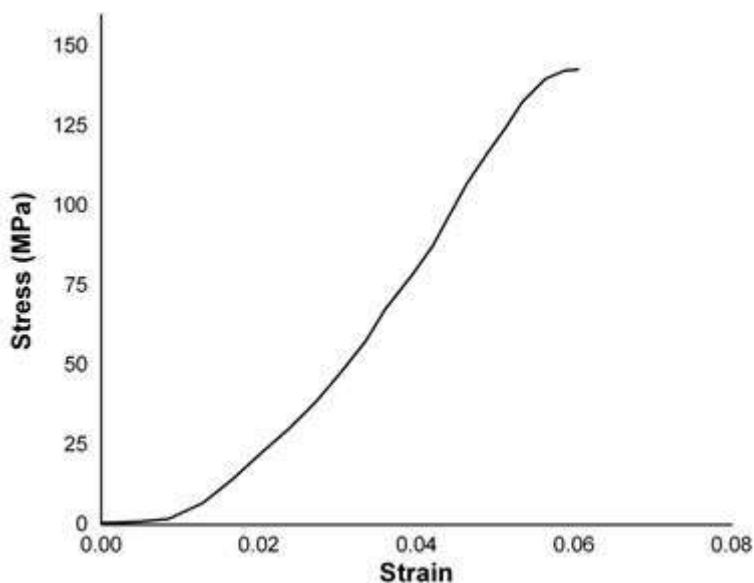


Fig.13 Stress - strain plot for compression test specimen

5. RESULTS AND DISCUSSION

The Rule of mixtures generally adopted for determining the properties of composite using constituent properties is represented by mathematical expressions (7-8).

$$E_c = V_f E_f + V_m E_m \quad (7)$$

$$\gamma_c = (\gamma_f * v_f) + (\gamma_m * v_m) \quad (8)$$

where E_c , E_m , E_f , V_f , V_m , γ_c , γ_m and γ_f are the compression modulus of the composite, compression modulus of matrix, compression modulus of fibre, volume fraction of fiber, volume fraction of matrix, the Poisson's ratio of the composite, Poisson's ratio of the matrix and Poisson's ratio of the fibre respectively. Halpin - Tsai developed models based on elasticity as simple equations (9-10) by curve fitting and hence they are semi-empirical in nature. [12-13]

$$E_c = \left[\frac{1+2s\eta V_f}{1-\eta V_f} \right] E_m \quad (9)$$

$$\eta = \left[\frac{\left[\frac{E_f}{E_m} \right] - 1}{\left[\frac{E_f}{E_m} \right] + 2s} \right] \quad (10)$$

where 's' and 'V_f' are the aspect ratio of the reinforcement, which is considered as one for spherical shaped particles, and volume fraction of fiber respectively [12]. Using numerical and experimental results obtained for granite epoxy with mass fraction of 70:30, the behavior of composites is determined. Table 4 gives a comparison of properties obtained by the simple rule of mixtures, Halpin-Tsai model and the proposed numerical model.

Table 4 Comparison of Compression modulus and Poisson's ratio

Properties	Rule of mixtures	Halpin-Tsai model	Proposed model	Experimentation
Compression modulus, GPa	24.941	7.55	5.088	4.23
Poisson's ratio	0.2765	0.2765	0.242	0.26

The compression modulus and Poisson's ratio of polymer matrix composites depend on several parameters like particle shape, matrix type, mass fraction of reinforcement and degree of interfacial bonding between matrix and

reinforcement. Since only volume fraction is taken into consideration by the rule of mixtures [12], the corresponding results show maximum variation in comparison to experimental results as shown in Table 4. It is also observed that the results obtained based on the proposed model are in closer agreement with experimental values than that obtained by other two models since particle shape and distribution have been considered in material modeling in addition to other factors.

5. CONCLUSION

In the present work, a three dimensional material model for EG composite using Representative Volume Element is developed. It is found that particle distribution does not have a significant influence on compression modulus and Poisson's ratio for a given volume fraction of the composite. The maximum volume fraction of reinforcement modeled within RVE is 25 % as reported in literature. However, it is found that a volume fraction of 47% could be modeled by applying Randi function in MATLAB software.

The results obtained based on numerical model are found to be more suitable for particulate reinforced composites with different size ranges of particles. Hence, the proposed numerical approach could be effectively used for material modeling of particulate type materials.

6. NOMENCLATURE

E	: Compression modulus in GPa
E_c	: Compression modulus of composite in GPa
γ	: Poisson's ratio
γ_c	: Poisson's ratio of composite
σ	: Equivalent stress in GPa
ε	: Equivalent strain
ρ	: Density in kg/mm^3
d_p	: Centre distance between particles in mm
η	: Aspect ratio of particle

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Experimental Study on Thrust Force and Wall Angle in Single Point Incremental Forming of Ti6Al4V

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ABSTRACT

With ISF, 3D objects can be made. By deforming the sheet in small increments, the final component is created. Sheet metal incremental forming is a reliable, flexible, and high-quality method of forming sheet metal. On incremental Ti-6Al-4V alloy formation is reported. In this case, a CNC vertical machining centre (VMC). This task involves creating a hemispherical-end fixture and tool. Tool rotation speed and feed rate were input process parameters. Experiments using Response surface methodology were used to study and explain output responses like wall angle and forming force (Central Composite Design).

Keywords: Incremental sheet metal forming; Response surface methodology; Central composite design; Vertical machining center, Ti-6Al-4v alloy

INTRODUCTION

Incremental sheet forming (ISF) is useful for prototyping and small batch production. Create component in CAD, then generate programme in CAM software to import into CNC Vertical Machining Center to create component using forming tool in CNC Vertical Machining Center. The sheet is held in place by a fixture while the forming tool shapes it according to the programme. The material is deformed locally to shape it. This method uses a simple general tool to make a variety of shapes without requiring a specific die setup. So it's only good for prototypes and small runs. Researchers are working hard to fully grasp this process's benefits. Experimenting with ISF would provide not only basic parameter information but also a process understanding.

LITERATURE REVIEW

In recent years, several academics have worked to improve incremental sheet forming technology. Many variables have been studied to improve process robustness and formability. We've previously discussed the evolution of incremental sheet formation. Kim and Park [1] used a variety of ball and hemispherical tools. Also used to assess formability. Lower input rate improved process formability. Formability varies with rolling tool movement. Vanhove et al. [2] used an AA 5182-O with feed rates up to 600 mm/min. High feed rates increased the maximum forming angle to 65° by improving material ductility.

Al 5052 alloy was studied by Reddy et al. [3] using the Box-Behnken method. For all depths, surface roughness is said to decrease with tool diameter. Up to a point, surface roughness increases with depth. Increased wall angle reduces surface roughness. Petek et al. [4] investigated process-induced deformation and forming force. The forming force increases with vertical step depth and tool diameter, the study found. With minor oxidation, Fan et al. [5] used electric hot incremental forming to work the Ti-6Al-4V alloy.

It was Park and Ji [6] who made the magnesium sheets. The finite element analysis was used to investigate higher temperature forming. In both axisymmetric and plane-strain experiments, formability increased with temperature. Progressive forming was developed to overcome forming constraints by increasing the forming angle. Ambrogio et al. [7] used Joule's influence on aeronautical alloys. The methodology was backed up by a workability window for the chosen materials. Working conditions for the wall angle and specific energy. Components cannot be precisely formed below the hazardous curve. Increasing specific energy reduced surface quality. Heating improved formability like cold forming.

Araghi et al. [8] built a hemispheric with a groove using incremental sheet metal forming and stretch forming. Comparable to two-point incremental shaping. SPIF vs. stretch forming sheet thinning. In both cases, finite element simulation was set up. The combined technique reduced forming time and produced a uniform wall thickness. These frustums were made by Minitoli et al. (9). The pyramid is 35 mm high and 70 mm in diameter. Conical shapes had more wall angles than pyramids. LS-DYNA numerical simulations showed that free surfaces can be generated for different strain values in the most stressed zone. For the greatest wall angle generated by incremental forming, Suresh and Srinivasa [10] experimented with varying wall angles. 110mm top base, 40-80° wall angle. They are compared. The theoretical model predicted thickness distribution better than the finite element model. Hamilton and Jeswiet [11] found that increasing feed rate to 8.89 m/min reduces surface roughness. One could only shape so much before the "orange peel" effect set in.

Aluminium and stainless steel are the only materials studied. Aluminium alloys have been studied in aerospace materials. Force and wall angle were not optimised in incremental forming. This study uses Ti-6Al-4V alloy sheet metal, which can only be formed into simple shapes using standard forming methods. The component's shape deviation is affected by the process's geometry, thickness, and residual stress. This study's goal is to predict the wall angle and thrust force of dieless formed sheet metal components.

EXPERIMENTAL WORKS

The experiments used a 150mm x 150mm Ti-6Al-4V alloy 0.5mm thick. Table I shows the material's chemistry. Inexperimental 3-axis CNC Vertical Machining Center 8000 rpm spindle, 5.5 kW drive motor, 450 x 350 x 350 mm maximum stroke length The machine receives the CAM tool path. Experiment setup for single point incremental formation in Fig 1. 1 The shaping tool (Fig. 2) is made of HSS M2 and TiN coated for durability.

Table I: Chemical composition of Ti-6Al-4V alloy [12]

Element	Weightpercent
Carbon	<0.08%
Iron	<0.25%
Nitrogen	<0.05%
Oxygen	<0.2%
Nickel	0.05
Hydrogen	0.015
Yttrium	0.005
Aluminium	5.5-6.76%
Vanadium	3.5-4.5%
Titanium	Balance

A CMM measures the manufactured object's wall angle. The component was initially clamped perpendicular to its surface. The cloud points' geometric properties were retrieved. An evaluation of the component's wall angle A CNC machine tool dynamometer measures forces during forming. A three factor three level factorial design was used to optimise tool rotation speed, feed rate, and incremental depth. The experiment was designed using a response surface method (central composite design). Table II summarises the levels of the factors.



Fig. 1 ISMF experimental setup



Fig. 2 Hemispherical form tool of diameter 15mm

TABLE II: Design parameters and their levels

Factor's	1	2	3
Toolrotationalspeed(rpm)	100	200	300
Incrementaldepth(mm)	0.1	0.2	0.3
Feedrate(mm/min)	1000	1500	2000

TABLE III: Experimental Design and Response Values

Run	Tool rotational Speed (rpm)	Step Depth (mm)	Feed Rate (mm/min)	Surface roughness (microns)	Wall angle (degree)
1	100	0.3	1000	1.14	27.45
2	200	0.3	1000	1.19	27.92
3	150	0.3	1500	1.1	27.67
4	200	0.1	1000	0.83	29.74
5	150	0.2	1500	0.92	28.78
6	150	0.2	1500	0.96	28.32
7	100	0.2	1500	0.88	28.20
8	150	0.2	1000	1.02	28.85
9	150	0.1	1500	0.77	29.61
10	150	0.2	1500	0.92	28.45
11	150	0.2	1500	0.9	28.70
12	100	0.1	1000	0.8	29.39
13	100	0.1	2000	0.74	29.10
14	200	0.2	1500	0.98	28.88
15	200	0.3	2000	1.08	27.52
16	150	0.2	1500	0.92	28.65
17	150	0.2	1500	0.94	28.43
18	200	0.1	2000	0.72	29.63
19	150	0.2	2000	0.85	28.38
20	100	0.3	2000	1.04	27.16



Fig. 3 Experimental specimen of ISMF

RESULTS AND DISCUSSION

These include tool rotation speed, incremental depth, and feed rate. A CMM measures profile accuracy. The best ideal process parameters were predicted using Response surface methodology using wall angle and force as responses. A wall angle and force are shown in Table III. Fig. 3 is an ISMF test subject.

A. FORMING FORCE

Forming force was calculated using data from each run's milling tool dynamometer. It helps visualise parameter effects. To the contrary, increasing feed rate from 1000 to 2000 mm/min has no effect on forming force. The forming force increases from 10 N to 23 N with depth. The reaction change is dictated by the incremental depth. More material to distort for major steps down More rapid tool rotation reduces forming force. By increasing tool sheet friction and localising heat, high rotation speed reduces forming forces Incremental depth of 0.1mm, form force 156 kg at 200 rpm.

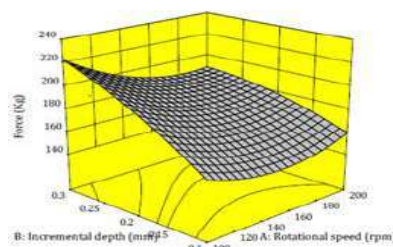


Fig. 4 Effect of tool rotational speed and incremental depth on forming force

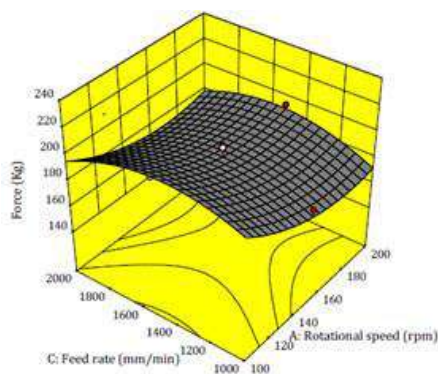


Fig. 5 Effect of tool rotational speed and feed rate on forming force

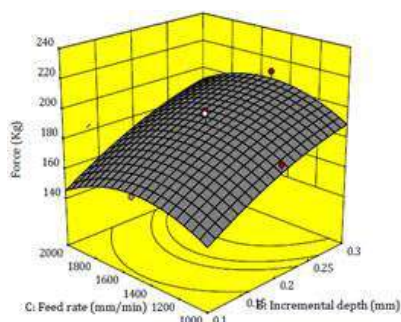


Fig. 6 Effect of incremental depth and feed rate on forming force

B. WALL ANGLE

Springback in die-formed parts causes nonconformance. But storing elastic energy reduces springback. Figs 7–9 show a minimum feed rate and step depth. Feed rate affects forming time. You can release elastic energy from the springbacked region before the forming is finished. As step depth increases, so does the amount of localised deformation. The wall angle increases with tool speed. So a faster spindle speeds up forming. With a 200 rpm spindle, 1000 mm/min feed rate, and 0.01 mm incremental depth, the maximum wall angle is 29.74 degrees. The 29.74° wall angle is within 0.26° of the conventional 30° wall angle.

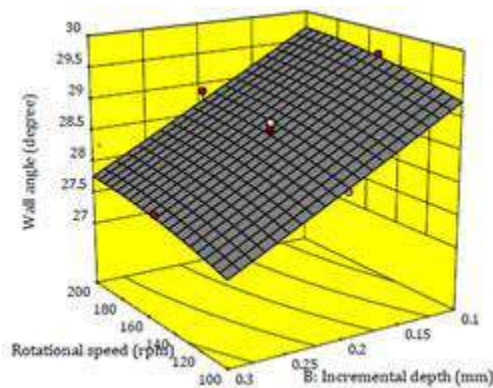


Fig. 7 Effect of tool rotational speed and incremental depth on wall angle

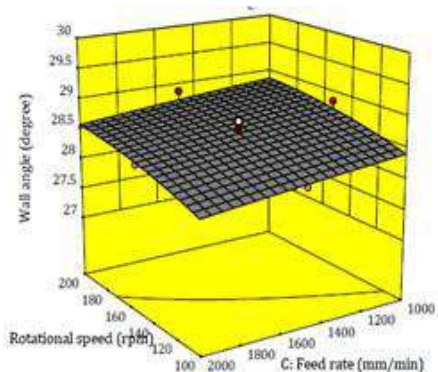


Fig. 8 Effect of tool rotational speed and feed rate on wall angle

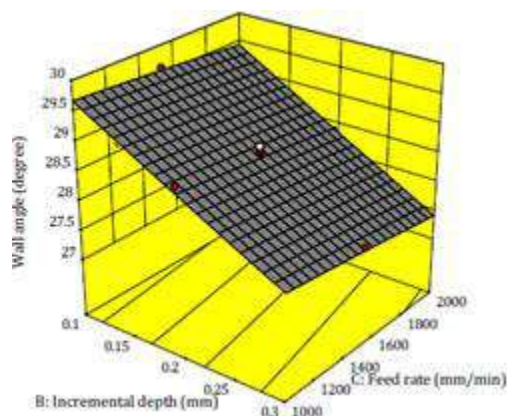
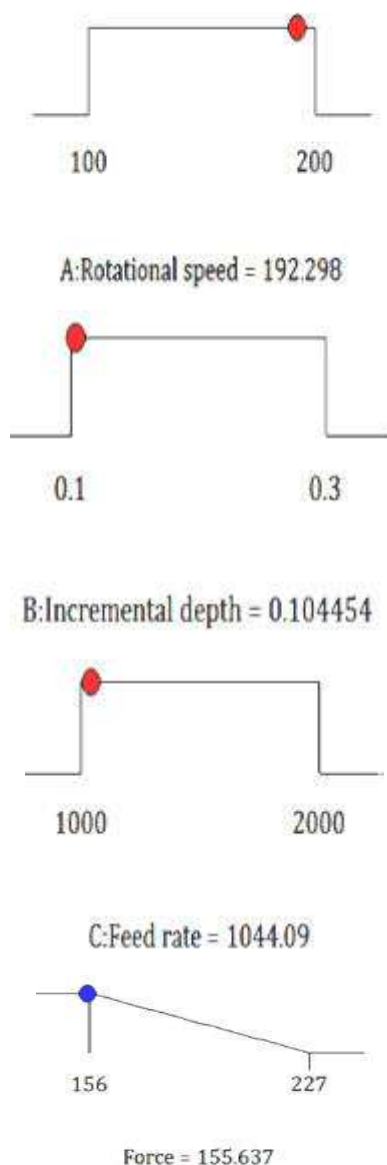
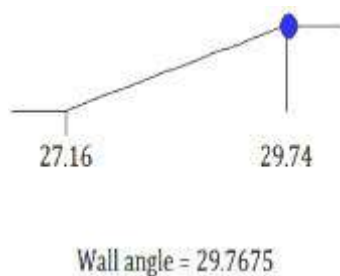


Fig. 9 Effect of incremental depth and feed rate on wall angle

C. NUMERICAL OPTIMISATION

By minimising or maximising optimization functions. The required response is chosen from the resulting regression equations. Desirability measures optimality of the output responses. Wall angle is always influenced by springback. The maximum wall angle must be determined because springback reduces it. 155.637kg force, 29.760 wall angle, 1044.09mm/min feed rate, 0.1mm incremental depth, 192.3rpm tool rotation. Prepare the component for optimal forming conditions for minimum surface roughness and maximum thinning.





CONCLUSION

With truncated part geometry, single point incremental forming of Ti-6Al-4V alloy sheet metal was studied. This work necessitates an end tool fixture design. Surface roughness, thickness, wall angle, and force are among the parameters tabulated in this section.

1. Although increases in spindle speed decrease forming force due to tool-blank friction, increases in incremental depth increase forming force.
2. The spring back region has less elastic energy stored and can release it before forming.
3. Inferred divergence between measured and actual wall angles is 97.80%.
4. On average, 192.3 rpm spindle speed, 1044.09 mm/min feed rate, and 0.1mm incremental depth produce 155.637 kg and 29.76° on average.

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Portable Solar Energy Harvester with Dual-Axis Tracking System

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ABSTRACT

The ever growing human population and increase in requirements have caused a hike in the demand for energy. In order to reduce pollution and depletion of resources, renewable energy resources are the most preferred alternatives to the current energy resources. The ever-present nature of solar energy makes it advantageous and hence the most preferred form of renewable energy. For effective utilization of the available solar energy, the area of land involved in solar power collection is to be increased and/or the conversion efficiency of the system is to be improved. A method was proposed to improve the amount of solar energy harvested by simultaneously improving the efficiency of the system and making the maximum use of the available area. The proposed portable system involves a set of solar panels mounted on a foldable mechanism and incorporated with a dual-axis tracking mechanism. A charge controller was incorporated to provide a constant output voltage from the system. The system was designed and fabricated to obtain power for charging electronic devices operating at a voltage of 5V.

Index Terms: Solar energy, tracking mechanism, Photovoltaic system, Charge controller.

INTRODUCTION

The need for exploiting renewable energy resources has paved way for numerous technological advancements in the past few years. The widely available and popular renewable energy sources include hydel energy, wind energy, bio fuel and solar energy. The solar energy proves to be the most preferred source of renewable energy as it is available in abundance and requires just a conversion panel for power production. The high initial investment required for setting up solar power plants hinders its widespread usage. In order to increase the rate of return of the investment, the efficiency of the system is to be improved. The efficiency of the photovoltaic system can be increased by improving the material of the photovoltaic panel and by incorporating additional systems to aid in utilizing the collected sunlight. A stand-alone photovoltaic model was designed incorporating tracking mechanism and charge controller in order to obtain the maximum power output from the available area.

Availability of Solar Energy

The solar energy incidence in India is 5000 trillion kWh with a daily average solar power generation of 0.2 kWh per m² of used land area [1]. Fig. 1 shows the annual average direct normal solar irradiance in India [2]. It can be observed that India has been provided with an abundance of solar energy that can be harnessed and utilized in any part of the country.

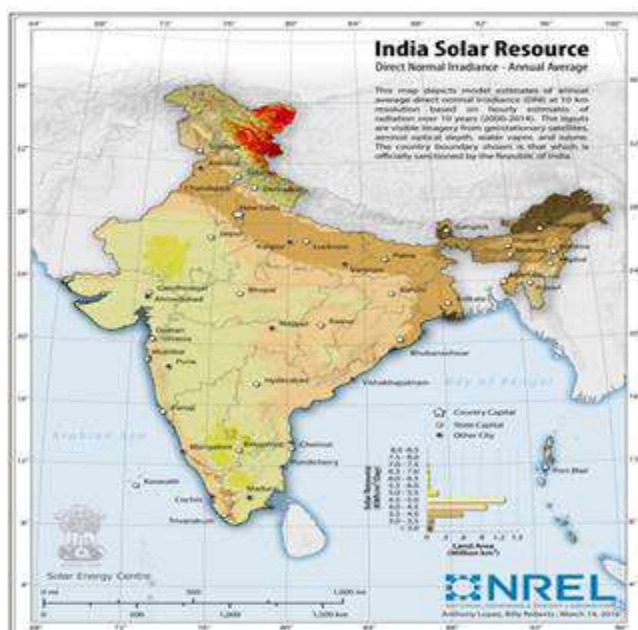


Fig. 1. Average annual solar irradiance in India [2]

LITERATURE SURVEY

The photovoltaic system was incorporated with various types of tracking systems and charge controllers to improve the conversion efficiency between the incident solar radiation and the energy collected in the battery.

Chen, Lim and Lim [4] presented a solar tracking formula for a heliostat that is arbitrarily oriented towards an arbitrarily located object. The formula can be modified based on the user requirements. Fathabaldi [14] designed an offline sensorless dual-axis solar tracker which yielded an increase in the absorbed solar energy of 20%.

Al-Mohamad [6] made use of two light detecting resistors for a single-axis solar tracker and programmable logic controller was used as the control unit. A dual-axis tracker using four LDRs and a microcontroller was designed by Bingol, Altintas and Oner [5]. The use of a sensing unit increased the cost of the tracker but is preferred more than the system involving solar equations. The solar radiation is not constant throughout the year and varies with altitude and location. These variations are not accommodated in the equations.

The various photovoltaic systems available for use are fixed panel, panel with vertical-axis tracking, panel with east-west axis tracking, panel with north-south axis tracking and panel with dual-axes tracking. The effect of the five types of panels on the power generated in flat plate photovoltaic panels is discussed by Abdallah [11]. When dual-axis tracker was used, a power gain of about 40% was reported when compared with a fixed surface in Jordan. The study conducted by Bahrami, Okoye and Atikol [12] showed that at any given latitude, the dual-axis tracking system absorbed the highest amount of sunlight when compared with the other four types of systems.

The output of the solar panels is a function of the input solar irradiation. It is necessary to obtain a constant voltage in order to safeguard the battery and prolong its life. Thus a charge controller is to be incorporated to convert the varying voltage and provide a constant voltage output without causing much loss in power. LokeshReddy et al [16] devised a solar charge controller consisting of series and shunt charge controllers. When compared with various other charge controllers, the proposed controller was found to perform better and the cost was lower. Dakkak and Hasan [17] designed a charge controller by using a microcontroller and improved the conversion efficiency of the system. Nguyen et al [18] designed a low cost fast solar charger that can be incorporated on the photovoltaic array on the rooftop of a vehicle. When using a microcontroller, the charge controller is provided with either a Pulse Width Modulation (PWM) algorithm or a Maximum Power Point Tracking (MPPT) algorithm. It was found that the use of such algorithms increased the efficiency of the charge controllers.

The performance analysis of a system helps in designing and optimizing it for further developments. Fara and Craciunescu [7] designed a stand-alone photovoltaic system in Romania. Mathematical models were developed for each element of the system and were analyzed using MATLAB/Simulink software. Mahmoud and Ibrik [20] studied three forms of energy sources for supplying power to remote villages in Palestine. It was found that the utilization of photovoltaic systems for rural electrification was economically feasible than other available alternate sources. Nafeh [8] designed and implemented a stand-alone photovoltaic system in a house in Egypt. Ahsan et al [9] studied a 1 kW off-grid photovoltaic system in New Delhi. It was observed that the system can provide an internal rate of return of about 1.7% on investment.

Development of Solar Energy Harvester

A solar energy harvester was designed to collect the maximum possible amount of sunlight and convert it to store in a battery of input voltage 5V without much loss in the conversion process. This battery in turn is used for powering electronic gadgets operating on 5V such as mobile phones, tablets and iPods. The proposed design of the model contains a foldable unit on which the solar panels are placed, a dual-axis tracking unit to continuously track the position of the sun and an electrical unit that converts the energy from the panels and stores it in a power bank or a battery. Fig. 2 shows the CAD model of the solar energy harvester.

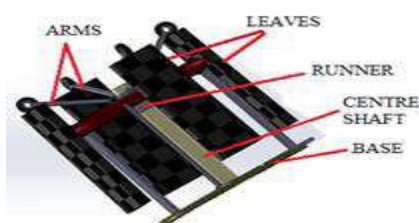


Fig. 2. Model of the solar energy harvester

The panels mounted on the foldable unit are to be extended and placed in a region with sufficient access to sunlight. The tracking unit ensures that the solar radiation falls perpendicular to the surface of the panels ensuring maximum energy conversion. The converted energy is not always of constant voltage as the incident solar radiation is not always consistent. Providing fluctuating voltage to a battery damages it. Thus a charge controller is introduced which tracks the input energy and provides output at a constant voltage by suitably varying the current. This controlled energy is used to charge the battery. The harvester was designed for devices working on 5V. A battery or power bank supporting 5V is connected to the output of the charge controller. Fig. 3 shows the energy flow in the system from the sun to the power bank or the batteries.



Fig. 3. Energy flow in the system

Development of Tracking Unit

As the proposed system is portable, it can be used in any place with access to sunlight. It is not manually possible to orient the solar panels to the direction of sunlight every time it is being used. Thus to facilitate the orientation of the solar panels irrespective of its initial position, a dual-axis tracking system is used. Further, tracking of the solar radiation increases the conversion efficiency of the panel which is the direct function of sine. The tracking unit requires hardware components including sensors, actuators and a controller and a control logic to operate the unit.

Hardware

Table 1 gives a list of components required for the tracking unit of the harvester.

TABLE 1: Components required for tracking unit

HARDWARE	COMPONENTS	QUANTITY
Light sensors	Light Detecting Resistor	4
Microcontroller	Arduino UNO	1
Actuators	Servo motors	2

Two sensors are allocated per axis to determine the maximum solar irradiation angle along that axis. Thus four sensors are used to determine the maximum irradiation angle along two axes. The sensors are placed at right angles to each other separated by an opaque screen to improve the accuracy of the sensors. The microcontroller chosen is Arduino UNO as it is compact, easy to code and is of low cost. Two actuators are required to rotate the panels along two axes. The servo motor is selected as it allows precise control of angular position. Fig. 4 shows the arrangement of the light detecting resistors along with the opaque screen used for shielding the light falling on one sensor from the other sensor.



Fig. 4. Arrangement of sensors

ELECTRICAL CONNECTION

The four light dependent resistors are connected to the ports of the microcontroller through a resistor. The voltage drop across the resistor is low when light falls on it. Thus it becomes difficult for the microcontroller to pick up the voltage drop. A resistor is connected in series with the resistor to increase the drop in voltage so as to aid the microcontroller in detecting the light intensity. Fig.5 shows the electrical connections of the sensors and actuators on the microcontroller.

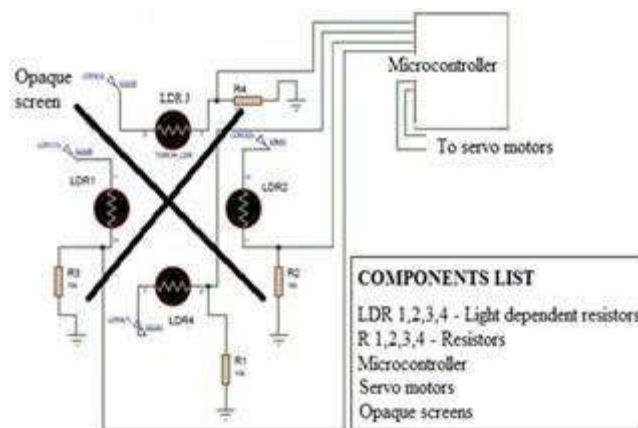


Fig. 5. Electrical connection of the components

CONTROL LOGIC

For any microcontroller to work, control logic is to be provided. The Arduino board receives signal from the light detecting resistors and by comparison determines the angle of maximum irradiation. The microcontroller then activates the servo motors to orient the panels in that angle. The purpose of the tracking unit is to place the panels perpendicular to the solar radiation for maximum incidence.

The signal from two light sensors along an axis is compared by the microcontroller. The servo motor is then actuated to rotate in the direction of the sensor detecting higher intensity of sunlight. The same process is carried out along the other axis. The sensing is not carried out continuously so as to reduce the energy consumed by the system. The sensing is done immediately when the solar energy harvester is put to use. Further tracking of sunlight is done periodically as the position of the sun changes significantly only after some time, say an hour or two. The program for tracking the sunlight is written in a personal computer and then transferred to the microcontroller board. Fig. 6 shows the program flow in the form of a flow chart.

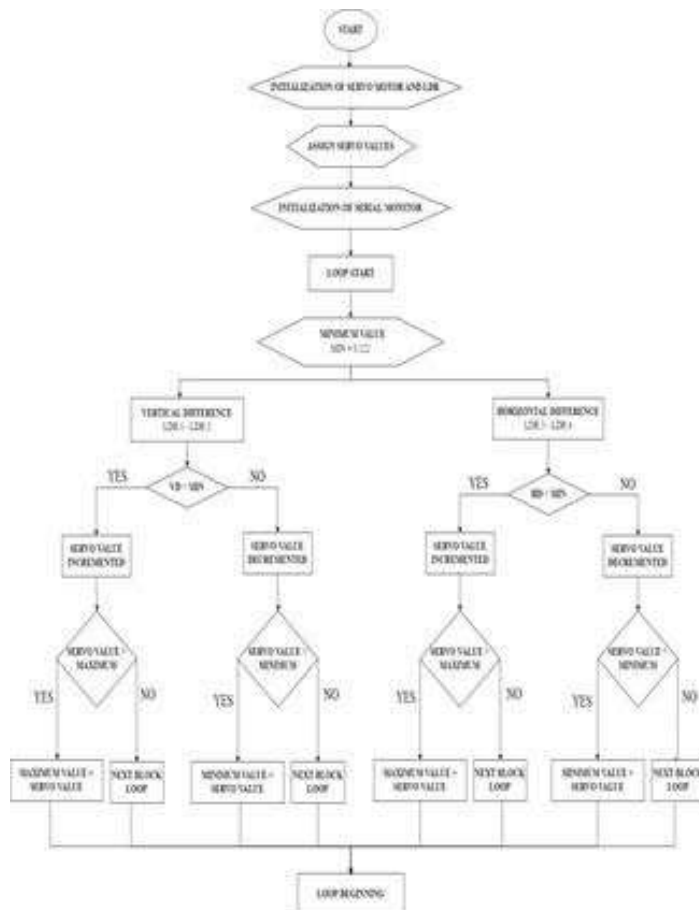


Fig.6.Program flow chart

SELECTION OF SOLAR PANEL

The selection of solar panels depends on the power required to charge the battery and the tracking unit. The solar panels are subjected to continuous research to improve its conversion efficiency. Thus for selecting the suitable panel, the desired power, the efficiency of the panel and the area required to generate the desired power are to be known. Table 2 gives the power required to be obtained from the solar energy harvester in order to charge a mobile phone with a battery capacity of 3000 mAh which is the average value of the battery capacities of some widely used mobile phones. The average power consumed by two servo motors and microcontroller is also considered as the power for these components is also obtained from the solar panel.

TABLE 2: Calculation of the power requirement

COMPONENT	VOLTAGE (V)	CURRENT (mAh)	POWER (Wh)
Phone	5	3000	15
Servo motors	5	1000	5
Microcontroller	5	80	0.4
Total power			20.4 Wh

The efficiency of the solar panel is assumed to be 17% and the solar input is taken from the solar energy data provided by NREL [3]. The equation 1 gives the relationship between the power required, the area of the panel needed to generate that power and the energy of the incident solar radiation [8, 10].

$$\text{Panel area, } A = \frac{L}{G_{av} \times \eta_{\text{panel}} \times \text{TCF}} \quad (1)$$

where

L is the average load to be generated by the panel, Wh

G_{av} is the average solar energy input per day, Wh/m²

η_{panel} is the efficiency of the solar panel

TCF is the Temperature Correction Factor

The efficiency of the panel is reduced with increase in panel temperature. Thus a temperature correction factor (0.9) is introduced to compensate the loss in power due to the temperature of the panel exposed to sunlight. From the equation, the panel area required to generate the desired power is 322.84 cm². The total area available on the harvester to mount the panels is 450 cm². The power generated from the available area is 28.43 Wh which is theoretically sufficient to run the system.

FINAL ASSEMBLY OF THE HARVESTER

The folding mechanism was fabricated using 3D printing technique. The tracking unit was mounted on the folding unit and the panels were fixed on the leaves. A set of polycrystalline Silicon panels of size 39*19 mm was used. The panel voltage was 0.5V and generated a power of 0.12 W. Twelve panels were arranged in series to obtain a voltage of 6V. Three such sets were formed and the sets were connected in parallel to obtain a current of 0.72A. The total power obtained from the panels is 4.32 W. In order to charge a system of 20.4 Wh, theoretically it would take 4.7 hours. Fig. 7 shows the electrical connection of the panels on the leaves.

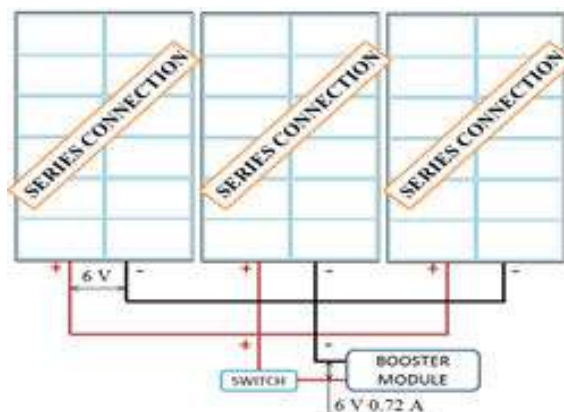


Fig. 7. Electrical connection of the panels

The booster module is the charge controller used to obtain output at a constant 5V to charge the power bank. The module contains a USB port that can be connected to the power bank. Fig. 8 shows the image of the solar energy harvester with all the components and electrical connections of the panel and the tracking unit.

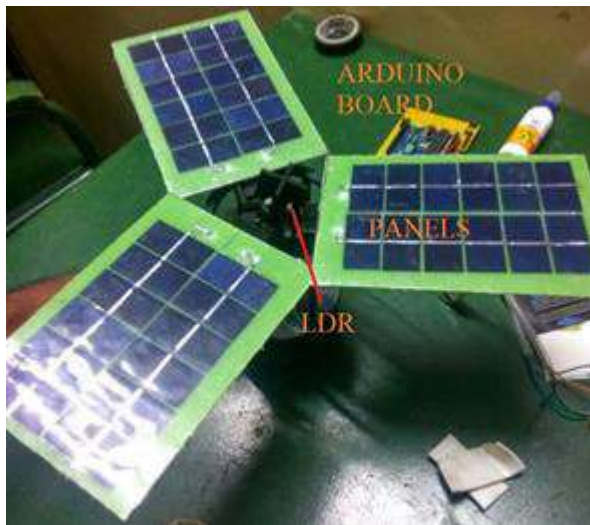


Fig. 8. Solar energy harvester

CONCLUSION

The present work attempts to provide a portable, clean and inexpensive form of conversion of solar energy into electrical energy. A solar energy harvester was designed with dual-axis tracking mechanism and a folding mechanism. The design was tested using suitable photovoltaic cells to study its power conversion capabilities. It was observed that the power generated from the available area is 28.43 Wh which is theoretically sufficient to run the system consisting of sensors and actuators. In order to charge a system of 20.4 Wh, it would take about 4.7 hours with the given set-up. The portable harvester can be placed at any location with a flat surface and sufficient access to sunlight to generate electricity to charge the electronic devices. In this world of electronic gadgets, these type of devices will be of more use to public and armed forces reducing their need to search for power plugs wherever they go.

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A Study on Academic Data Management System for Improvement of Academic Performance in Select Pune Based Management Institutes

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ABSTRACT

Various trends in the hardware, software, Information Systems, information technologies have made significant changes in academics as well as business environment. The concepts of data now are not limited up to information but it has reached to knowledge and intelligence. There are various information systems which give support to business operations as well as academic data management. All such information systems are the powerful instruments of academic performance and ensure that the appropriate data is collected from various sources, processed and sent further to all needy destinations. Business Analytics satisfies diverse needs through a variety of systems through computing rather than specific method application or product. Adaptability with related technologies has become important issue in all business applications as many factors such as Technology, Globalization, Competition, Communication, Infrastructure, and Internet are affecting today's business environment.

One of the significant developments in the last decade of 20th Century was emergence and convergence of number of technologies such as Business intelligence, Data Warehousing, Data Mining, Machine learning and Artificial intelligence playing important role in descriptive and predictive analytics.

Due to COVID-19 Pandemic the role of business analytics in managing data is increased and in academics it has become prominent in student, teachers, and academic activities retention and for gaining competitive advantage.

The main objective of this research paper is to understand tools which are used for academic data management and are they useful for improving academic performance in order to predict and improve upcoming situations.

Keywords: Information Systems, Business Analytics, Big data, Business Intelligence, Adaptive Academic data management systems, Knowledge Management Systems, competitive advantage.

INTRODUCTION

Present Scenario in Academic Institutions: Presently management institutions are making use of Microsoft Excel, Microsoft word, Tally as a business intelligence tool for routine activities at operational and tactical level. Conversion of existing information systems into Adaptive Intelligence System by making our machines more intelligent is essential in today's scenario. It is also necessary to change the role of basic management functions into intelligent management, Reporting and Budgeting which can leads to self served, self validating fully automatic organization. When intelligent system applications like fully automatic washing machine, intelligent monitors, TVs can help us to make our home intelligent then why our computer s can't become intelligent self monitoring machines? The answer is yes. It is possible using artificial intelligence techniques.

Scope of Academic Business Analytics Systems:

SMS: Security Management system such as the close circuit television, alarm or warning systems, movement tracking system, IoT for sensing environmental inputs, Smoke detector and alarm etc.	SSI: Student/Staff Soft skills improvement systems
HMS: Healthcare Management Systems	FMS: FacultyManagement/Performance system.
CMS: Communication Management System paging, cordless, mobile telephone systems, audio video systems etc. Use of social media platforms	WMS: Waste Management systems
PMS: Parking Management Systems	SBI: Student/Staff Behavior systems
IMS: Infrastructure Management Systems	AMS: Attendance Management Systems
CDS: Campus Decorative Systems	TMS: Time Table Management systems
RMS: Resource Management Systems	DMS: Document Management systems
LMS: Library Management System	SPS: Student/Staff Performance Systems
SSS: Student Selection Systems	EMS: Examination Management Systems
SAS: Student Admission System	RMS: Record Management Systems-student /faculty data
	ADS: Administration Management Systems
	ECA: Extra Curricular Activity Management Systems.....

Effective planning of these Systems with the help of analytics will help the academic institutions for Organizational Development, Learning, Motivation and it will improve overall organizational effectiveness.

World is moving towards from data, Information, Knowledge and Intelligence. In Academics it can be used as tacit as well as explicit knowledge. Academic environment is best suited for Knowledge based expert systems. Such knowledge based expert systems are required to gain Competitive advantage through Reduction, Reuse, Recycling and Recovery Sustainable Development Thus academic business analytics plays very important role into educational business.

Keyterms

Intelligence: Intelligence is ability to understand and respond, ability to predict and adapt, ability to take appropriate timely decision. Intelligence is also how to identify the problem.

Business Intelligence: Business intelligence is often defined as a broad category of application programs and technologies for gathering, storing, analyzing, and providing access to data in structured formats. .

Adaptive Academic data management systems: A fully automatic systems in which all decisions about learning environment from students admission, teachers recruitment, faculty subject allocation to result analysis could be made by using facts , not instinct by making our current generation computers more intelligent. Adaptive academic data management systems works on the same principle of Adaptive Business Intelligence.

Academic Business Analytics: Maintaining statistical records of all academic activities such as students, staff, faculty, library data, placement data, examination data, result data, resources data, University communication, maintaining dashboard for various academic activities etc. with the help of analytics software's.

Aims and Objectives: Many information systems exist as part of academic management systems doing smart work by using computers more intelligently. The main objective of this research work is to study analytics aware organizations which deal with big data and tasks. The other objectives include

1. To study the adequacy of current data management system in management institutions
2. To study the extent of application of various business analytics tools used by management institutes for successful adaptive academic intelligence initiative for big data management.

HYPOTHESIS

1. The extent of using specific Business Intelligence tool for day to day academic activities is directly related to the age of the management institutions.
2. The digital literacy amongst the staff is dependent on the training efforts conducted by the management institutions.

RESEARCH METHODOLOGY:

The Research methodology will be exploratory in providing a new framework for adaptive academic intelligence.

Sampling Design

Sampling units: Management Institutions which are sufficiently established offering Master's program and are affiliated to University of Pune

Sampling size: 20 colleges, five respondents per college -100

Sampling Procedure: convenient non-probability sampling.

Sampling Element: Teaching/Non-teaching staff

Data Analysis: Hypothesis Testing

Chi square test of Correlation was exclusively used for testing the stated hypothesis.

This test is an extensively used mathematical method in which the numerical representation is applied to measure the level of relation between linear related variables. The coefficient of correlation is expressed by " χ^2 ", $df = \text{the degree of freedom} = (\text{no of rows} - 1) \times (\text{no of columns} - 1)$; O is the observed and E is expected frequencies.

The Formula for Chi-Square is as follows :

$$\chi^2_c = \frac{(O_i - E_i)^2}{E_i}$$

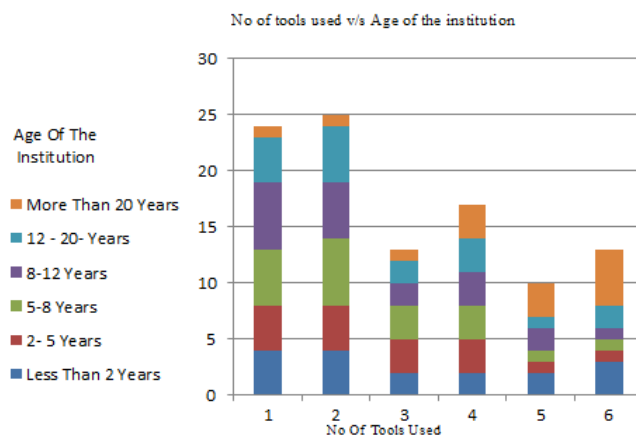
Research Hypotheses:

Hypothesis 1:

HA1#: The extent of using specific Business Intelligence tool for day to day academic activities is directly related to the age of the management institutions.

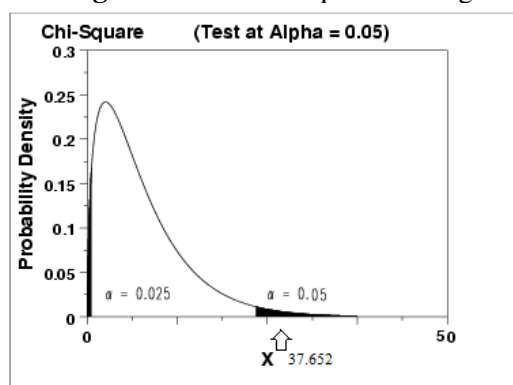
H0 1#: The extent of using specific Business Intelligence tool for day to day academic activities has no relation to the age of the management institutions.

Figure no ----- No of tools used v/s Age of the institution



When the responses by the consumers were tested for cross tabulation & co-relation for the variables No of tools used v/s Age of the institution the critical value for Chi square test of Correlation(χ^2) at degrees of freedom $df= 25$, significance level $\alpha = 0.05$ as observed to be 37.652

Figure no ----- Chi square Testing



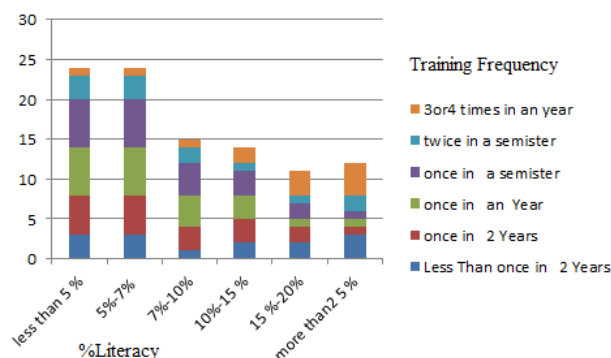
The Table value for Chi square test of Correlation(χ^2) obtained was observed to be 53.76. For null hypothesis to be true the value should be lesser than the critical value which is not in the case observed. Hence we reject the null hypothesis and approve the alternate hypothesis and conclude that there is a positive co-relation between the No of tools used v/s Age of the institution.

Hypothesis 2:

HA2#: The digital literacy amongst the staff is dependent on the training efforts conducted by the management institutions.

H0 2#: The digital literacy amongst the staff is independent of the training efforts conducted by the management institutions.

Figure no ----- % Literacy v/s Training Frequency



When the responses by the consumers were tested for cross tabulation & co-relation for the variables No of tools used v/s Age of the institution

The critical value for Chi square test of Correlation(χ^2) at degrees of freedom $df=25$, significance level $\alpha=0.05$ as observed to be 37.652. The Table value for Chi square of Correlation(χ^2) obtained was observed to be 114.7. For null hypothesis to be true the value should be lesser than the critical value which is not in the case observed. Hence we reject the null hypothesis and approve the alternate hypothesis and conclude that there is a positive co-relation between the No of tools used v/s Age of the institution.

OTHER OBSERVATIONS

1. It is observed that all institutes use Ms Excel and Ms Word as a Data storage/ data forms/Analysis Tool.
2. All institutes had their user interface (Public appearance) through their website with .edu domain. Few institutes used Social Media platform such as Facebook, Instagram and twitter and LinkedIn as their user interface. Very few (20%) institutes are using only Facebook as interaction media.
3. 80% institutes are having semiautomatic system for time table, student attendance, fees, faculty /staff attendance, Leaves, Payroll, Exam, Result, Placement data management. 20% have complete fully automatic systems for day to day activities with own ERP solution. 10% Institutes were maintaining data using data warehouse.
4. 10% Institutes have their departmental data marts. Rest all 80% institutes use databases with excel.
5. Almost all institutes have Biometric device of attendance and CCTV cameras in the premises but only 10% institutes used RFID in library, CHATBOTS in their user interface, sensors with CCTV as Artificial intelligence systems.
6. Subjects like Artificial Intelligence, ERP, Data warehousing and data mining are included in the syllabus theoretically but Practical implementation of AI, NLP, Robotics, IoT, RFID is not seen in academic institutes for gaining competitive advantage.

CONCLUSION

Fundamental components of Business Intelligence and analytics are already fast emerging in other areas of business but it is not so in academics. The lacuna is more prominent in newer organisations. Database creation, autonomy and intelligent decision making with smart systems can be regarded as focus for artificial intelligence to cope up with situation like pandemic covid-19. Training of staff can to a certain extent enhance the efforts

RECOMMENDATION

Although descriptive analytics does provide significant insight into business performance academicians should concentrate on such systems which are based on predictions and should go towards optimization of day to day transactions. Information stored in databases should be integrated and automated properly. Reengineering of each and every system is required. Gap Analysis is required to be done.

Academic institutes should move forward by investing in efforts to use adaptive business analytics for sustainable development.

Academic institutes as well as universities must devote resources intelligently to become sustainable and to provide students with a living experience in a sustainable environment.

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ELT for Medical Professionals through Literary Pieces – An Application Study

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ABSTRACT

This paper tries to provide with a spotlight on the English Language Teaching to the medical professionals using the literary pieces right from Shakespeare to modern literary creation, as a tool to teach the English language for the aspirants. Many a quote from literary master pieces still is quoted and cherished in a day-today-con by the erudite scholar and the commoner with minimum education. Hence the paper proposes an idea, with due consultation of existing papers on the topic presently and previously as well, how could far effectively the literary texts in general or quotes or excerpts in particular be used for English language learning process.

Keywords: ESL Class, Literary genre, Teaching tool, Native color, Language proficiency.

INTRODUCTION

Gone are the days where ELT (English Language Teaching) means only English grammar or grammar translation method in an ESL (English as a second language) class room. Now the trend has changed in many ways including in approaches. Now the focus is on LSRW (Listening, Speaking, Reading and Writing) for any language learning after teachers got exposed much to the areas and theories of applied linguistics. But still, people would agree as far as ESL learning is concerned this LSRW not able to apply its order in ESL but it is applied in reverse – writing, reading and rarely there is a choice for speaking or listening. Even if they tend to listen to and speak, the chance of experiencing the native variety is less or almost nil. To avoid these hitches to some extent, the paper aims at seeing the literary master pieces; drama, poem, essay, criticism etc; getting used in ESL class, as an opportunity and it also involves this into a SWOT

(Strength, Weakness, Opportunity and Threat) and throw a light on the spots. The authors combination (from different domain) in this paper creation, though rare, is found to be good as one is teaching and the other is in library; where he sees and touches many literary pieces and shares with. Thereby this paper rather than a review was mooted and formed as an idea. Come on let's get into the core.

STATE OF ESL CLASS

English language teaching in the non-native land of English is given with style of their living land set-up only. Any language, not necessary to be English, if only we learn it with the originality—style, culture, land etc.—the learning of a language is getting fulfilled. That too, as far as English is concerned it poses far from the crowd of India. Indian language feature is different from European language. Grammar, structure and culture – everything—give a unaccustomed posture to the learner. The language learning is set up in tune with vernacular. If such is the case, the ESL learner struggles a lot. Briefly speaking, many of us speak and write English but we don't think in English. Thereby the fluency and proficiency of English a learner get is not only getting affected but also it creates a panic among the learner. To learn, any language, it has to be with the native touch—means culture and structure---. A mere use of 'sorry' by a native speaker becomes almost untranslatable in Tamil. This a second language learner cannot understand unless he understands the color of English.

Learning a language without native color is not a blunder but the learning process not getting completed is point here. Here the 'literary master pieces' i.e. learning or teaching through literature comes handy to the teaching and learning process. Come on let's discuss further and develop the arguments. Though it titles as English for medical professionals, it could be applicable to all the ELT or ELL.

INDIAN OR NATIVE CREATION COMES HANDY

Though it is only for being aide to the teaching and learning process, needless to say there's no hard and fast rule or no need to be so crude and skeptic in choosing material but to be clever enough to be choosing the tool by perusing the literary pieces – be it a poem or any other genre. Whatever it is, the English is authority, the English is yardstick and they are the bench mark. So we are supposed to choose, by priority, theirs to be getting the color of natives in the process of language learning, i.e. not the methodology of teaching or learning we are discussing but the tool only.

QUOTES FOR FLUENCY AND PROFICIENCY AS WELL

We have seen supra that gone are the days where ELT stood for grammar teaching only. Now a day, thanks to the concept of global village, people have started getting much visit to English land and culture. British and American compete on each other to inculcate their tradition and culture through MNCs (Multi National Company) here in India and other non European countries. Before these seasons, the term ELT was mentioned only here and there. Only importance was towards the content of the literary piece given for syllabi. Hence, what this writing gives thrust is that the awareness has increased on ELT, that too with respect to pronunciation and style. People tend to hurry for imitate either British or American. These all could be seen as a day order today.

Considering all theses; if a student comes for ESL, he is to learn vocabulary, normal everyday dialogue phrases or minor sentences with native style and manner and so on.

WHAT CAN BE GAINED THROUGH LITERARY PIECES?

As we brought to the readers' notice, the literary piece that we use for teaching and learning process only as a tool. But the benefits we get out of it are plenty, such as vocabulary, right context and right usage and the beauty and aesthetic sense of the language. Besides, the proficiency is assured and thereby the fluency gets developed confidently and reassuringly.

HOW TO USE IT (Literary Genre – the Tool for ESL Learning)?

It is really an art we say. Every literary genre, when both the learner and teacher come across and see a sentence or a quote, he or she has stand and stare to take it out and customize it to the usage by paraphrasing or rephrasing. Let's work on it with examples.

1. W. Turner quotes, the university wits, Greene on Shakespeare rather jealous in tone, in his edition – Merchant of Venice, "... Shakespeare is able to bombast out a blank verse as the best of you..being an absolute Johannes Factotum", is in his own conceit the only Shakescene in a country.

Here our eyes are getting attracted to the phrase *Johannes Factotum* is natural. Let's work on it. It is a Latin origin: In the 16th century, factotum was used in English much like a surname, paired with first names to create personalities such as "Johannes Factotum" (literally "John Do-everything"). It means A **person who can do many different kinds of work**; a Jack of all trades.

Miriam Webster cites this as

In the 16th century, *factotum* was used in English much like a surname, paired with first names to create personalities such as "Johannes Factotum" (literally "John Do-everything"). Back then, it wasn't necessarily desirable to be called a *factotum*; the term was a synonym of "meddler" or "busybody." Now the word is more often used for a handy, versatile individual responsible for many different tasks.

Example: He was the office *factotum*.

Now the usage 'jack of all trade and master of none' is a customized one from Johannes Factotum by someone like us.

2. "All that glitters is not gold—

Often have you heard that told.

(Act II scene VII: Merchant of Venice, William [Shakespeare])

'All that glitters is not gold' even now it is getting used as such for saying of, an external beauty probably won't tell the truth or the external beauty doesn't necessarily retain the inner self.

'Gilded tombs do worms in fold'. Here the quote sounds the same as 'all that glitters is not gold' only. Even so the vocabulary 'Gilded Tomb' may be noted and created room for vocabulary development.

- a) This way," the fed said, starting down a corridor lined with **gilded mirrors** and marble statues.

- b) He stopped to evaluate the **gilded ornaments**

3. Unhappy that I am, I cannot heave. My heart into my mouth. I love your majesty

(Act I scene I: King Lear, William Shakespeare)

This can be customized to our everyday conversation, like

a) I cannot heave out my heart exactly due to some sort of inconvenience.

b) She hesitates to bring her heart unto the mouth

4. Age cannot wither her, nor custom stale her infinite variety

(Antony and Cleopatra, William Shakespeare)

Customized as follows to fit in our usage:

The mother land India cannot be withered owing to her infinite variety that she inherited. Nor the custom stales her beauty and variety.

5. Which way I fly is hell; myself am hell; And in the lowest deep a lower deep, Still threat'ning to devour me, opens wide, To which the hell I suffer seems a heaven.”

(Milton’s Paradise Lost, Book IV)

Wherever I go, I face an ill luck, and I feel I fit for nothing. It tries to swallow me it better feel a heaven out of my hell where I live.

6. Nothing! Nothing will come of nothing (Act I scene I: King Lear, William Shakespeare)

You will gain nothing if you invest nothing. This saying is spoken by the title character in the play **King Lear**. King Lear is telling his daughter Cordelia that she will gain no favors from him if she does not make elaborate speeches saying she loves him. This can very well be adopted in conversing.

7. Some books are to be tasted, others to be swallowed, and some few to be chewed and digested;

(Francis Bacon; Of Studies)

CONCLUSION

What the paper, all through pages, has tried to put forth is nothing but fluency in general and proficiency in particular. It has discussed the reasons for the same. It is of original work that we should study for the ESL Teaching and Learning for the chance of blending the MIT (Mother Tongue Influence) in the TL (Target Language) we learn is significantly less. That is the one and only reason the paper reiterates. Of course there is many a way and method to teach and learn English language, but this method – using literature pieces-- would come handy is the argument the paper discusses.

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Role of Theories of Punishment in the Administration of Criminal Justice System

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ABSTRACT

The administration of Criminal Justice System is not a new concept. Administration of justice is a very wide subject. It is not only the judiciary which is responsible for the administration of justice but the legislature and the executive also play an equally important role. The Courts of law come into picture at a later stage to decide the right or wrong of a dispute whether civil or criminal. Administration of justice becomes the most important job of the state which implies the support of right within a political society by means of the physical strength of the state. Justice is administered through the judicial organ of the government. Justice is administered according to law and the Courts of Justice plays the vital role in the administration of justice. Theories of punishments plays an important role in achieving the goal of the administration of Criminal Justice System. There is a deep relationship between the theories of punishment and criminal justice system. To proper maintenance of criminal justice system, such theories give new thoughts to the courts to proper administration of justice.

Keywords: Administration of Criminal Justice System, Deterrent Theory, Preventive Theory, Reformative Theory, Retributive Theory, Expiatory Theory, Theory of Compensation.

INTRODUCTION

The Administration of Criminal Justice System is based on the principles of fairness, transparency and human rights. But these principles underlying criminal law, criminal justice system in India has failed in attaining of these objectives in reality. The reason in failing to fulfill the basic principles of justice system does not lie in its objects, but in proper handling and managing. The main problem before criminal justice system is delayed disposal of cases. 'Justice delayed is denial of justice' is the cardinal principle of criminal law and based on concept of fairness in criminal trial. Apart from this interest of society, the question of life and death of accused lies in the rights and interests of aggrieved person. For proper administration of justice and solving the problem of criminality in the society, speedy disposal of cases is very important. In India, the right to speedy trial has now been recognized as fundamental right enshrined in Article 21 of Constitution of India. Speedy trial is also important in order to gain public confidence in criminal justice system. It also plays very crucial role in prevention and control of crime.

Administration of criminal justice is a part of administration of justice that is a necessary ingredient of any civilized government to maintain peace and order in the society. To end the crime and society and maintain law and order, here is a dire need of punishment. A number of theories have been propounded to answer the question out of which the following have been given more importance:

1.2 RELATION BETWEEN CRIMINAL JUSTICE SYSTEM AND PUBLIC WRONG

A criminal proceeding as one designed for the punishment of a wrong done by the defendant, and a civil proceeding as one designed for the enforcement of a right vested in the plaintiff. We have now to consider a very different explanation which has been widely accepted. By many persons the distinction between crimes and civil injuries is identified with that between public and private wrongs. By a public wrong is meant an offence committed against the state or the community at large, and dealt with in a proceeding to which the state is itself a party. A private wrong is one committed against a private person, and dealt with at the suit of the individual so injured. The thief is criminally prosecuted by the Crown, but the trespasser is civilly sued by him whose right he has violated. Criminal libel, it is said, is a public wrong, and is dealt with as such at the suit of the Crown; civil libel is a private wrong and is dealt with accordingly by way of an action for damages by the person libelled.

Blackstone's statement of this view may be taken as representative: Wrongs that he says are divisible into the two sorts or species, private wrongs and public wrongs. The firstly are infringement or privation of the private and civil rights belonging to individuals considered as individuals or there are upon quickly termed civil injuries the second is a breach or violation of public rights and duties that affects the whole community considered as a community and distinguished by harsher appellation of crimes and misdemeanors". Conversely, and in the second place, all crimes are not public wrongs. Most of the very numerous offences that are now punishable on summary conviction may be prosecuted at the suit of a private person; yet the proceedings are undoubtedly criminal none the less. the divisions between public and private wrongs and between crimes and civil injuries

are not coincident but cross divisions. Public rights are often enforced, and private wrongs are often punished. The difference between the criminals and civil wrongs are based not only on any difference in the nature of the rights infringed but also on a difference in the nature of the remedies applied.

The credible of this theory in question is chiefly attributable to a certain peculiarity in the historical development of the administration of justice. Where the criminal remedy of punishment is left in the hands of the individuals injured, to be claimed or not as they think fit, it invariably tends to degenerate into the civil remedy of pecuniary compensation. Men barter their barren right of vengeance for the more substantial solation of coin of the realm. Offenders find no difficulty in buying off the vengeance of those they have offended, and a system of money payments by way of composition takes the place of a system of true punishments.

At the present day, for the protection of the law of crime, it is necessary to prohibit as itself a crime the compounding of a felony, and to prevent in Courts of summary jurisdiction the settlement of criminal proceedings by the parties without the leave of the Court itself. Such is the historical justification of the doctrine which identifies the distinction between civil injuries and crimes with that between public and private wrongs. The considerations already adduced should be sufficient to satisfy us that the justification is inadequate.

1.3 DETERRENT THEORY

The deterrent theory of punishment gives importance to the notion of deterrence in the mind of the criminal as well as in others. The offender knows that if he violates the law, he would be punished with penalty, and this fear causes him to behave as a normal human being. Like this, by punishing the criminal, a deterrent effect is created in the mind of others that if they thought of violating the law they too would be punished with penalty, and this fear in them keeps them away from breaking the law. In other words, the notion of fear is the basis of this theory by which civilized behavior by all is expected to be ensured. Thus, emotion of a man plays an important role. It is clear that more serious the offenses more severe the penalty. Our ancient sages had suggested the level of punishment in the forms of gentle admonition, harsh censure, deprivation of property and corporal pain in that order, and even then if an offender could not be restrained then all modes should be applied with hardness.

There is a lot of criticism by the critics of this theory of the deterrent theory of punishment in modern times. It is contended that this theory has proved ineffective in checking crime. Even when there is a provision for very severe punishments in the penal law of the country the also people continue to commit crimes.

1.4 PREVENTIVE THEORY

Preventive theory means the imposition of penalty with a view to prevent or disable the offender from committing the offence again. Repetition of the crime is prevented by disabling the criminal. Prevention of a wrongful conduct is ensued. It is based on the principle that prevention is better than cure. The offender is rendered incapable of committing the crime again. This can be done by imposing capital punishment, or by imprisonment, or by disqualification orders like suspending driving license in cases of motor vehicle offences, or by preventive detention, or by security for keeping the peace and for good behavior, and so on. Preventive detention and security for keeping the peace and for good behavior are some of the preventive measures and must be distinguished from the penal aspect of the preventive theory.

1.5 REFORMATIVE THEORY

The reformatory theory as comparison to other theories is a recent concept that lays emphasis on the reformation of the criminal. It treats criminals as primarily sick people that needing corrective measures with a view to restore them to the society as good citizens. Victor Hugo had quoted that as to open a school is to close a prison. This theory follows this quote. It believes in educating the offenders in such a way as to make them better citizens of tomorrow. It treats a criminal's mind as a diseased mind which requires careful treatment and proper attention to cure him. It does not take punishment as an end in itself but as a means to an end. It treats crime as a pathological way which can ordinarily be corrected by skilful treatment.

A therapeutic approach is the motto of this theory. The emphasis is on reform and rehabilitation of the offender. Prisons are correctional centres under this approach where the criminal is given adequate training so that after his release he could easily become a part of the society once again without being a burden on it. The harsh and savage punishment is ruled out by this theory. Basic human dignity is always kept in mind deprave treatment to a criminal is looked down upon. Reformation seeks to bring about a change in the character of the offender. It believes in causes of crime to be explored more vigorously in a personalised manner, and then a personalised treatment is recommended. The growing emphasis on probation, parole and suspended sentences by the modern penology is a sign of the acceptance of this theory in the present day.

In *Raju Jagdish v. the State of Maharashtra*, the Hon'ble Supreme Court has directed the States to think about implementing the reformatory and rehabilitation programmes contained in the Model Prison Manual of 2016. The manual which has been approved by the Ministry of Home Affairs refers to the education of prisoners which is vital for the overall development of prisoners. It also suggests physical education such as Yoga, health or hygiene education, moral and spiritual education among others.

In *Manga v. State of Punjab & ors.*, it was held by the Punjab and Haryana High Court that parole is a reformatory process and it cannot be denied on apprehension of absconding. The release on parole for the purpose that the prisoner can meet with his family members.

1.6 RETRIBUTIVE THEORY

This theory is based on retribution that an eye for an eye and a tooth for a tooth. Such notion is the motto of this theory. The offender must be made to suffer in proportion to the injury he has caused to the victim is the principle behind this theory. The thinking of revenge gets an upper hand. Retaliation becomes overbearing. The theory proceeds on ethical grounds and moral culpability of the culprit. This theory was developed more prominently in the olden days when the injured person was given a right to take revenge on the person causing the injury.

1.7 EXPIATORY THEORY

The expiatory theory is considered to have a link with the retributive theory, and even hold the opinion that it is a part of the retributive theory. This theory propounds that the punishment should be in order to adjust the suffering to the sin. The offender by suffering pays the debt that is demanded by justice and owed to authority inflicting the suffering and so becomes reconciled once more with that authority. The punishment should be in proportion to the quantum of wrong, and after the wrongdoer undergoes the punishment. It is presumed that he gets purified, and therefore, he once again becomes an accepted member of the society.

1.8 THEORY OF COMPENSATION

The main object of this theory is not only to prevent further crimes but it also to compensate the victim of the crime that suffers a lot. The logic is that the motive of criminality is greed and if the offender is made to return the deceitful benefits by acting the crime, the intention of punishment would dry up.

In certain cases, the Supreme Court has awarded compensation to persons who have suffered at the hands of government servants. In *Bhim Singh v. State of Jammu and Kashmir*, Bhim Singh was a member of the Legislative Assembly. He was arrested while on his way to attend a meeting of the Assembly. The result was that he was deprived of his Constitutional right to attend the Assembly session. The Supreme Court awarded a sum of Rs.50,000 as compensation and ordered the same to be paid within two months.

In *Kara v. State NCT of Delhi*, the Delhi High Court while hearing an appeal to determine compensation amount mentioned under Section 357 of the Code of Criminal Procedure issued certain directions to the trial Court to take necessary steps to implement the order relating to compensation.

1.9 CONCLUSION

It can be concluded that the Administration of Criminal Justice System is based on the principles of fairness, transparency and human rights. But these principles underlying criminal law, criminal justice system in India has failed in attaining of these objectives in reality. The object of criminal justice is to punish the offender. A number of theories have been given from the ancient period for concerning the very object of punishment. The view of the other class of theories is that the purpose of punishment is retribution. There are many theories of punishment i.e., preventive theory, deterrent theory, expiatory, reformatory theory, retributive theory, and theory of compensation.

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Social Inclusion Strategies of Internal Migrant Workers in Indian Tea Plantation Sector

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ABSTRACT

Social inclusion is defined as the series of positive initiatives that are endured with the aim of achieving equality of goods and services, that enables individuals to participate in a society as well as which encourages awareness irrespective of social and cultural background and discourages discriminations prevailing in the society. The objective of this research is to analyse social inclusion strategies which are framed for internal migrant workers. A structured questionnaire was circulated among 185 migrant workers of tea plantations in Munnar, Kerala. The analysis indicates that health care and legal protection strategies play an important role in the effective inclusion of migrant workers. It is inferred that age and educational qualification has a role to play in inclusion of migrant workers. Findings of the research concludes that health care policies, working hours, etc provided by the organization plays a crucial role in the life of migrant workers.

Keywords: Internal migrant workers, Indian Tea plantation, Social Inclusion.

I. INTRODUCTION

Indian Tea Plantation industry is the oldest and a significant contributor to the nation's economic development by offering employment opportunities for skilled, unskilled and semi-skilled labourers. The tea plantation industry down south, especially Kerala is witnessing a huge number of internal migrants from parts of Jharkhand and Assam. Internal migrants are those people who goes to other places within the same national boundaries. In a country like India, internal migrants constitute around 1/3rd of India's urban population and the prominent reason for urban development. It is well known that internal migrant workers contribute about 10 per cent to the national GDP (Deshingkar, P and Akter, S. 2009). Internal migrants are an integral part of India's development and the contribution towards the rising GDP cannot be achieved without them. Though the contribution made by migrant workers in the growth of a nation is remarkable yet they are neglected and most of the time they are regarded as "outsiders" by the host society due to which the internal migrants face exclusion and xenophobia (Bhagat, R.B. 2011).

Social inclusion and proper recognition have also been an obstacle which creates a major downfall in the economic well-being and eventually degrades the morale of host society (Bhagat, R.B.2011). A path which leads to sustainable growth is based on the better inclusion of migrant workers and on factors like cultural diversity, social cohesion and human rights. If a nation wants better economic prosperity and diversity, it should focus on having an inclusive spacing with reasonable housing, health, education services, improved infrastructure and sanitation. The quality of migrant's life will become better only when they have easy access to government services and welfare programmes (Kundu, A. 2012). Social inclusion is gaining momentum all over the world and policy makers as well as government should acknowledge that social inclusion is very much essential for the sustainability and development of the country (Beland, D 2007). Inclusion of migrant workers is vital in the entire migration process, though it always remains as a controversial issue. In the present economic scenario which is becoming more and more globalized, there is a huge transformation noticed over the past 50 years in migrant growth and diversification on various grounds such as the origin of the migrant, socio-economic background and more diversified population based on various grounds such as social, cultural, ethnic and religious diversity is being seen around in receiving societies as a result of migration (World Migration Report, 2020). The present research focuses on the social inclusion strategies undertaken by the tea plantations in Munnar, Kerala.

II. REVIEW OF LITERATURE

The literature for this research is extensively concentrated on the previous research conducted around the world concentrating on the various policies and strategies focusing social inclusion. A large number of studies are being carried out in the field of social inclusion and the scope of inclusion has also been identified in many researches. Social inclusion plays a significant part in the development of a nation and the policies or strategies framed in this area are discussed.

i. HEALTH CARE

Health was believed to be a benefactor in creating happiness and vitality among the migrant workers. When there is an exclusive focus on health and the concept of health care among the migrant population through, it ensured that there was equal opportunity in getting the benefits (Ottawa Charter, WHO.1986). Over the period when there were better health care facilities, there was effective utilization of resources in order to enable all the people to attain their health to the maximum potential. Health has a pivotal role in inclusion of the migrant workforce. The development of policies which recognized the impartial access to health service along with reduced social cost which would eventually improve the social cohesion and protect public health. Training of health-staffs can be ensured to provide culturally – sensitive support to the migrant inhabitants. A platform which can be organized to address their obstacles relating to the xenophobia (racial intolerance) and discrimination against these migrants towards proper access to health and empowerment for self-help. Service initiatives needs to be formulated that provides psycho-social support of migrants where they could address their physical and mental challenges, which they experience throughout their entire migration cycle. The stakeholders responsible for ensuring the health of migrant workers are employers and governmental agencies in destination countries who benefits from labour migration. The key players who are accountable to balance the stakeholder's interest that includes employers, employees, and the general public are government regulators such as the ministry of Manpower (Global Compact Thematic paper, 2015).

When it is seen as a wide spectrum, the life of migrants can be initiated towards a better living with health as a main component which gives them better opportunity in bringing them along with the society to which they migrate. The World Economic Forum has evaluated various schemes and programmes such as “migrant-sensitive health services” which takes an effort to improve the health conditions of these workers. Another method is the engagement of migrants on health policy issues and evaluating how the universal health coverage can be made into an inclusive effort and effective strategy for the migrants. Connecting the strength through the acceptance is the foremost and imperative issue in social inclusion. When migrant workers are accepted and recognized in their host society with the aid of the key influencers such as finance, health, etc., then it becomes a vibrant ingredient for their existence, well-being, and identity as well as to give in their maximum potential towards their organization also.

ii. SOCIAL SECURITY

An initiative to stabilize the working conditions of the migrant workforce, inclusive legislation known by the name “Unorganized Workers social Security Act, 2008” was passed by the parliament, but it incorporated a diluted and fragmented social security approach to unorganized migrant workers. The labour laws in India, including those which are applicable to the migrants are very complex and very often they are seen with a cross-purpose. Even though there are various regulations present to stabilize the life of migrant workers, they always face problems of social security. The enrolment process of migrants in the host society either by creating a bank account or registering and enrolling them in identification provisions such as the Aadhar Programmes (in India) will help them to establish their identity and will eventually create a sense of belongingness which ultimately creates a way for a better living (Deshingkar, P.2013). Identity and its documentation are considered to be the biggest challenges which the migrants face. Proving their identity in the host place is the core issue and this can persist even after several decades. Identity documents such as birth certificate, which is the primary proof of citizenship in a country like India and this particular document serves as the vital ingredient for acquiring other documents like ration card and election card. The basic problem of establishing an identity can result in a loss of access to entitlements and social services which may hinder the migrant's accessibility towards their rightful provisions such as subsidized food, fuel, etc. If this could be stabilized in the host area, the migrants may have a better living (Abbas, R and Varma, D.2014). The participation of migrants in the political life in the host society can emerge into two different forms. It is either voting in the local, national or regional elections, and even at times it can take the form of a candidate contesting for the election by joining an association with political parties (Huddleston, T.2017). Even though a sense of belongingness is created among the migrants through various process such as enrolment, studies reveal that systems which are created to financial stability in the form of opening a bank account in the host society and hassle-free remittances will help in achieving the inclusion (UNESCO, 2013). Migrants are usually seen residing in shanty shelters mostly erected out of tin and tarpaulin which does not provide a safe stay. Most of the migrants are slum-dwellers and the in 2011 around 68 million Indians were living in slums which does not provide a peaceful living. If proper housing facilities are provided to the migrant workers, the vulnerability of these people will reduce (Varma, R.A, 2014). China serves as a best example in providing decent shelters for their migrant workers. The employers and contractors need to focus on this particular aspect of providing shelter for the migrant (Srivastava, R. 2012b).

iii. FINANCIAL POLICY

Over the years, financial education is gaining wide momentum and empowering migrants about the financial education is another important phenomenon which will enhance the standard of living. In the present scenario, migrants have a greater role in reducing the poverty and they need to have tools, products and skills to make most of the income, yet they face financial exclusion and it is still prevalent across the globe. It has been found that around 59% of the migrants are financially excluded and this may lead to lack of self-confidence in the host society due to which they may mistrust financial institutions. Inhibiting financial education can be a great entrance to teach the migrants about managing their money in the host place and may even learn about the variety of financial products and services such as saving products and it schemes, electronic facilities, etc. As a result of the financial education provided to the migrants, their families to benefit and there would be increased inclusion (Atkinson, A. and F. Messy .2015).

When there is access to the labour market and financial inclusion through various means of collecting data on the incoming migrant flows which has mapping of skills, qualification and language proficiency, providing information and training services to the migrants and their family members in the initial stage itself so that they will be able to facilitate their financial inclusion. The strategies which focuses to promote labour market and the development of professional skills such as internships and trainings can be done (Global Compact Thematic Paper, 2015). Methods which adopt on-the-job training to migrant women as well as childcare in the long run will enable access to meaningful employment and will be a support for self-employment. There are around 164 million migrant workers worldwide in the year 2017 and the concept of labour market inclusion is a key policy area. Its importance has been increasingly emphasized in terms of migrant's economic contributions to both the receiving as well as the origin societies (ILO, 2018). Likewise, it is observed that there are varieties of dimensions being discussed ranging from access to employment and general or targeted support, to the protection of migrant workers (Huddleston, et al, 2015).

As seen from the previous literatures, the labour market inclusion has been gaining momentum and it is found that the labour market inclusion depends upon various socio-economic situations and the policies of each country. The migrant's demographic characteristics such as the age, gender, language skills, qualification and the circumstances of the migration process were also analysed. Even though financial inclusion and enrolment procedure does well for the migrant groups to an extent, they get more satisfied and secured only when the host society provides them with social welfare measures. The welfare measures play a crucial role as it is an important provision which is seen as an element of social bonding. This very bond creates secured income and commitment to involve in work which will obviously increase the overall production capability (Orozco, M. and M, Jewers. 2014). The welfare rights such as easy access to health, housing, education and other basic forms of social provisions will eventually boost the morale of the migrants and leads to better inclusion towards their host society (Azad, A. K. 2005).

iv. EDUCATION SUPPORT:

When it comes to the part of education, it ultimately creates a larger impact among the migrant workforce. Gone are those days where these people were ignorant and did not take or find any initiatives for educating their children as well as educating themselves with available sources. Many studies have revealed that education has a crucial role in changing the lives of migrant workforce which finally creates inclusion. Education to the migrant's children will definitely act as a leading criterion in creating inclusion among the migrants. Certain schemes by the government such as the 'Sarva Shiksha Abhiyan' ensures that the mobile population is not left out and deprived out of basic education (Deshingkar, P and Sandi, M.2012).

When there is unhindered access to quality education it can act as an indicator as well as a prerequisite for the inclusion of migrants in the host area. Quality education which and when provided to the children of migrants can leads to better inclusion. There is a chance for developmental activities taking place for skilled migrants, it can have greater impact in bringing out more innovation and development which results in higher education. The report has also analysed and depicted that there is a tremendous increase in the competitive advantage which is further characterized by intense and multidirectional flows of information, knowledge and investment (UNESCO, 2010)

When there is access to education is provided with the aid of tailored services which are based on the level of education, literacy level and mother tongue targeted skill training. When there is a development of an online training resources for certain areas such as language training and interpretation services. Initiatives in providing enhanced integration services to migrant's children for education, language and socio-development activities.

An increased number of schools which concentrates on the language of the migrant population (Global Thematic Paper, 2015)

The migrant population will be viewed more positively when they attain higher educational qualification and access to primary education for migrant's children is also a fundamental right. When migrant's children are provided with quality education in the host society, preferably which has the element of migrant's mother language, culture and so on, shows a positive sign and has a got greater impact to social inclusion. The migrant's educational outcomes are still lower than those of their native counterparts as well as the performance of migrant's education depends upon a larger number of factors such as language, skill, socio-economic and cultural backgrounds. It was then interpreted that education plays a crucial role in promoting tolerance among the migrants and paves a better path towards social inclusion (Filsu, S., E.C. Meroni and E. Vera-Toscano, 2016).

v. LEGAL PROTECTION:

India has been taking various initiatives to ensure that the internal migrant's do not face exclusion. In specific, it is working with an aim to provide an overview of existing and innovative practices to increase the inclusion strategies of internal migrants in the society (UNESCO, 2013). Legal protection of the migrants seems to be an indispensable element which leads to the concept of social inclusion. In many places, the migrants are facing a lot of hindrances in accessing and receiving the social protection schemes and public services. This impedes their ability to claim the basic socio-economic and political rights. The ideology of regionalism (sons of the soil) favours employing the local workforce rather than the migrants (UNICEF, 2012).

There are many legislations for the legal protection of the migrant workforce and the prominent ones which reported by UNICEF (2011) as part of the National Workshop on Migrants are given below. The Inter-state migrant workmen's act (1979) has been poorly implemented and requires more amendments. The next legislation which comes under this category is for the building workers (Building and other construction workers act, 1996). However, the notification of the act governed by the state government has been a very slow process. A principal flaw in the act is that, it treats construction workers as immobile and does not provide for locational or even inter-sectoral mobility.

Based on the literature, the social inclusion strategy is demonstrated (Figure 1)

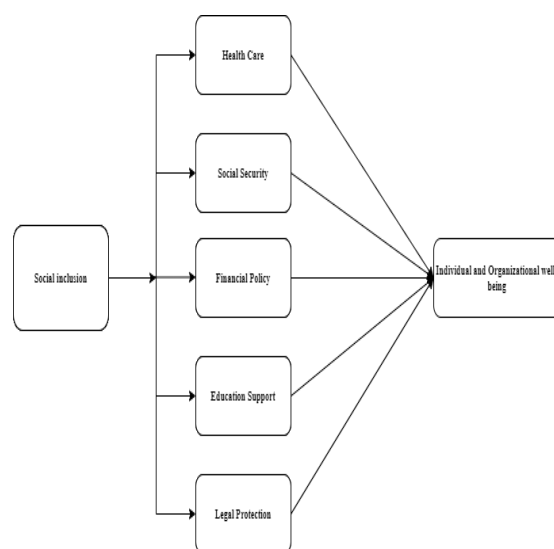


Figure 1: Social Inclusion Strategies

III. OBJECTIVES

- To identify the perception of migrant workers on various social inclusion factors like health care, social security, financial policy, education support and legal protection.
- To understand the differences in social inclusion factors based on different age groups and their educational qualification.

IV. METHODOLOGY

Data Collection: A questionnaire was framed for the present research that comprises 31 questions on healthcare, social protection, financial policy, education support and legal protection. The target population for this research are the migrant workers working in the tea plantations of the largest private limited company that

comprises of 6 divisions in Munnar, Kerala. Out of 369 migrant workers, 185 valid responses were received for the research (around a strike rate of 50%).

Table I: Sample Description Of The Respondents

S. No	Name of the Division	Total of migration	No of responses	Strike Rate
1	Factory	38	38	100
2	Benmore	60	47	78
3	Kadugumudi	76	36	47
4	Lower	75	26	35
5	Top	60	21	35
6	Upper	60	17	28
	Total	369	185	50

V. ANALYSIS AND DISCUSSION

Level of perception on various social inclusion factors:

To identify the most important social inclusion factor, mean analysis was carried out for the following factors namely, health care, social security, financial policy, education support and legal protection.

• SOCIAL INCLUSION STRATEGIES:

Table 2 gives the mean values of each social inclusion strategies and it is inferred that legal protection is having the highest mean value of 4.92 which implies that the migrant workers consider this factor as the most important factor migrants require, followed by financial policy, health care, education support and social security factors. Financial policy is considerably important for the migrant workers as the prominent reason for migration is financial growth and economic development. The health care policies and education also play a prominent role in the inclusion of migrant workers.

Table 2: Level of Perception- Social Inclusion Strategies

Social Inclusion Strategies	Mean
Health care	4.30
Social Security	3.28
Financial Policy	4.41
Education support	4.07
Legal protection	4.92

Further to understand each strategy, individual level mean analysis is done that explains how each strategy is imperative in the inclusion of migrant workers (Table 3 to 7).

• HEALTH CARE:

This inclusive strategy focuses on the health care initiatives provided by the organization and other health related issues taken care by the migrant themselves as well as the organization.

Table 3: Health Care

Inclusion through Health care	Mean
Special care in food	3.94
Walking everyday improves health	3.62
Not addicted to bad habits	3.99
Proper medical attention	5.00
Health care policies by Org	4.96
Overall mean	4.30

The mean value of health care inclusion strategy is found to be 4.30. Health care such as proper medical attention and health care policies provided by the organization are having high mean values whereas others are having comparatively less mean value. This indicates that the migrant workers are concerned with the health care initiatives provided by the company (Table 3).

• SOCIAL SECURITY

The social security inclusion strategies are those which are enacted for the well-being of the migrant workers with the aim of creating an awareness and affiliation to their host society.

Table 4: Social Security

Inclusion through social security	Mean
Social security schemes	2.42
Aadhar card	4.98
Bank account	4.97
Migrant acts	1.92
Insurance scheme	1.10
Accommodation	4.99
Policy for Social security	4.87
Food allowances through PDS	1.00
Overall mean	3.28

When comparing the social security inclusion strategies with the other strategies, it is having a mean value of 3.28. Food allowances is having the lowest mean value of 1.00 and the highest mean value is found in support to get Aadhar card (Table 4). It is inferred that migrants get more support from the company for taking Aadhar card and the food allowances through PDS is less. The social security initiatives is having a low mean value of 2.42 and the consciousness about the migrant laws (1.93) which shows that they are not aware about the rights and provisions available for their well-being. The internal migrant workers are not having any kind of investments in insurance schemes which indicates their ignorance level regarding the provisions available.

• **FINANCIAL POLICY**

The financial policy consists of factors such as opening of bank, importance of saving and indicates how financial policy improves the life of migrants.

Table 5: Financial Policy

Inclusion through financial policy	Mean
Opened bank account	5.00
Save money	4.95
Importance of saving	4.98
Sending money regularly	4.95
Investment Scheme	1.03
Overcome poverty	4.98
Extra wages	4.99
Overall mean	4.41

While comparing with legal protection inclusion strategies, financial policy is having a mean value of 4.41 and the second highest. The extra wages provided by the organization is having the highest mean value of 4.99 followed by other financial strategies (Table 5).

• **EDUCATION SUPPORT:**

The education support related the importance of education and how far educational support is being rendered by the organization where the migrant workers are employed.

Table 6: Education Support

Inclusion through Education Support	Mean
Importance of education	4.81
No interest to study	1.69
Education support	4.92
Education overcomes poverty	4.79
Overall mean	4.07

The education support inclusion strategies are having a mean value of 4.07 (Table 6). The interest to study was less among the migrant workers and the education support given by the company had high mean value.

• **LEGAL PROTECTION**

The legal protection inclusion strategies are related to the support provided by the organization for the migrant workers which includes working hours, safe work environment, etc.

Table 7: Legal Protection

Inclusion through legal protection	Mean
Working hours	5.00
Safe work place	5.00
Policy for protection	4.96
Grievances redressal	4.90
Handle workplace	4.95
Productivity level	4.91
Positive changes	4.97
CQ training	4.70
Overall mean	4.92

The highest mean value is found in legal protection. Company working hours and safe work place are having high mean value of 5.00 (Table 7) which indicates that the migrant workers are very much happy with the legal protection offered by the organization.

B. Difference In Social Inclusion Factors Based On Age:

To find the difference in the social inclusion factors based on age and educational qualification, one-way ANOVA was performed.

• **DIFFERENCE BASED ON AGE**

Age is one such factor which influences migration to happen and in order to find how the factors are benefiting the migrant workers after their migration. In order to find which age group people getting the paybacks of inclusion factors, analysis is carried out using one –way ANOVA (Table 8).

Table 8 Difference in Inclusion Strategies Across Age.

Social Inclusion strategies		Sum of Squares	df	Mean Square	F	Sig.
Health care	Between Groups	3.153	4	0.788	3.293	0.012
	Within Groups	43.096	180	0.239		
	Total	46.250	184			
Social security	Between Groups	0.164	4	0.041	0.272	0.896
	Within Groups	27.204	180	0.151		
	Total	27.368	184			
Financial	Between Groups	0.017	4	0.004	0.644	0.632
	Within Groups	1.210	180	0.007		
	Total	1.227	184			
Education support	Between Groups	1.805	4	0.451	2.437	0.049
	Within Groups	33.322	180	0.185		
	Total	35.126	184			
Legal protection	Between Groups	0.360	4	0.090	3.401	0.010
	Within Groups	4.761	180	0.026		
	Total	5.121	184			

While finding the difference between factors of social inclusion and age, the significant value for health care (0.012), education support (0.049) and legal protection (0.010) which indicates that there is a significant difference in the social inclusion factors and age. The significant value for other factors is above 0.05 which indicates that there is no difference in factors and age. Hence, there is a statistical difference found in health care, education and legal protection whereas there is no statistical difference found in the other 2 factors (Table 8).

A post-hoc analysis was carried to identify the perception level of different determinants across the age groups (Table 9 to 11).

Table 9 Difference in Health Care Across Different Age Groups.

Age when migrated	N	Subset for alpha = 0.05	
		1	2

>35	5	3.6400	
31 to 35	18		4.1556
21 to 25	112		4.3250
26 to 30	45		4.3422
<20	5		4.6000

From the post hoc test, it is inferred that migrant workers belonging to the age group of less than 20 have acknowledged that health care factors are important for social inclusion of migrant workers than that of other age groups. This is due to the fact that lower age group people depend and demand more support in terms of their personal health care like taking special care in their food habits, going for a walk to maintain their health and not getting addicted to habits like smoking and alcohol consumption.

Table 10 Difference in Education Support Across Different Age Groups

Age when migrated	N	Subset for alpha = 0.05
		1
>35	5	3.6000
31 to 35	18	3.9444
26 to 30	45	4.0222
<20	5	4.1000
21 to 25	112	4.1228

From the post hoc test, it is inferred that migrant workers belonging to the age group of 21 to 25 have acknowledged that education support plays an important role for effective social inclusion of migrant workers. Migrants of lower age feel that education can help to alleviate from poverty and lead a better life. This age group migrants feel that their children should be well educated and have a better life.

Table 11 Difference In Legal Protection Across Different Age Groups

Age when migrated	N	Subset for alpha = 0.05
		1
31 to 35	18	4.8125
26 to 30	45	4.8944
<20	5	4.9250
21 to 25	112	4.9487
>35	5	5.0000

From the post hoc test, it is inferred that migrant workers belonging to the age group of more than 35 years have acknowledged that legal protection is essential for effective social inclusion of migrant workers.

• **Difference based on educational qualification:**

Education is one of the most important criteria in today's competitive world. People move around to different places to gain better education and better job prospects. To find how educational qualification can be an influential factor towards migration, one –way ANOVA was performed.

Table 12 Difference In Social Inclusion Strategies And Educational Qualification

Social Inclusion strategies		Sum of Squares	df	Mean Square	F	Sig.
Health care	Between Groups	2.474	4.000	0.618	2.543	0.041
	Within Groups	43.776	180.000	0.243		
	Total	46.250	184.000			
Social security	Between Groups	0.151	4.000	0.038	0.249	0.910
	Within Groups	27.217	180.000	0.151		
	Total	27.368	184.000			
Financial	Between Groups	0.007	4.000	0.002	0.244	0.913
	Within Groups	1.221	180.000	0.007		

	Total	1.227	184.000			
Education support	Between Groups	1.057	4.000	0.264	1.396	0.237
	Within Groups	34.069	180.000	0.189		
	Total	35.126	184.000			
Legal Protection	Between Groups	0.363	4.000	0.091	3.436	0.010
	Within Groups	4.758	180.000	0.026		
	Total	5.121	184.000			

When finding the difference between social inclusion strategies and educational qualification, the significant value for health care factors is 0.041 as well as legal protection is 0.010 which indicates that there is a significant difference in social inclusion factors. The significant value for other factors is above 0.05 which indicates that there is no difference in inclusion factors and educational qualification. Hence, there is a statistical difference found in health care and legal protection factors whereas there is no statistical difference found in the other 2 factors (Table 12).

A post-hoc analysis was carried to identify the perception level of inclusion factors across the different level of educational qualification (Table 13 and Table 14).

Table 13: Health Care Across Educational Qualification

Educational qualification	N	Subset for alpha = 0.05	
		1	2
Uneducated	31	4.1484	
Below 10th std	72	4.2611	
10th std	33	4.3152	
12th std	46	4.4217	4.4217
UG degree	3		4.8667

From the post hoc test, it is inferred that migrant workers who are undergraduates have acknowledged that health care factors are crucial for effective social inclusion of migrant workers. This is because migrant who are undergraduates are aware about the health care available and provided by the organization and they depend on the support provided by the organization to take care of their personal well-being.

Table 14: Legal Protection Across Educational Qualification

Educational Qualification	N	Subset for alpha = 0.05
		1
Below 10th Std	72	4.8819
10th Std	33	4.8902
12th Std	46	4.9701
Uneducated	31	4.9758
UG Degree	3	5.0000

From the post hoc test, it is inferred that migrant workers who are undergraduates have accredited that legal protection initiatives are supportive for effective social inclusion of migrant workers. This is due to the fact that internal migrant workers who are undergraduates are well versed in the legal protections available to them and work accordingly further enhancing their attitude in an optimistic way.

VI. KEY FINDINGS OF THE RESEARCH

• Social Inclusion strategies:

- Legal Protection: It is inferred from the research that the migrant workers in tea plantations sector gives more importance to legal protection factors. They look for more support in terms of safe workplace, working hours, grievances redressal cell, policy for protection, etc are having more priorities.
- Financial Policy: The research findings indicate that migrant workers in the tea plantation sector are focused on financial benefits which is the most promising outcome of migration. Importance of opening a bank account in the host society and saving more money is concentrated by migrant workers.
- Health Care: Proper medical attention is having a mean value of 5.00 which proves that internal migrant workers expect medical attention to be offered by their organizations frequently. They are also keen about the health care policies provided by the organization and ensure that they are not addicted to any kind of bad habits.

- Education Support: Education support is having a mean value of 4.07 which infers that migrant workers expect support from their host society as well as their organization to provide education support for their children. Internal migrant workers believe that education helps to overcome poverty and they are well aware about the importance of education.
- Social Security: It is inferred from the research that the accommodation facilities provided by the organization to internal migrant workers is having the highest mean value of 4.99 which indicates that they are happy with what the organization has given them. Apart from accommodation, initiatives taken to open bank accounts and get Aadhar card in the host society is expected more by the internal migrant workers. Internal migrant workers are not aware of certain factors such as the social security schemes, migrant acts, etc requires more concentration to improve the life of migrant workers.
- Age is an important factor towards inclusion. Internal migrant workers in the age group of less than 20 years expect tremendous support through inclusion strategies when compared to migrant workers of other age groups.
- Education has an influencing effect in inclusion. Migrant workers who are undergraduates recognize that healthcare and legal protection are essential in inclusion of migrant workers. Internal migrant workers with under graduation feel that only when there is proper education, they are able to be aware about the health care and legal factors governing inclusion.

VII. MANAGERIAL IMPLICATIONS

Organizations should focus on the following to ensure effective inclusion of internal migrant workers:

- Legal Protection: Though internal migrant workers are content with the legal protection initiatives provided by the organization, effort should be taken to retain these initiatives for a long period of time.
- Financial Policy: To an extent financial policy satisfy the internal migrant workers but additional effort has to be taken by the organization to make sure that awareness regarding investment schemes are given to the migrants and they invest in such schemes.
- Health Care: Organizations and the host society can undertake initiatives to ensure internal migrant workers take special care in their food habits and healthy practices. Awareness programmes can be given to migrant workers which stimulates a healthy lifestyle.
- Education Support: Internal migrant workers are pleased with the efforts and initiatives provided by the organization which supports their children's education but there are migrant workers who does not possess any kind of interest in education. Either the organization or the host society has to discover the prominent reasons and identify why there is no interest to study, so that proper remedial measures can be taken to upgrade the life of internal migrant's education.
- Social Security: The organizations has to take extra effort in ensuring that the social security initiatives are helpful for the migrants. Awareness can be given by the organization regarding the social security schemes and the various migrant laws, so that internal migrant workers will be more vigilant and active. Insurance schemes can be introduced which ensures superfluous savings. Organization and host society can assist the internal migrant workers to get food allowances through public distribution system so that they will not be deprived of any benefits provided by the government.
- All the initiatives taken either by the organization or the host society should reach all the internal migrant workers in spite of their age. Health care and education support are acknowledged by the migrant workers belonging to the age group of less than 20 and age group of 21 to 25 whereas legal protection is acknowledged by the migrant workers belonging to the age group of more than 35 years old. Efforts are needed to make sure all the age group migrant workers get benefitted.
- Education plays a vital role and initiatives should be taken to ensure that all the internal migrant workers who are less educated and the ones who does not possess any education are also well aware about the rights. Programmes or campaigns can be organized to assist the migrant workers which enhances them in spite of their educational qualification.

VIII. CONCLUSION

For the purpose of this research various kinds of literature based on migration were used to identify the prominent reasons for migration. Several factors were identified as the reasons for migration and literatures based on many countries such as India, China, Russia, etc were covered for this research. The research further

documented the determinants or factors influencing internal migration among the migrant workers working at the tea plantations of Munnar, Kerala. Among the factors or determinants of internal migration, economic and financial factors have got the highest significance in influencing internal migration.

Migration under various circumstances has brought out positive gains on their livelihood and skill enhancement but in some cases, exploitation was witnessed. This research, thus, further leads towards to argue that migration among the lowest stratum of the society is followed by many hurdles which can be minimized by protecting the rights of the migrants through legal initiatives and enhancing the informal interactions of the migrant population.

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Achieving National Water Sustainability by Managing Agricultural Water Usage

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ABSTRACT

Potable water is fast becoming a very scarce resource in this world. In India this is becoming a major cause for concern unless a plan of action is put in place in a determined manner. Though a lot of effort is being put in various places like recycling plants, reverse osmosis plants, etc, the primary cause is still left unchallenged, and sometimes even overlooked. This paper focuses primarily on the major cause of water overconsumption, which happens to be agriculture and its uncontrolled use of water and suggests a few measures to conserve water, even in conventional agriculture, so that the national water availability could be managed in a sustainable manner

Keywords: Sustainability, rainwater harvesting, soil water holding capacity, bhungroo, water pollution, water recycling, blue gold, green water, heirloom varieties, water usage policy

World Water Consumption Scenario

Water is also known as blue gold and a resource that is often taken for granted. Even though two thirds of the surface of the earth is covered by water, a bulk of this happens to be non consumable sea water. Fresh water is a miniscule percentage of the total available water on this planet. As per the central water commission report (2020), ministry of Japshakti fresh water stands at around 37.5 million BCM while ocean waters stand at 1348 million BCM, which shows that Less than 3% of available water is fresh, all of which is not potable. Even in this fresh water a bulk of it is found in polar ice caps and deep underground aquifers deeper than 800m. Thus even in available fresh water, a very small portion is available for use.

Hinrichson and Tachio (2002) note that we are withdrawing water faster than we can recharge it. He also notes that Human water consumption has increased over 20 fold since 1950. This leads us to hypothesise that

H1: There has been a huge increase in water consumption over the fifty years suddenly while supply has remained more or less constant

He further points out that between 1990 and 1995 water consumption increased six fold. In less than 30 years more than 50 countries would face severe water scarcity. This raises alarm bells worldwide. The next world war could well be fought for water. Importantly he notes that the main culprit behind this is related to faulty irrigation and agriculture practices. Another interesting point noted here is that over 80% of the world's precipitation runoff happens to be in sparsely populated areas on the globe. They have mentioned four dimensions of the water management conundrum

1. Population dynamics
2. Water usage
3. Human outcomes
4. Environmental outcomes

Worldwide the water usage by agriculture stands at 68% (Hinrichson and Tachio, 2002) while only 23% is used by the industrial sector, and this includes the industrialised nations. So for the developing nations and the others, the water usage stands to be much higher for agriculture. The hydrological cycle is being thrown off gear due to a sudden shift in consumption patterns worldwide. Added to this, the pollution of water is further depleting the available fresh water and this too is mainly due to agrochemicals, namely fertilisers, pesticides and weedicides. Industrial effluents too are increasing, though they are far less than the agriculture related pollution of the water bodies.

The Indian Water Usage Status

Moving the discussion to India, the facts throw more light on water availability (CWC report, 2020)

Average annual Precipitation	4000 BCM
Avg. precipitation during Monsoon (Jun-Sept)	3000 BCM
Natural Runoff	1986.5 BCM
Estimated utilizable surface water resources	690 BCM
Total utilizable ground water resources	433 BCM

Total annual utilizable water resources

1123 BCM

The point to note is the huge runoff which stands at around 50% of received rainfall. And after accounting for all other wastes the total available water stands at around 22% of available fresh water. Much of available freshwater in the form of precipitation is lost. This represents a huge opportunity for water management efforts. Bhat (2014) notes that only 2.5% of earth's water is fresh water and 98.8% of this fresh water lies in polar ice caps and deep underground water. He further notes that only around 0.3% of the freshwater available is found in lakes, rivers and the atmosphere. A bulk of the precipitation returns to the sea. While it is impossible to use up all the precipitation, it still has left plenty of room for storage solutions. This leads us to the following hypothesis

H2: A bulk of the available fresh water in India is unutilised due to runoffs

H3: Precipitation is still a huge supply of available fresh water when compared to surface or underground water

Bhat, (2014) also points out that 78.5% of the utilised fresh water goes towards irrigation and the rest accounts for industry, drinking, energy and other uses. Clearly agriculture takes up a lion's share in the water consumption pie. And when projected to 2050, the share of irrigation falls a little to 68.8% and in the remainder of the pie the biggest growing sectors happen to be drinking water and energy sectors. Importantly industrial usage increases marginally from 5.2% to 6.8% only. This leads us to the following hypothesis

H4: To manage available fresh water, India needs to deal with irrigation water to make the biggest impact on water conservation

H5: Industrial consumption is very miniscule to affect water depletion, and should be considered only for their pollution impact on existing water bodies

Hinrichsen and Tacio (2002) also point out that in India a large area of land has been abandoned as it has become unfit to cultivate as an after effect of modern agricultural practices that have left it saline and uncultivable.

Karunthachalam, (2013) notes that India is faced with problems of reduced rainfall, reduced groundwater levels and increased pollution levels in freshwater available. These issues are creating a huge stress on both humans and animal populations across the nation. The root causes are pointed out to be negligence, poor management, wrong technologies used and lack of responsibility for the proper usage of available water resources. Datta, (2019) notes that the per capita water availability has come down from 5,177 cu m in 1951 to 1,545 cu m in 2019. And importantly the fact that only 8% of the rain water is saved during monsoons. That 92% of the rainwater runs off points to a lack of policy and effort on part of sustainability experts. Being a distributed downpour across the nation, the need of the hour cannot be met by means of mega projects to store this water. There is hardly any effort to store this water, either as surface water or underground water. As a result the groundwater levels have been falling every year and have reached alarming levels today. This leads us to propose the following hypothesis

H6: In the absence of a proper water management system, ground water will soon run out and water scarcity will be widespread

Jain, (2017) points out that freshwater resources are being rapidly depleted and polluted necessitating a series of steps to remedy the situation. He also goes on to point that both drought and floods are issues to be dealt with due to irregular precipitation over the last few years. Sen(2018) notes that over 80% of the consumed water is used for agriculture. He also notes that all governments are generously spending on irrigation projects while neglecting water conservation practices in agriculture. He also mentions that 80% of waste water in Israel is being used for irrigation. Added to this is the inefficiency of flood irrigation, which leads to the use of nine to ten times more water than other methods like drip irrigation. It is imperative to cut down on agricultural water usage. He proposes the following hypothesis

H7: India needs to change both recycling and farm water policy to ensure sustainability of water resources

H8: Efficient transportation and delivery mechanisms should be used as a matter of policy in India

Pandey et al (2020) point out that the water utilisation efficiency in India is very low and that better water management methods can lead to a greater efficiency of water utilisation. Taft, (2015) notes that 25% of global freshwater amounting to USD 14 billion is wasted annually. Additionally growing crops for fuel is a wasteful application of water. This could be extended to include most modern hybrid crops which need more water than

the old heirloom varieties and even though they might give higher yields, result in use of greater amounts of fertilisers and pesticides to get appropriate yields in the first place. This also results in the damage to the soil, leading to inability of the soil to hold moisture which is known in hydrology circles as green water. Most studies have focused on blue and grey water, but not green water, which is the life source of most plants.

The Suggested Interventions

Pani et al., (2021) propose artificial recharge of aquifers. Most rainwater harvesting techniques only deal with capturing precipitation and water flows and sending it underground, while having no clue on where this water goes. Instead a more purposeful method of recharging aquifers is suggested, based on scientific methods and principles. Managing agriculture input water too is mentioned. Suresh, (2020) suggests the use of Bhungroo approach to precisely spot dry zones under the ground and systematically harvest water to occupy these dry zones under the ground, mimicking the underground natural aquifers, but at a point much closer to the surface. This results in the water remaining fresh in nature with very little dissolved salts and being much easier to extract using low power water pumps, in addition to avoiding the evaporation loss in collected rainwater. Kwoyiga and Stefan, (2019) suggest a managed aquifer recharge process to ensure adequate ground water for future use. Five methods of recharging have been listed out

1. Well, shaft and borehole recharge
2. Spreading methods
3. Induced bank infiltration
4. In channel modifications
5. Runoff harvesting

The first three deal with infiltration, while the last two deal with interception of water.

Libohova, (2018) suggests that soil organic matter is vital for holding water that is known as green water or soil moisture. This implies that in soils having a high content of organic matter, the chances of flooding are much less and runoff loss is minimised. This also means that soil microbes are present in abundance and result in a good porous soil structure. Mao et al., (2019) has suggested amending soil with biochar to improve water holding capacity. Rehman et al., (2020) propose a manure based biochar amending to improve the water holding capacity of soils. This leads us to propose that

H8: Amending agricultural soil is the key to retaining soil moisture and hence reducing watering needs of the crops grown on it

On the whole this points to the fact that while modern agricultural practices have undoubtedly improved crop yields, it has neglected consumption of vital resources like water and the damage caused to soil organic matter and depleting existing water resources in a totally unsustainable manner. Htwe et al., (2021) have suggested better methods to grow water thirsty crops like rice which consume a bulk of the water used in agriculture. These models use only 10% of the water needed by conventional rice cultivation methods while using only 5% of the planting material and still yielding double the amount of rice when compared to conventional farming methods. This leads us to propose the following hypothesis

H9: Along with other water conservation methods, it is essential to develop better methods of rearing crops using alternative methods so that the water consumption for the same process is reduced. We need to challenge current practices of water consumption and usage in crop cultivation.

CONCLUSION

Water resource depletion is very much a reality that cannot be overlooked. It has to be dealt with in multiple dimensions, especially in relation to agricultural usage. The major ones being water policy framing, harvesting precipitation, recharging aquifers, improving soil structure and developing better methods of farming. This requires education farmers on a large scale and simultaneously researching better methods of growing crops with lower water needs and easier methods of storing rain water, given that India has a regular seasonal rainfall known as the monsoon.

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Retinal Vasculature Measures and Linked Diseases: A Review on Theories and Models

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ABSTRACT

Studies related to eye vasculature are gaining attention in recent years due to the non-invasiveness nature and the data enclosed in vascular structural imaging helps in the diagnosis of various systemic diseases like cardiovascular diseases, Diabetic Retinopathy (DR), hypertension and stroke. The structure of blood vessels in the retina provides ample scope to study the structural and functional characteristics of the circulatory system. This paper provides a structured review on the theory and model of the eye, systemic diseases and retinal imaging techniques, with a focus on predicting Cardiovascular Disease (CVD) risk factors from retinal images and the significance of Artificial Intelligence techniques in predicting diseases.

Keywords: Retina, Fundus image, Imaging techniques, cardiovascular disease, Artificial Intelligence, Deep learning

INTRODUCTION

Eye endows with the vision of sight to observe the world around us. The main significant parts of the eye are cornea, pupil, iris, cornea, retina, choroid and sclera. Retinal layers convert the light into neural signals which is processed in the visual cortex of the brain. Vascular changes in veins, arteries and capillaries within the eyes affect the circulatory system includes. Since retina allows direct non-invasive examination of the circulation, which will be useful in diagnosing both eye and systemic diseases. Ocular diseases like age related macular degeneration, glaucoma and systemic diseases include diabetic retinopathy, hypertension, and cardiovascular diseases can be predicted by examining the anatomical structures of retinal images [1].

Advancement in imaging techniques developed several medical imaging devices to capture the different parts of the eye and observe the pathological signs. Fundus photography and Optical coherence Tomography are widely used techniques to capture the retinal images [1]. Growth in Computer-Aided Diagnosis (CAD) has anticipated giving the ophthalmologists suggestions for diagnosing and treating the diseases. It not only guides the clinicians with objective opinion, but also suggests the progression of diseases for routine screening and early detection. With the development of Artificial Intelligence (AI) techniques, analyzing and examining the medical images provides higher accuracy of prediction of diseases. This paper reviews the research on retinal imaging techniques, the most prevalent diseases discover from retinal images, and the role of AI in diagnosing ocular diseases.

Clinical Background

Anatomy of the Eye

Figure 1 represents the structure of the eye. Eye structure consists of various anterior and posterior chambers. The outer layer contains transparent cornea, and the sclera. The cornea consists of tissues that help to focus the light. The eye color is determined by the iris that is also involved in controlling the pupil through its set of muscles. Pupil is termed as the opening in the middle of the iris part. The amount of light entering into the eye is manipulated through this opening. Retina is situated in the inner eye that consists of light sensitive cells. The lights that are reflected from an object fall on retina and are converted into electrical signals. These signals are sent to the brain for processing through the optic nerve. The optic nerve is a thick bundle of nerve fibers attached to the back of the eye [2]. It transmits visual information from the retina to the brain.

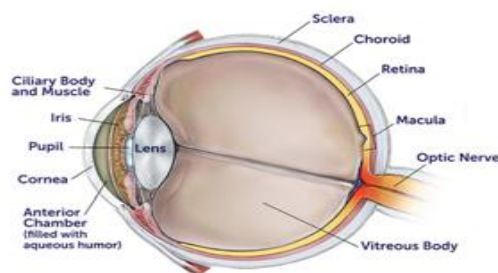


Fig 1. Cross sectional view of the Human Eye [1]

OPTIC DISK

The area where the optic nerve connects the brain to the retina and the size is about very few mm in diameter. This area is called the optic disc. It is the point through which major blood vessels enter the retina. The central point of the optical disc is called the optic cup. Severity of glaucoma can be assessed through the variation in this cup to disc ratio. However, the ratio and inclination of main vessels vary in eyes [2].

MACULA

The macula is the middle of the retina, which is responsible for sharp and fine vision. The macular area looks darker and has a diameter of approximately 5 mm. The center of the macula contains fovea which produces visual acuity with the help of cone cells. Age related macular degeneration severely impair the central vision which is diagnosed by fluoresce in angiography and optical coherence tomography [2]. Exudates in the macular region may be originated in diabetic retinopathy, and age-related macular degeneration

RETINA

The retina has layer of sensitive tissue, located near the optic nerve head. Photoreceptors associated process the incoming light and send the signals on to the brain. Retinal blood vessels include arteries, veins and its branches. The vessel carries oxygen and nutrients are called as arteries, where veins supply low oxygen blood to the heart. Color and caliber will distinguish the arteries and veins. The arteries appear in bright red color with narrow width. Veins have wider width, and dark red color. The ratio of the width of an artery to a vein is 2:3 for normal subject.

Retinal Imaging Modalities

Retinal imaging techniques have been developed rapidly to diagnose the retinal and systemic diseases. It acquires a detailed picture of the interior eye which shows the retina, blood vessels, and optic disk. Imaging techniques enable non-invasive evaluation of vascular structures. This helps the ophthalmologist to discover vision loss, distinct diseases and check the health of eyes. The review presents the widely used fundus imaging modality with a clinical application. Figure 2 shows the fundus photography.

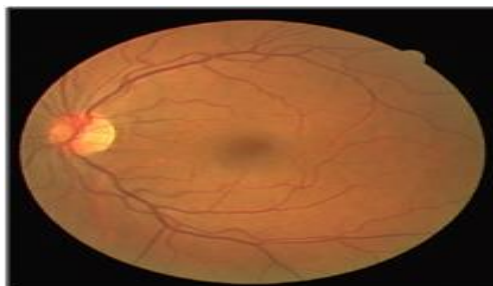


Fig 2. Fundus image [3]

Fundus photography is widely utilized in clinics for to monitor the severity of systemic diseases especially diabetic retinopathy, cardiovascular disease. Optical coherence tomography (OCT) is preferred for examining the choroidal vascular structure and macular edema. Fluorescence in angiography is used to monitor the patient's condition on a routine basis.

Fundus camera captures the structure of retina, blood vessels and optic disk in two-dimensional (2D) view. Field of view gives the angle range of the image for magnification. Traditionally used fundus cameras provide 30° to 45° field of view [1]. Imaging beyond 50° is called wide-field photography and it can be increased with the help of montage patterns. Figure 3 shows the montage image. German ophthalmologist in 1891 obtained the first photographic images of the retina, which shows the blood vessels [1]. Gullstrand developed the fundus camera, which is widely used to image the retina. The modality would be chosen based on its safety and cost, since fundus imaging had persisted as the primary method of retinal imaging.



Fig 3. Montage fundus image of the right eye of a patient [4]

The next modality is fluorescent angiography technique, where a fluorescent dye is injected into the blood stream. As dye passes through the blood vessels, photographs reveal the abnormality or pathological signs in the retina. OCT that stands for Optical Coherence Tomography generates 3D cross-sectional images of the retina. Since this is a non-invasive technique, it has found wide popularity. Using OCT, the retinal layers could be differentiated to examine the retinal diseases.

Fundus photography is used for mass screening and detection of various ocular and systemic conditions.

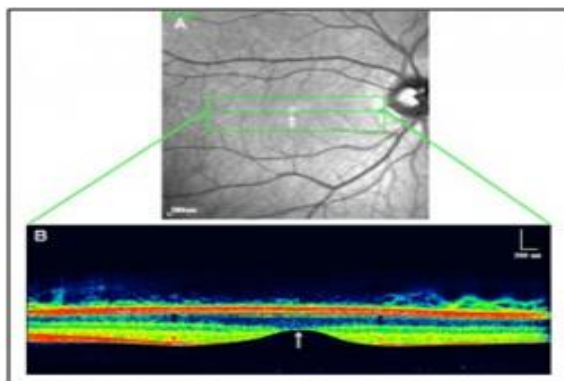


Fig 4. Fundus photo and Optical coherence tomography images [5]

Retinal and Systemic Diseases

Retinal vasculature shares the microcirculation with heart and brain; various diseases show their progression in the retina. This section gives an overview of the most dominant diseases that can be examined via retinal images. The diseases include age-related macular degeneration (AMD), glaucoma, diabetic retinopathy which are the common cause of blindness. Therefore, understanding their implications and severity stage provides earlier detection and treatment in clinical fields.

A. Diabetic Retinopathy

Diabetic retinopathy (DR) is a complication of diabetics which damages the retinal blood vessels. It occurs due to high blood sugar levels in subjects [5]. In early stages, vessel swelling, bleeding and bulging of capillaries occur in the retina which is categorized as non-proliferative diabetic retinopathy. It develops the abnormal lesions like Microaneurysms (MAs), hemorrhages, exudates and cotton wool spots [6]. MAs occur due to bulging of retinal capillaries and it appears as small, round dots in fundus images. The count of MAs has a relationship to examine the severity of DR. The diameter of MAs ranges from 10 μm to 100 μm . Exudates are yellowish white fatty lipids with irregular shape and size. Hemorrhages are larger than MAs which appear in dot and flame shape [6]. Figure 5 illustrates the retina with lesions. In advanced stage, abnormal blood vessels will grow on the retinal surface called as proliferative diabetic retinopathy. It leads to complication of vitreous hemorrhage, retinal detachment, blindness. Figure 5 shows the retina with abnormal lesions.

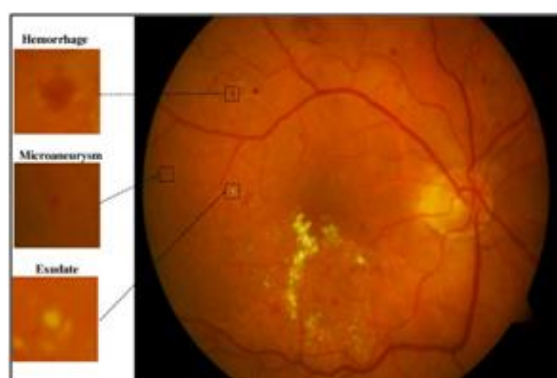


Fig 5. Retinal Fundus Image with abnormal lesions for DR [6]

B. Age-Related Macular Degeneration (Amd)

Age-related macular degeneration (AMD) leads to gradual damage to the macula, which is responsible for central vision. It occurs for people over the age of 60 years. Aging and family history are the significant risk factors for AMD. There will be no early-stage symptoms for AMD. The two types are dry AMD and wet AMD. In dry AMD, yellowish deposits accumulated in the macula. In Wet AMD, there will be growth of new blood vessel into the macula which leaks fluid into the retina. Figure 6 shows the effect of AMD.

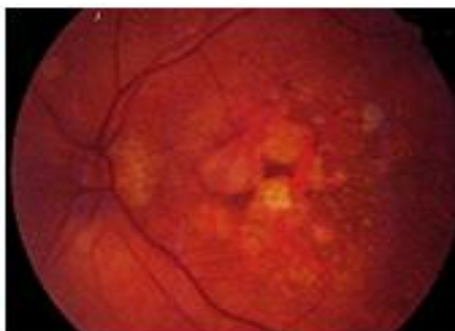


Fig 6. Age-related macular degeneration [7]

C. GLAUCOMA

Glaucoma is the cause of blindness, which damages the optic nerve and produces the loss in visual field [3]. Main risk factor of glaucoma is elevated intra ocular pressure (IOP) that damages the blood vessels and optic nerves as shown in Figure 7. Also optic disk is damaged which is replicated in varying optic disk cup ratio. Glaucoma is called as 'sneak thief of sight' because it damages the nerves without any early symptoms. Early detection and treatment will diminish the visual loss due to glaucoma.

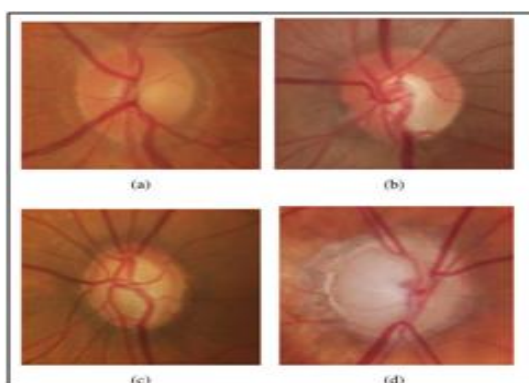


Fig 7. Retinal Fundus Images

(a) No Glaucoma (b) Early Glaucoma (c) Moderate Glaucoma and (d) Severe Glaucoma [3]

D. CATARACT

Protein in the eye prevents the lens to send clear images to the retina which forms a cloudy area in the lens. Cataract causes blurry vision, double vision, fading of colors. The cataracts develop slowly and become severe for adults resulting in visual disorders. The symptoms include diabetes, smoking, obesity, eye injury. Cataracts can be cured by surgery where artificial lens replace the damaged lens [8].

CARDIOVASCULAR DISEASE

Cardiovascular diseases remain the leading cause of mortality even though advances in prevention and diagnosis therapy available. It places a substantial burden on the economies of low- and middle-income countries. Many people are diagnosed late in the progression of disease and may die in younger age. The risk factors include high blood pressure, cholesterol, smoking, alcohol consumption, obesity which are modifiable and other case includes age, gender, and genetic history. Though many studies are available to predict CVD risk from risk factors, still there remains a need for early-stage prognosis and risk stratification.

The clinical test includes Coronary Computed Tomography, ECG to diagnose CVD, research studies show the interest in non-invasive mode of identifying the risk of CVD. The retina offers an opening to study in vivo the structure and pathology of the human circulation. Retinal vasculature can be observed non-invasively which provide the pathway to examine heart diseases, hypertension, stroke, diabetics. Microvascular alterations provide significant information to examine the systemic diseases. Cardiovascular diseases are characterized by changes in the vascular structure of retina. There have been numerous researches showing the relationship between vessel calibre changes and its development to heart diseases. Medical image analysis is stepping to transition into AI-powered medical professions. DL has been used to detect diabetic retinopathy, glaucoma, macular edema and age-related macular degeneration from retinal images. Also, DL is used for screening and monitoring major eye diseases for patients in primary care settings. DL in fundus imaging may be considered as

a screening tool to identify early risk factors of CVD. This paper outlines the initiative of predicting cardiovascular risk factors from retinal images.

The retinal circulation shares various features with the heart and cerebral microcirculation. As the eye's vasculature structure is easily examined from retinal images, which may indeed be a window to the heart. Changes in the microvasculature structure can be used for the diagnosis of cardiovascular diseases. Cardiovascular diseases include hypertension, coronary heart disease, diabetes, and obesity. Systemic conditions have association with vascular changes in the retina.

Small changes in the blood vessels within the eyes affect the vascular, circulatory and cerebral system. Vessel caliber and vascular morphology are the significant biomarkers derived from fundus photography.

Reduction in the width of the retinal arterioles to venules (AVR) is a predictor of diseases like hypertensive retinopathy, stroke and CVD occurrence. Specifically, in women narrower retinal arterioles and wider venules was associated with the extent of CAD. AVR is calculated as ratio of Central Retinal Artery Equivalent (CRAE) and Central Retinal Vein Equivalent (CRVE). From the vessel segmentation graph, ROI is fixed around OD. Six arterioles and venules having width greater than 30 μm are considered inside ROI. The CRAE and CRVE are determined by using the modified Knudston formula.

Widened venules have more effect in cardiovascular diagnosis. Arteriovenous nicking and occlusions are observed due to vascular damage [1]. Figure 8 shows the signs of CVD in retinal images. Diabetic retinopathy is caused by the damage to the retinal blood vessels. The major cause of this damage is uncontrolled rise of blood sugar levels. Among adult diabetic patients, heart disease and stroke are estimated to be the leading cause of death [9].

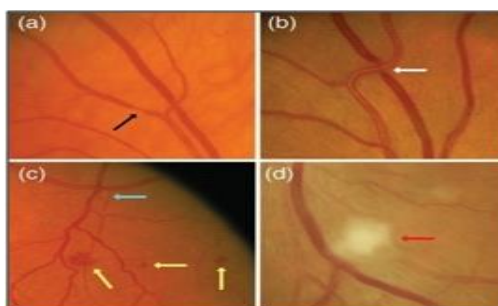


Fig 8. Vascular abnormalities

- a) Black arrow: arteriolar narrowing, b) White arrow: arterio-venous nicking, c) Yellow arrow: hemorrhage, Blue arrow: microaneurysm, d) Red arrow: cotton wool spot [9]



Fig.9. a) Normal image b) Image with tortuous blood vessels

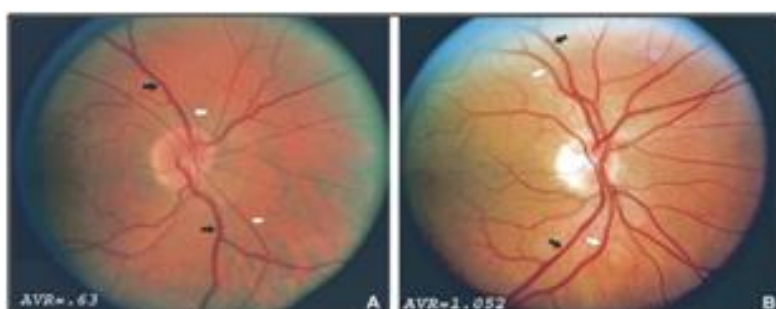


Fig 10. White arrow: arteriolar diameter; black arrow - venular diameter [10-11]

Retinal vascular morphological parameters such as branching angle, fractal dimension and vessel tortuosity are also used to measure the risk of CVD [12]. The typical vascular structure of retina is shown in Figure 11. Retinal vascular attributes are extracted from segmented retinal images. Branching patterns of the blood vessels vary from simple to complex. Fractal dimension of the images are proportional to the complexity of the branching patterns. The tortuosity of the blood vessel curvature is a function of the curvature along the path of the vessel, and the total length of the path of blood vessel. A smaller tortuosity value indicates the straightening of the vessel. From the branching pattern, daughter vessels are identified at each bifurcation of the vessel and the subsequent vessels. The first angle subtended at the division is termed as the branching angle. The average branching angle of the blood vessels including arterioles and venules are found through the arteriolar branching angle and venular branching angle.

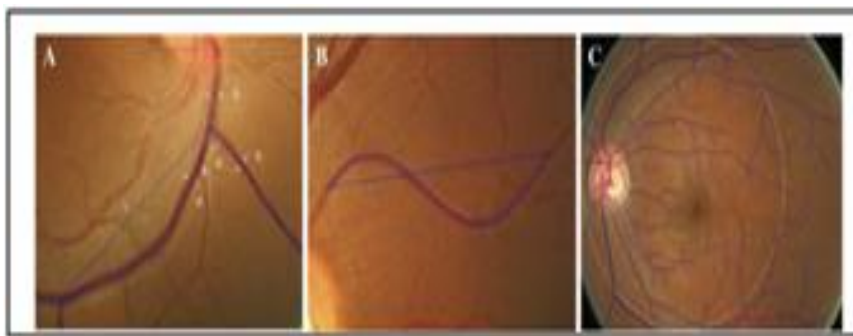


Fig. 11. a) Branching angle, b) Tortuosity c) Branching pattern [12]

VII. Clinical Applications of AI in Ophthalmology

Medical images contain millions of datasets that can be examined and identify the pattern using artificial intelligence (AI). The aim of machine learning and deep learning techniques are to detect and quantify the pathological features in retinal disease. AI algorithms have provided accurate performance in the detection of diabetic retinopathy and age-related macular degeneration [13]. This section discusses the summary of the AI methods for ophthalmic applications, limitations in clinical deployment and future research.

The machine learning algorithms are classified into supervised learning and unsupervised learning. In the researches that employed the machine learning algorithm, the steps involved the development stage, such as pre-processing, feature extraction, dimensionality reduction and classification/segmentation.

Pre-processing is performed in different approaches, image quality improvement, noise removal, contrast enhancement, illumination adjustment. It leads to improve the vessel region for further analysis. Some of the pre-processing methods identified from the survey, channel extraction, channel conversion, histogram equalization, gamma correction, filtering.

Supervised learning can be used for the following scenarios,

- Classification: To categorize the image based on disease type or stage.
- Segmentation: To extract the regions of interest based on anatomy or the lesions occurring in an image.
- Prediction: To predict the future outcomes or occurrence of disease.

AI based medical device is developed in April 2018 by the US to detect the severity of DR. The device is named as iDx-DR, where the image is automatically categorized into mild DR) or not. They tested the device with 900 diabetic patients and achieved an accuracy of 87.4% for positive result. This automated system provides the support for ophthalmologists and diagnose the severity stage of diseases.

AI techniques are developed for the diagnosis of AMD. Deep learning algorithms are used to detect AMD with a sensitivity of 93% and specificity of 89% for the dataset of 72,610 fundus images [14]. OCT has the potential to examine signs of AMD that are not observable on fundus image. OCT based AI system was modeled using 3265 images and validated in 367 individuals with sensitivity and specificity of 93% [15]. In clinical settings, fundus photographs have been shown to be useful in diagnosing AMD at earlier stages. Integrated models are also developed to combine the OCT images and visual field data [16]. It provides an accuracy of 82% (only OCT), 84% (only visual field) and 87% (both).

Many systemic diseases like hypertension, atherosclerosis and obesity are diagnosed from retinal images using Artificial Intelligence (AI) techniques. Poplin et al. established a model with dataset having fundus images of 2,84,335 for predicting cardiovascular risk factors. Features like age, sex, smoking habit, blood pressure were

identified with high accuracy [17]. There are some studies which demonstrate the effect of systemic diseases on age and sex. ResNet 152 architecture is developed and trained for age and sex prediction without any pathological diseases. The trained model was tested in four datasets which contains images from normal, hypertension, diabetes, and smoking participants. From the study, we identified that vascular conditions and ageing process have different effects in retinal image. CNN architecture is trained with retinal database obtained from Diabetic Retinopathy screening programme. It consists of 5 convolutional and 3 fully connected layers. The objective of the model is to predict the smoking status. The images were contrast enhanced or skeletonized. The contrast enhanced model outperforms skeletonized with an accuracy of 88.8%. Also, research suggests the alterations in the architecture of the vasculature alone are not adequately predictive markers for the accurate detection of the smoking status of a cohort with diabetes. Automated algorithms will provide the support to diagnose the diseases from retinal images.

VII. CONCLUSION

Examination of the retinal vasculature has been identified as a non-invasive and cost-effective means of identifying eye and systemic diseases like diabetic retinopathy, hypertension, glaucoma, macular degeneration, cardiovascular risks. Abnormalities in retinal arteries and veins, formation of lesions are the significant biomarkers for the detection of diseases. Fundus photography and optical coherence tomography are the widely used imaging techniques to capture the image of eye for the diagnosis of above diseases. Studies have emphasized the importance of Artificial Intelligence techniques in diagnosing the diseases, which provides proactive medical care for patients and reduces the manual work of clinicians.

The research work can be extended to employ Artificial Intelligence techniques to predict the risk of CVD based on features extracted through image processing techniques from fundus camera images. Even though contemporary researches claim to have predicted CVD risk, they are majorly based on images acquired from databases and/or data collected in developed countries and have their own limitations. Hence, there is a need to create a robust methodology within Indian context for prediction of CVD risk using retinal images. Enhanced deep learning algorithms can also be utilized to examine the retinal vasculature and detecting CVD risk.

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A Review on Urinary Sediment Particles and Related Kidney Diseases

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ABSTRACT

Kidney and urinary tract diseases are identified by detecting various particles present in the urine sediment. The different urine sediment particles are Red Blood Cells, White Blood Cells, Epithelial Cells, Crystals, fungi, and Casts. Microscopic examination of urine sediments reveals the presence of these particles. Traditionally urine sediment examination is performed by using centrifuge urine samples. Machine learning and deep learning methods utilize images of urine sediments to perform automated urine sediment microscopy. The results from this analysis determine various types of urine particles present in the sample. Thus it aids in the diagnosis of different kidney and urinary tract diseases such as haematuria, kidney stones, and urinary tract infections.

Keywords: RBC, WBC, Epithelial cells, UTI, Haematuria

1. INTRODUCTION

Nowadays kidney diseases are common and are affected by millions of people worldwide. Kidney and urinary tract related problems causes' death of 830000 people every year. 18467000 people having disability-adjusted life due to renal diseases [1]. Kidney stones are commonly found to be in industrial countries which affect 1 in every 1000 people annually [2].

Kidney diseases can be diagnosed by the examination of urine sediment particles by identifying the presence of various particles in the urine sediment images namely, RBC, WBC, crystals, casts, fungi, epithelial cells, etc. Urine sediments can be analysed by two types of examinations namely, physical method and chemical method. Microscopic analysis of urine sediments are carried out when these two methods detects any unusual result. The microscopic method for urinalysis based on urine sediment images detects the presence of different types of particles present in the corresponding urine sample. The presence of such particles indicates various kidney-related diseases. This paper describes the particles found in urine sediments and diseases caused by the presence of various urine particles.

2. Urine Sediment Particles

Urine sediments usually consists of various particles such as erythrocytes (RBC), leukocytes (WBC), Mycetes, Crystals, Casts, Fungi, bacteria and epithelial cells. Urinalysis examines the presence of urinary particles for diagnosing various kidney diseases.

2.1 RBC

A Red Blood Cells (RBC) also called Erythrocytes commonly found in blood cells. Erythrocytes are usually biconcave disc-shaped cells and their major product is hemoglobin. RBCs are the carriers of oxygen and carbon dioxide in the human body [3]. An Erythrocyte has an average diameter of 8 micrometers. Oxygen movement from pulmonary capillaries to tissue capillaries to exchange carbon dioxide is carried out by erythrocytes.

There are mainly two types of RBC found in urine sediments. An RBC having a smooth surface with a round or biconcave-shaped structure is called isomorphic RBC and an RBC having a contour with irregularity in their structure are called dysmorphic RBC [4]. The two types of RBCs are shown in Figure 1. Dysmorphic cells having a wide morphological spectrum includes acanthocytes [5]. Distortion in the cytoskeleton of RBC is the main reason for the dimorphism in RBCs. The distortion is caused due to the passage of red cells through the renal tubules and through the glomerular membrane gaps.

Other than these two types of RBCs, various types of RBCs that are present in the urine of haematuria patients are sickle cells, anisocytes, and poikilocytes and their presence in the urine is very rare. Sickle cells were observed in patients having sickle cell disease or sickle cell traits. There is a mild chance for occurrence of Haematuria in the urine of the patients with sickle cell trait and is 3-4% [3]. An RBC with varied cell size is called anisocytes and an RBC with varied cell shape is called poikilocytes.

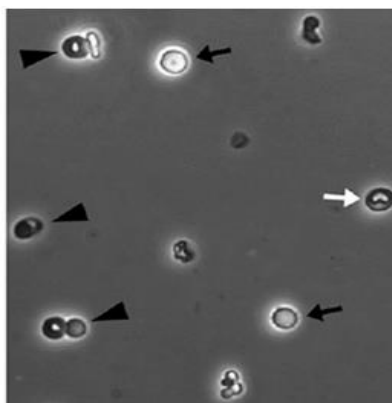


Fig 1: Black arrows represents Isomorphous cells, white arrows represent dysmorphic cells, and arrow heads represents acanthocyte [2]

2.2 WBC

White Blood Cells (WBC) also called leukocytes are a type of blood cell in the human body usually found in blood and lymph. Structure WBC is shown in figure 2. WBCs are part of the immune system in the body [6]. There are mainly five types of leukocytes namely neutrophils, eosinophils, basophils, lymphocytes, and monocytes [7].



Fig 2: White blood cells.

Half of the WBC population is occupied by neutrophils. Neutrophils are the primary cells for the immune system that respond to a bacteria or virus entered into the body. Once released from bone marrow neutrophils die after 8 hours. But 100 billion neutrophils are produced every day [8]. Basophils occupy only 1% of the total WBC concentration. They mount a nonspecific immune response to pathogens. Basophils release histamine and some other chemicals by stimulation [9]. Lymphocytes are mainly two types and they are B cells and T cells. T cells directly kill foreign particles in the body and B cells are responsible for humoral immunity. B cells produce antibodies that remember an infection when the body is affected by that particular infection a second time [10]. Monocytes occur around 5% to 12% of WBC and their function is to clean up the dead cells by migrating into tissues [11]. Eosinophils cover 5% of the white WBC in the bloodstream and are present in high concentration in the digestive tract [12].

Leukocytes travel through different organs of the body to monitor problematic germs or infections in the various organs of the body. Normally a few levels of leukocytes are found in urine. The presence of a high concentration of leukocytes in the urine may indicate various infections in the kidney or urinary tract. Diseases identified by the presence of a high number of WBC in urine are bladder infections, kidney stones, kidney infections, urinary system blockage, and holding in urine. Presence of leukocytes in urine cause different symptoms that include shivering and fever, lower back and side pain, acute pelvic pain, nausea or vomiting and long term pelvic pain [13].

2.3 CRYSTALS

Urine may contain many chemical particles. Sometimes these chemical particles form a solid salt-like structure called crystals. Normally crystals can be present in the urine sediment of healthy persons caused by the slight excess of protein or vitamin C. Many of the urine crystals are not harmful. However, urine crystals are the indicators of various kidney diseases. The presence of crystals in the urine may cause fever, presence of blood cells in urine and it may lead to jaundice and fatigue. The different categories of crystals commonly found in

urine are calcium carbonate crystal (figure3), uric acid and hippuric acid, cysteine (figure 4), calcium oxalate crystal etc. [14].

Uric acid crystals may be barrel, plate-like, or diamond-shaped structures and are orange-brown or yellow in color. The uric acid deposition in the urine may due to the Protein-rich diet or it may be the result of chemotherapy or kidney stones. Taking enough amount of water and keeps hydrated is the best way to treat the crystals. Calcium oxalate crystals are colorless and having dumbbell or envelope-shaped it is heavily associated with kidney stones. Kidney stones can be formed by the presence of a high number of oxalate. Hippuric acid may rarely see in urine. It may be yellow-brown or clear and have needle-like prisms or plate-like shapes. It also appears in the urine of healthy individuals. Calcium carbonate crystals resemble round discs with smooth surfaces and appear in the urine as a light brown color. Cysteine causes crystal formation and kidney stones. Kidney stones produced by cysteine are larger than the kidney stones produced by the other types of crystals. Cysteine crystal formation is a very rare condition and it may be due to genetic problems [15].

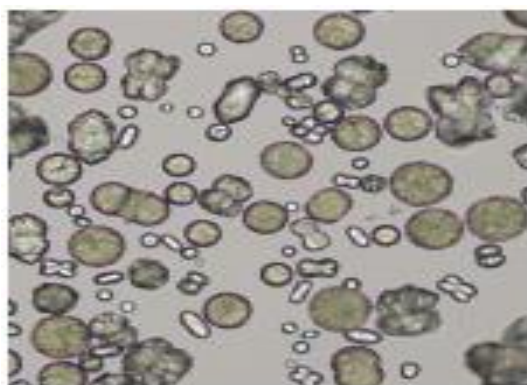


Figure 3: Calcium carbonate crystals



Figure 4: Cysteine

2.4 CASTS

Casts are tiny tube-shaped particles in urine sediment which is formed by the crystallisation of protein in the kidney nephrons [16]. Casts represent the biopsy of the kidney. The presence of casts in the urine indicates the existence of kidney diseases. Based on the morphological features casts are classified as Hyaline casts, RBC casts, WBC casts, Bacterial casts, epithelial casts, granular casts, waxy casts, fatty casts, etc. [16]. The hyaline cast is secreted by renal tubular cells which are produced by the solidification of Tamm-Horsfall micro-protein. Hyaline casts are found in normal individuals and are considered to be non-specific. The presence of hyaline cast causes decreased urine flow due to exercise, vomiting, or fever. However, the high amount of hyaline casts may indicate damage to the kidney due to the reduction of blood flow to the kidneys [17]. In healthy individuals, a small amount of hyaline cast is found between 0 -2 casts per low power field. Hyaline casts cause increased acidity in urine and highly concentrated urine. The cellular cast is composed of either RBC, WBC, or epithelial cells. It may be difficult to identify the type of cell which produces cellular cast. The presence of RBC in the cast may be due to the leakage of RBCs through the glomerular membrane. WBC casts are composed of neutrophils in WBC and it may indicate the infection to the kidney cells. The presence of WBC casts or RBC-WBC mixed casts causes acute glomerulonephritis.

Epithelial casts are formed by the renal epithelial cells and it is a serious condition that causes viral disease and exposure to toxic substances such as mercury, various drugs, etc. Epithelial cast as shown in figure 5.



Figure 5: Epithelial casts

2.5 Epithelial Cells

Epithelial cells are normally found at the surface of the body such as skin, blood vessels, urinary tract, etc. presence of a large number of epithelial cells indicates the infection to the kidneys or kidney diseases. Based on the shape and size epithelial cells are categorized as renal tubular epithelial cells, squamous epithelial cells, and transitional epithelial cells as shown in Figure 6, Figure 7, and Figure 8 respectively [18]. Renal tubular epithelial cells also called renal cells which are the common epithelial cells found in the urine of most healthy individuals. An increased number of renal epithelial cells might be due to kidney disorders. Squamous epithelial cells are the biggest cells commonly found in female urine and it has come from the vagina and urethra. Transitional epithelial cells are common in older adults and found in the male urethra and renal pelvis.

The normal count of urine epithelial cells in humans are 1-5 cells per high power field. The moderate number above the normal count indicates yeast, urinary tract infection (UTI), and kidney or liver diseases. The presence of more than 15 renal cells indicates the improper functioning of the kidney. The occurrence of squamous epithelial cells in the urine sample causes the contamination of the urine.

The occurrence of large number of epithelial cells in the urine indicates that the patient is at higher risk condition. The higher count of epithelial cells might be due to kidney stones, diabetes, family history of chronic kidney disease (CKD), or enlarged prostate.

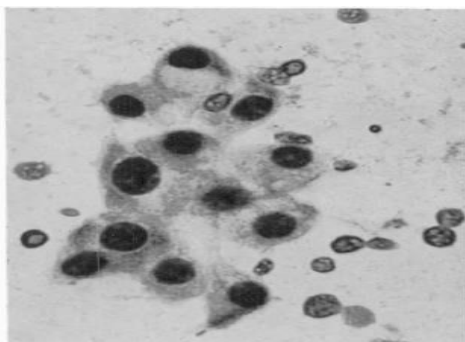


Figure 6: renal epithelial cells in urine sample

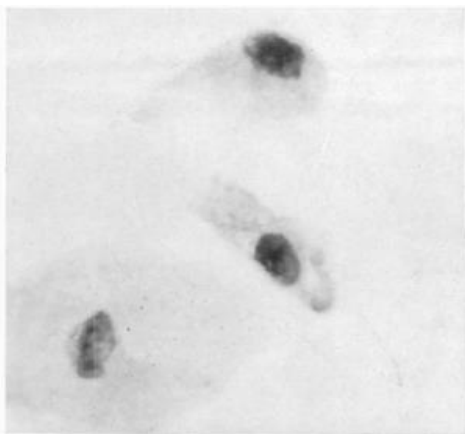


Figure 7: Squamous epithelial cell

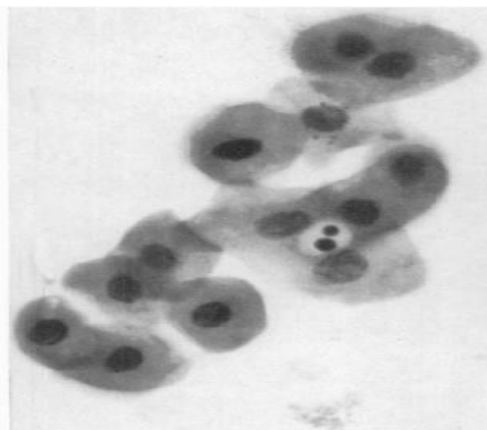


Figure 8: Transitional epithelial cell

2.6 FUNGI

Urinary tract infection due to fungi is caused by the candida species called candiduria. Candida fungi are the most common pathogenic fungi in the urinary tract of both males and females. Fungal infections in the urine primarily affect the bladder and kidneys. High-risk patients with candiduria may lead to cystitis by the presence of bladder inflammation.

3. CONCLUSION

This literature described various types of particles present in urine sediment samples and various types of diseases diagnosed by the presence of these particles. The urinary particles described in this paper are erythrocytes, leukocytes, Epithelial Cells, Crystals, fungi, and Casts. The presence of urinary particles in the urine sample may indicate the various types of kidney diseases such as urinary tract infections, Haematuria, kidney stones, bladder cancer, and chronic kidney diseases. Urine sediment particles can be detected by using manual microscopic examination and by automated examination by using machine learning and deep learning framework. Manual microscopic examination is a time-consuming and labour-intensive process. Automated urine sediment microscopy can be performed by using urine microscopic images.

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On CFD Simulation to Optimize Internal Coolant Channel Design for Reducing Tool Wear in Tap Tool and its Validation

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ABSTRACT

The tapping is one of the important manufacturing processes because of its application on the components involved in high precision fastening device and power transmission system. Tapping process being performed as the final manufacturing process, any error in this process leads to losses involving cost, time and man power from the preceding stages. In this paper, internal coolant flow channel of the tap tool is modified and analyzed using CFD. Initially, a conventional internal coolant channel design was analyzed using CFD, the results showed the cutting edges are not properly supplied with coolant fluid. Hence, the existing design was replaced with inclined hole positioned along the center line of flute. To validate the CFD simulation tap tool with modified internal coolant channel was fabricated. Then the tool wear of conventional tap with unmodified and modified coolant channel design were compared using machine vision and tool maker's microscope. This comparison of tool wear values proved less tool wear and increase in tool performance for the modified internal coolant channel.

Keywords: Tap tool, internal coolant channel, CFD Simulation, Tool wear.

1 INTRODUCTION

Tapping is an operation similar to threading, in tapping the threads are made on the internal side of the component. The tapping operation has its own importance in the field of manufacturing industry and it is considered has the one of the finishing operation for a product. The tapping plays an important role in working of the product. It helps to join two mating components in an assembly. The major applications are seen in re-working automotive components, industrial or fabricator shops.

Tapping is usually done with the help of a tool called Tap. A tap is used to make (cut) new threads or clean out existing threads in a screw mechanism. Though this tool is most commonly used by machinists and engineers, automotive technicians may also have a tapping set in their toolbox. There are dozens of situations where having a solid knowledge and appreciation for the science behind tapping threads into a piece of machinery can prevent hours of troublesome work and hundreds of dollars in replacement parts. For a complete tapping operation, three different types of tap tools are used. The first tool is called as Taper tool followed by plug tool and then bottoming tap. The taper tap can be identified by the visible and pronounced tapering of the cutting edges. This provides a very gradual and less aggressive cutting action. The distinct feature of a taper tap is the 8 to 10 threads that taper from the tip to the full cutting force diameter. A taper tap is most often used as a starter tap for difficult blind holes. The gentle taper of the cutting edge is the most forgiving when tapping by hand and allows for a straight hole to be cut in especially hard materials. A plug tap has a less pronounced taper to the cutting edges. This gives the plug tap a gradual cutting action that is less aggressive than that of the bottoming tap but more aggressive than a taper tap. Typically, the plug tap will have 3 to 5 tapered threads before the full cutting diameter is engaged. Plug taps are great when used with through-holes, as they are almost as easy as taper taps to start, but also offer a more complete set of threads. The third style is a bottoming tap. Bottoming taps have 1 to 2 tapered cutting edges before the full cutting force is engaged. Though this tap is extremely hard to start threads with, it is capable of cutting threads all of the way to the bottom of a blind hole. Bottoming taps are best used after a taper or plug tap has been used to cut the initial thread.

The tap tool can be used in hand operated machines where three taps have to be used simultaneously in an order to make a successful thread. The tool can also be used in drilling machines like radial, bench and pillar type machines. It can also be used in NC based machines like vertical machining centre, horizontal machining centre. The tool breakage during tapping operation due to excessive torque can lead to heavy losses in production. When using CNC machines the tapping operation will be more accurate and tool breakage can be reduced unlike hand operated machines. Still proper coolant circulation can prevent such tool breakage and enhance the tapping process. Hence a literature survey was done to study the various works done by the researchers in enhancing the tapping operation. The Kei-Lin Kuo et al [1] experimented the tapping operation by using the ultrasonic vibration during the tapping operation. He drilled holes in the difficult to machine material like Titanium alloy. Once the hole is drilled, he tried to make internal threads with the help of vibration assisted tapping. The vibration was generated with the help of piezo-electric actuator. The results were plotted

for tap's travel distance inside the hole against the amplitude of vibration and tapping torque. The work by Syed Mohibuddin Bukhari et al [2] studied the influence of drilling tool geometry for hybrid composite materials. He discussed the influence of drilling tool geometry on hole geometry in hybrid composites. Surface quality was evaluated in terms of surface roughness. Ekrem Ozkayaa et al [3] in his work implemented the concept of twist drill tap by modifying its geometry. He analyzed the new tool geometry by using CFD simulations. The main advantage of using this twist drill tap is to decrease the abrasive wear and thermal load developed during the tapping operation. A. Gil-Del-Vala et al [4] experimentally studied tapping wear mechanisms on nodular cast iron. He used coating of titanium nitride over the conventional taps and machined in nodular cast iron material. The energy dispersion spectroscopy and optical images were taken to study the impact of coating on reducing the tool wear. The results showed a significance improvement in reducing the tool wear. D. Biermann et al [5] did CFD simulations to study the influence of varying coolant channel design in a tap tool. By changing the channel designs, the improvement in wear ratio was observed based on the simulation results. With this literature studies it is clear that by improving the coolant channels the tool life of the tap tool can be increased. Hence in this work, it is planned to design a new coolant channel and see its impact using the CFD simulations.

2 Design and Analysis of Tap Tool

The conventional tap tool and modified tap tool design was modeled using the Creo parametric 3.0 modelling software. The software was used for developing the 3D model of the tap tool based on the dimensions of the straight flute tap tool. Fig.1 shows the CAD model of the designed tap tool and workpiece.



Figure 1: CAD model of tool and workpiece

2.1 MODELING AND ANALYSIS FOR CONVENTIONAL TAP TOOL

The conventional tap tool was modelled using Creo parametric 3.0 modelling software and is shown in Fig.2. The Fig.2 depicts the coolant channel design followed in the conventional tap tool which shows the coolant channel passes at the centre of the tool and splits over into four pathways at the end of the tool.

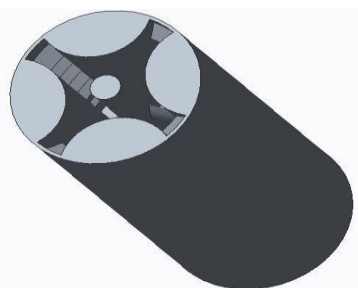


Fig. 2 Conventional Tap tool model

Using this developed model, the simulation model was defined following the actual processing conditions given for a tapping operation. The coolant passing through the inlet and outlet channel ambience was created and the final CFD model was generated using ANSYS 14.5 and the developed CFD model is shown in Fig.3

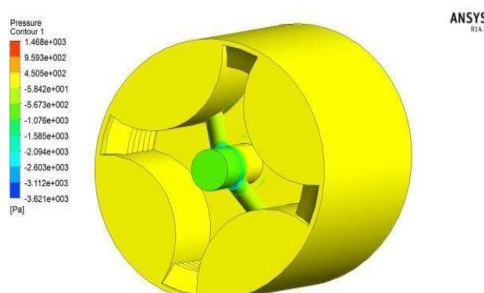


Fig. 3 Conventional tap tool CFD model

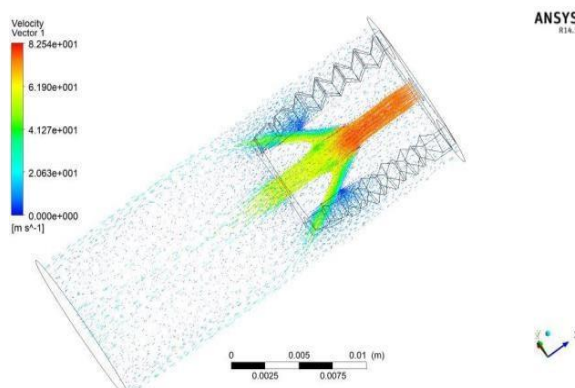


Fig. 4 Simulated result for conventional tap tool

The simulation for the defined conditions was successfully generated using the ANSYS 14.5. The result obtained for the conventional tap tool model is shown in Fig.4. The simulation results show that the coolant flows through all the four channels at a velocity of around 50 – 70m/s and exits the tap tool. Another important observation noticed is, when the tool rotates, the flow is orientated and exits the fluid pathways at a high velocity in a direction opposite to the direction of cutting edge. This result proves that the sufficient quantity of coolant is not supplied to the edge of the cutting tool.

2.2 MODELING AND ANALYSIS FOR MODIFIED DESIGN TAP TOOL

The tap tool with modified coolant design was modeled using Creo parametric 3.0 modeling software and is shown in Fig.5. The Fig.5 shows the modified coolant channel design. From the modified design, we can see clearly the coolant channels are provided around the centre axis of the tool instead of coolant channels in line with the axis of the tool like conventional tool. By modifying this coolant channel design the flow of the fluid is further analyzed.

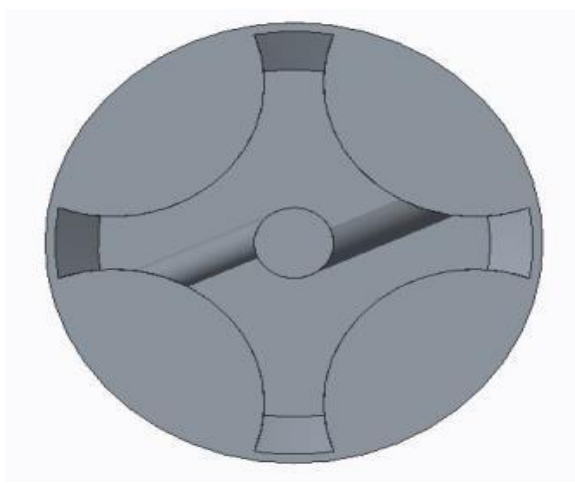


Fig: 5 Modified internal coolant channel design

Using this modified channel design model, the simulation parameters were defined following the actual processing conditions given for a tapping operation. The coolant passing through the inlet and outlet channel ambience was created and the final CFD model was generated using ANSYS 14.5 and the developed CFD model is shown in Fig.6

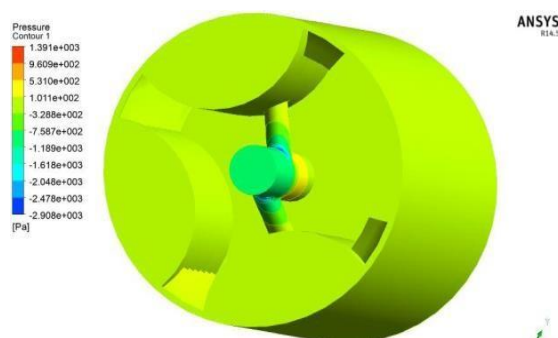


Fig: 6 Modified tap tool CFD model

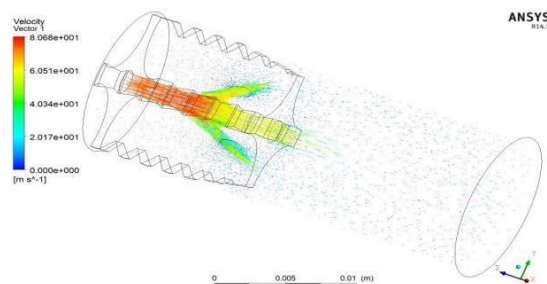


Fig: 7 simulated result for modified tap tool

The simulation for the defined conditions was successfully generated using the ANSYS 14.5. The result obtained for the modified tap tool model is shown in Fig.7. The simulation results show an increased flow of coolant in the direction of cutting edges at a velocity of around 50 – 70m/s. Another inference noted is uniform distribution of flow at the cutting edges when the fluid pressure is around 6 – 10bar, this show even at lower rotation during threading process the coolant flows through all the pathways in feed direction. Even when the tool rotates, the flow is orientated out with high velocity in the direction of cutting edges. This result proves the modified coolant design is capable to reduce the tool wear since it supplies coolant at the cutting edges during machining.

Table 1 Result comparison for conventional and modified tap tool.

	Outlet Pressure (Pa)	Velocity (m/s)
Conventional tap tool	1980	72
Modified tap tool	3420	68

The results obtained from the simulations for conventional and modified tap tool were compared and shown in Table 1. The results show the outlet pressure and velocity obtained with the modified tap tool is much higher when compared with the conventional tap tool.

3. FABRICATION OF MODIFIED TAP TOOL

The modified tap tool with internal coolant channel design with offset profile was fabricated based on the CFD simulation results. Fabrication of such a tap tool with modified internal coolant channel was produced by using EDM drilling machine.

The brass electrodes of diameter of 1mm and 2mm were used for machining holes in tap tool using Sodick K1C EDM small hole drilling machine.



Fig: 8 Drilled modified tap tools

EDM process was used to drill hole for the selected M12 straight flute tap tool. In through- hole process, two different tap tools were used. They are straight and inclined. The holder was set at an angle of 250 for holding workpiece in order to drill the inclined hole. In total 1 blind hole and 2 through hole with inclined and offset holes were generated on the tap tools as shown in Figure 8.

4. EXPERIMENTAL WORK

In order to validate the results obtained from simulations, an experimental work was planned. The tapping operation was done on a mild steel workpiece material. The conventional tap tool and modified tap tool fabricated were used as tools and tapping operation was performed on work material using the BMV45*TC75 vertical machining center machine. The Figure 9 shows the experimental set-up for tapping operation.

To measure the weight of the tap tool before and after the each experiment, a SARTORIUS BSA224S weighing machine with an accuracy of 0.001g was used. The tool wear happening around the edges of the cutting tool is inferred with the help of optical images taken using the tool maker's microscope.



Fig. 9 Experimental set-up with tap tool

5. RESULTS AND DISCUSSION

i) Dimensional analysis of conventional tap tool before the tapping process:

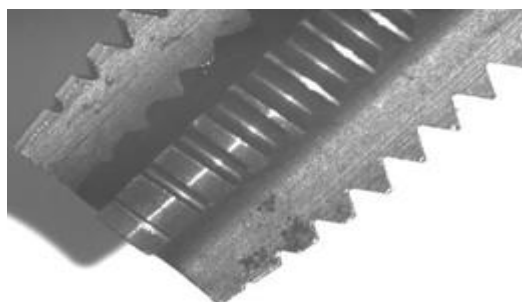


Fig: 10 Microscopic image of conventional tap tool before the tapping process

The Fig.10 shows the microscopic image of the conventional tap tool before the tapping process was performed. The tap tool dimensions before the tapping process is given in Table 2.

Table 2 Dimensions of conventional tap tool before the tapping process

Measured dimension	Initial reading (mm)	Final reading (mm)	Difference(mm)
Chamfer length	20.245	13.865	6.38
Chamfer height	12.78	11.86	0.92
Pitch of thread	13.51	11.745	1.765
Height of thread	12.25	11.1	1.15
Chamfer angle	13°	0	13°

ii) Dimensional analysis of modified tap tool before machining process:

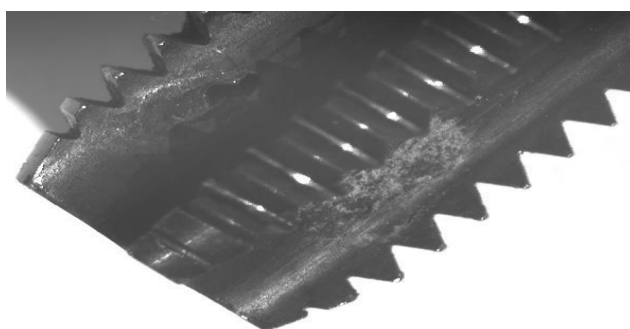


Fig: 11 Microscopic image of modified tap tool before the tapping process

The Fig.11 shows the microscopic image of the modified tap tool before the tapping process was performed. The tap tool dimensions for the modified tap tool before the tapping process is given in Table 3.

Table 3 Dimensions of modified tap tool before the tapping process

For measurement	Initial reading (mm)	Final reading (mm)	Difference (mm)
Chamfer length	16.685	13.81	2.875
Chamfer height	8.6	7.565	1.035

Pitch of thread	12.43	10.725	1.705
Height of thread	10.11	7.935	2.175
Chamfer angle	13°	0	13°

iii) Dimensional analysis of conventional tap tool after the tapping process

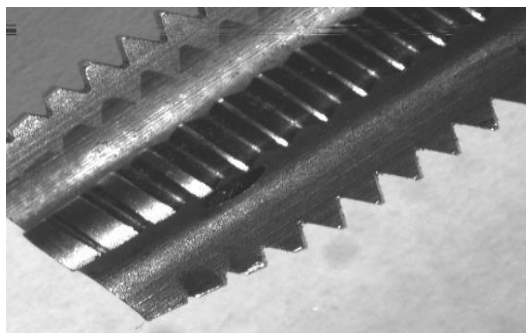


Fig: 12 Microscopic image of conventional tap tool after the tapping process

The Fig.12 shows the microscopic image of the conventional tap tool after the tapping operation was completed. The tap tool dimensions for the conventional tap tool after the tapping process is given in Table 4.

Table 4 Dimensions of conventional tap tool after the tapping process

Measured dimension	Initial reading (mm)	Final reading (mm)	Difference (mm)
Chamfer length	21.06	14.99	6.07
Chamfer height	12.035	11.125	0.91
Pitch of thread	12.41	10.66	1.75
Height of thread	12.98	11.9	1.08
Chamfer angle	13°	0	13°

iv) Dimensional analysis of modified tap tool for after machining process

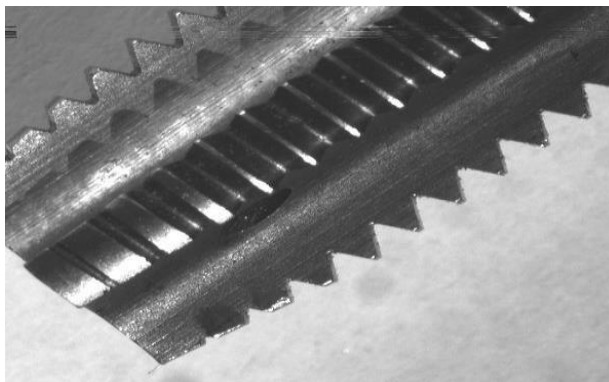


Fig: 13 Microscopic image of modified tap tool after the tapping process

The Fig.13 shows the microscopic image of the modified tap tool after the tapping operation was completed. The tap tool dimensions for the modified tap tool after the tapping process is given in Table 5.

Table 5 Dimensions of modified tap tool after the tapping process

For measurement	Initial reading (mm)	Final reading (mm)	Difference (mm)
Chamfer length	12.58	9.77	2.81
Chamfer height	11.795	10.765	1.03
Pitch of thread	8.285	6.525	1.76
Height of thread	12.19	11.025	1.165
Chamfer angle	13°	0	13°

The weights of the conventional and modified tap tool before and after the tapping process were measured. The tool wear rate obtained for both the tap tools were found using the Equ.1.

Before machining:

Weight of conventional tap tool = 41.7404 g

Weight of modified tap tool = 44.1935 g

After machining:

Weight of conventional tap tool = 41.7384 g

Weight of modified tap tool = 44.1684 g

Formula:

$$\text{Tool Wear Rate} = \frac{W_1 - W_2}{\text{Cycle Time}} \quad (1)$$

where,

w1 - Weight of tap tool before machining.

w2 - Weight of tap tool after machining.

Tool wear rate for conventional tap tool:

$$\text{Tool wear rate} = (41.7404 - 41.7393)/400$$

$$\text{Tool wear rate} = 83 \mu\text{g/s}$$

Tool wear rate for modified tap tool:

$$\text{Tool wear rate} = (44.1935 - 44.1684)/400$$

$$\text{Tool wear rate} = 62 \mu\text{g/s}$$

The results shows the tool wear rate of 62μg/s is obtained for modified tap tool which is much lesser than the tool wear rate of 83μg/s obtained for conventional tap tool. This result proves that the internal coolant modified tap tool reduces tool wear when compared with the conventional tool.

CONCLUSION

In this work, the increased tool wear occurring in the conventional tap tools is studied. The commercially available tap tool with an internal coolant channel and modified tap tool with internal coolant channel is modeled and coolant flow is simulated. The simulated results are also experimentally validated.

- The conventional tap tool and tap tool with modified coolant design is successfully modeled.
- The Simulation was generated for analyzing fluid flow in conventional tap tool and modified tap tool.
- The simulation results favor the modified tap tool design provides more coolant at the cutting edges with more velocity and pressure when comparing with conventional tap tool.
- The experiments were carried out with conventional tap and modified tap tool, the amount of tool wear occurred in modified tap tool is 62 μg/s when compared with tool wear of 83 μg/s in conventional tap tool. This result proves that the modified tap tool is better than the conventional tap tool.

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Design and Development of Robotic Gloves

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ABSTRACT

A stroke occurs due to the interrupted or reduced blood supply to the part of the brain preventing brain tissue from getting sufficient oxygen and nutrients. A Brain stroke sometimes can cause temporary or permanent disabilities. One of the major complications is Paralysis (the loss of muscle movement). Hemiplegic stroke: For a stroke on right side of the brain, the patient may become paralyzed or lose control of certain muscles on the left side of the body. The patient must go to rehabilitation to recover from the aftermath of the stroke. Recovery time of each stroke patient is different, but we can speed up the process through some continuous therapy. Hemiplegic / hemiparesis patients will have difficulties in moving the limbs, hands etc, through rehabilitation, their hand or limb activities can be improved One such method is the usage of robotic gloves, it will in increasing the muscular activity thereby reducing the recovery time.

Keywords: Stroke, robotic gloves, hemiplegic stroke, paralysis, rehabilitation.

1 INTRODUCTION

A stroke, (known as brain attack or cerebra-vascular accident) occurs when there is insufficient amount of oxygen and nutrients in the brain. This insufficiency is a cause of reduced blood supply to the brain via the arteries. This might cause the death of brain cells which finally results in the impairment of the functions that are controlled by the brain cells like speech, muscle movement, difficulty in hearing and reduced eyesight.

A stroke is a medical emergency because it sometimes results in death or permanent disability of the person or brain damage. When a patient is affected by a stroke, they can be identified by the symptoms.

This includes the disfunction in the areas controlled by the region of brain being damaged. The symptoms of stroke include Paralysis, weakness or numbness in arms, legs or a left/right side of the body, difficulty in utterance or understanding the speech, problems in vision like blackened, blurred, or double vision, Severe headache with unknown cause, Loss of balance or co-ordination and Dizziness.

There are some symptoms that vary among the gender also. According to the statistics, the 4th leading cause of death in U.S population is the stroke. Women are at greater lifetime risk when compared with men. Men are affected by stroke in the younger years, but they have fewer risks.

The signs of having a stroke in women include:

- Vomiting
- Hallucination
- Pain and general weakness
- Fainting and unconsciousness
- Seizures
- Sudden behavioral changes like increased agitation

The signs of stroke in women include:

- Eye Drooping and Slurred speech

It is very important to identify the symptoms so that the patient can be treated soon.

The strokes are of different types namely, Transient ischemic attack (TIA), Ischemic stroke and Hemorrhagic stroke.

2 TYPES OF STROKE

2.1 Transient Ischemic Attack (Tia)

A TIA (also known as mini stroke) is caused when the blood flow to the brain is insufficient or temporarily blocked, usually caused by a blood clot. The symptoms are also temporary, and they will disappear after few hours.

The main cause for TIA is due to the accumulation of cholesterol-containing fatty deposits which are also known as atherosclerosis in the artery or any other of its branches that supplies oxygen and nutrients to your brain. Plaques could cause decrease in the blood flow through an artery. It also could possibly lead to clot development.

Its symptoms are like stroke, but the positive outcome of this is that it only lasts for about 24 hours and after a full recovery can be achieved. TIA can also be regarded as an indication that possibly an area of the brain is not having efficient blood supply and that possibly a stroke could follow in the nearby future. Although, it's not severe compared to a stroke, urgent medical attention needs to be sought out.

2.2 ISCHEMIC Attack

An ischemic stroke is caused by a blockage in one of the brain arteries. The block may be due to a blood clot or maybe caused by atherosclerosis. Atherosclerosis is a condition where plaque (fat) builds on the walls of a blood vessel causing a blockage which results in ischemic stroke. They occur when the blood supply is not enough to part of the brain. This type of stroke holds count for most of the strokes. The cause of blocked blood flow in an ischemic stroke could be resulted due to blood clot or by atherosclerosis, which is a disease that results in narrowing of the arteries over time. Symptoms of ischemic attack include weakness, numbness or paralysis in face, arm, or leg of a person. It also affects speech, and poor understating of others communication. Blindness and Loss of balance or coordination is also a symptom.

2.3 Hemorrhagic Stroke

A Haemorrhagic stroke is caused by a damage in blood vessel (burst or leaking vessel). This causes high pressure and damages the brain cells. The two possible causes are Aneurysm i.e., High BP (Blood Pressure) which can lead to a burst of blood vessel.

The survival rate after facing a haemorrhagic stroke is around 26.7% within a period of five years. The period of life-expectancy varies with respect to the patient's age and medical conditions. Long-term survival rate prognosis is more guaranteed amongst the younger patients, but they would have to follow some conditions. Those conditions include living without hypertension, alcohol intake and diabetes mellitus. It most commonly occurs when a weak blood vessel ruptures. Aneurysms and arteriovenous malformations (AVMs) are the two types weakened blood vessels that usually cause haemorrhagic stroke. The common cause of haemorrhagic stroke which cannot be controlled no matter the condition is high blood pressure

3 TREATMENT AND RECOVERY

Several medications are prescribed for the stroke. It includes Tissue plasminogen activator (tPA), Anticoagulants, Antiplatelet drugs, Statins, Blood pressure drugs.

The stroke patients must undergo rehabilitation as soon as possible, the patient has to go for various therapies to improve the affected areas like physiotherapy, speech therapy and so on.

Each time, the patient who has undergone paralysis, numbness, weakness in their arms must seek the help of a doctor or physiotherapist to undergo rehabilitation. To have effective rehabilitation, we propose a robotic glove which will imitate the working of the alternative healthy hand increasing the muscular activity thereby reducing the recovery time. It also reduces the burden of a physician/ physiotherapist.

4 LITERATURE SURVEY

This chapter presents the literature survey on evaluation of human stability using machine learning.

A device with two sensors: flex sensors and a force sensitive resistor (FSR), as well as an accelerometer. The device's purpose is to detect muscle force as a result of muscle flexion and extension activity. They used the KL-71001 (Biomedical measurement system) component [1] to determine which muscle (extensor carpi or M. brachialis) has the most activity in post-stroke patients. As a result, the extensor carpi has the highest level of activity.

The design of the Robotic Glove[4], which incorporates a leather glove, an artificial tendon, and a flex sensor. The sensorial system generates signals, which are then processed by the Arduino Uno microcontroller, the actuation system, which employs a linear motor, and the software structure, which employs MATLAB and Simulink to achieve finger control. The main idea is to provide balanced control between functional electrical stimulation and exoskeleton for a faster patient rehabilitation process.

The glove [6] employs soft machine actuator technology and a thin profile of rectangular elastomeric bladders with strain limiting materials to produce different properties in different directions. It also includes a hydraulic

pump and a supporting electro-mechanical component, which are housed in a portable, electrical box that protects both the insides and outsides from water leaks, dust, and other hazards.

The Vicon marker set utilised in this study evaluated the positional changes of the four markers that were positioned on the active fingers as well as at the base of the hand. It included information on using an actuator, micro motors, and mostly vacuum provided by an air pump. It was a unique marker set that gathered information from the first two fingers and thumb. A second order IIR filter was used to filter the data. The primary goal of this paper [2] is to minimise weight and save money.

The soft robotic glove, which provides active finger extension for hand rehabilitation training, to supplement rehabilitation to stroke patients with clinched fist deformity [7]. On the metacarpophalangeal (MCP) joint of a dummy finger model and a healthy individual, the device's extension torque gene was rated. The gadget was able to create large extension torques to assist with finger extension for both healthy and stroke participants, according to preliminary results.

Robotic exoskeletons have always been the first to be proposed as a means of assisting stroke survivors with hand function during day-to-day activities. The issue with this suggested exoskeleton is that it is inconvenient to use. It's inflexible, weighty, and could make the user uncomfortable. The major goal of this article[8] is to create a design for a soft robotic glove that assists with hand functions using fabric-reinforced soft pneumatic actuators. Because of the way it supports functional tasks during ADLs, such as gripping and other actions for the patients, the device is proposed to be produced in this way. It goes into much detail about.

The most common rehabilitation method for stroke patients is repetitive hand movements to help them regain movement and strength. The gloves mentioned in the paper[3] are made with a cable system that helps them open and close their hands, as well as their gripping mechanisms and coordination. The glove is used to control the position and force of the fingers. This paper describes in detail the entire range of motion across one degree of freedom that the glove moves through.

5 METHODOLOGY

The development of our project is formulated in a flow chart described in Figure 1. Proposed project consists of following two sections healthy hand and paralyzed hand. These sections contain the following parts. Transmitting End (Healthy hand) contains Flex sensors, Arduino uno and Transmitter. Receiving End (Affected hand) contains Servo motors, Arduino uno and Receiver.

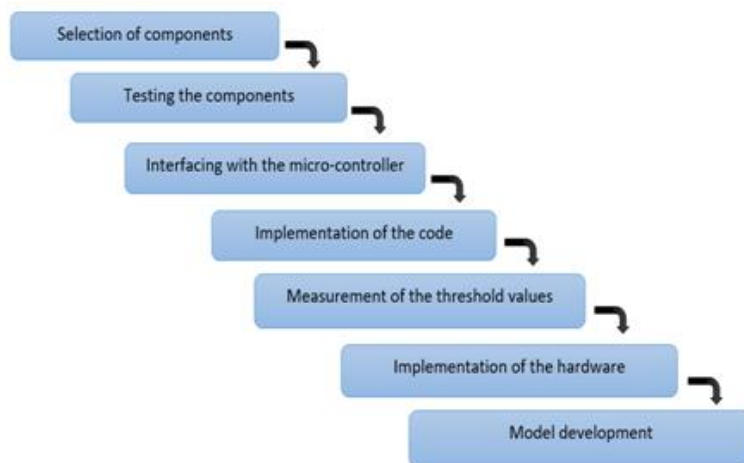


Figure 1: Flowchart for the design and development of robotic gloves

5.1 FLEX SENSORS

The flex sensors generate the variation in resistance according to the pressure applied. By nature, the human fingers can be twisted in one direction and hence a one-way sensor is optimal. The output from the sensor is used to drive servo motors and rotation can be controlled from 0 degree to 180 degree. The component that changes resistance when bent or flexed is known as flex sensor. A nominal resistance is provided by unflexed sensor. The resistance gradually increases when the flex sensor is bent in one direction. Corresponding voltage change to the flex is done but flex sensor thus providing us with an accurate replication of a natural movement. Although the sensor's usable range can be flexed without issue, care should be taken to avoid flexing beyond of that range. For best results, secure the base and bottom portion and only allow the actual flex sensor to flex. The resistances observed when the flex sensors are bent are listed. This resistance was then calibrated and

transformed into angles, which were subsequently used in the Robotic Arm for grabbing purposes. Flex sensors are placed on the glove to cover the full length of the finger. Flex sensors output is connected to the Analog input of microcontroller according to voltage divider principle.

Table I. Specifications for Flex Sensor

Operating voltage	0-5V
Power rating	0.5Watt{continuous},1Watt{peak}
Life cycle	1 million flexes
Operating temperature	-45 degree to +80 degree
Flat Resistance	25K
Resistance Tolerance	+30%
Bend Resistance Range	45K to 125K Ohms

5.2 Arduino-Uno Microcontroller

Arduino is incredibly versatile allowing interfacing of electronic circuits through ports and provide programming environment for real time development. Arduino boards are able to read inputs-in this project it helps in receiving Analog input from the flex sensor and making servo motor run which in turn makes a movement in the hand.

Table II. Specifications for Arduino Uno Microcontroller

Microcontroller	Arduino uno
Operating voltage	5V
Recommended Input Voltage	7-12V
Input Voltage Limit	6-20V
Analog Input Pins	6(A0-A5)
Digital Input Pins	14(6 provide PWM output)
DC current (input/output ports)	40 milliamperes
DC current (3.3V pin)	50 milliamperes
Flash memory	32 Kilobyte
SPAM	2Kilobyte
EEPROM	1Kilobyte
Frequency	16MHz

5.3 RECEIVER AND TRANSMITTER

The RF transmitter/ receiver help in receiving and sending enabling RF communication.

TRANSMITTER:

The transmitter section contains an Arduino UNO and a 434Hz transmitter module. The following is a description of the transmitter part's design. The four pins of an RF transmitter module are VCC, GND, data, and antenna. The data pin is connected to any of the Arduino's digital port pins. When there is a delay of a few seconds, the transmitter sends the character 0 and when there is a delay of a few seconds, it sends the character 1. The project's transmitting side has been turned on. The data 1 is transmitted via RF transmission, and the data 1 is received by the receiver. RF modules are utilized in robotic gloves and have a wide range of applications. Both the transmitter and the receiver operate in tandem. The transmitter can only send data. Because the HT12E is a 4-bit encoder module, we can create 16 alternative input and output combinations. They're 18-pin ICs that can work with a 3V to 12V power source. They have four data bits and eight address bits, which must be set the same on the encoder and decoder in order for them to work together.

RECEIVER:

The receiver section contains an Arduino uno and a 434 MHz receiver module. The four pins of an RF receiver module are VCC, GND, data, and antenna, with VCC connected to 3.3V and GND connected to ground. The data pin of the Arduino is linked to pin 12 of the board. The data 1 is transmitted via RF transmission, and the data 1 is received by the receiver. When the data transmitted is 0 on the transmitter side, the process is switched off, and when the data received is 0 on the receiver side, the process is also shut off. As a result, the receiver imitates the activities of the transmitter. RF modules are utilized in robotic gloves and have a wide range of applications. Both the transmitter and the receiver operate in tandem. Only information can be received by the receiver. As a result, the receiver module is unable to send data. The HT12D is a 4-bit decoder module, which means it can handle 16 distinct input and output combinations. They have four data bits and eight address bits, which must be set the same on the encoder and decoder in order for them to work together.

Table III. Specifications for Transmitter and Receiver

Receiver frequency	433MegaHz.
Receiver typical sensitivity	105Dbm
(Receiver current) supply	3.5mA.
(Receiver) operating voltage	5V
Transmitter frequency range	433.92MHz.
Transmitter supply voltage	3Vto6V
Transmitter output power	4to12Dbm

5.4 SERVO MOTORS

Rotatory or linear actuator that enables for precise linear and angular position, velocity, and acceleration control. As a function, a servo motor is a unique sort of motor that is automatically operated up to a certain limit for a given command using error-sensing feedback to adjust performance. V- is the Ground terminal, V+ the supply voltage, and S the Control (Signal) are the three electrical connection cables that come out of the side. Pulse Width Modulation (PWM) signals sent from an external controller are received by the control S (Signal) wire and converted by the servo on board circuitry to operate the servo. A servo motor can typically rotate 90 degrees in both directions for a total of 180 degrees.

Table IV. Specification for Servo Motors

Pulse width	500us – 2400us
Rotation / support	Bushing
Shaft diameter	4.5mm
Speed	0.32 oz
Torque	4.8V: 25. oz-in (1.80 kg-cm)
Gear type	Plastic

5.5 Arduino Ide Software

The Arduino Integrated Development Environment - or Arduino Software. The Arduino Uno, Mega and Arduino Nano automatically are powered up through USB or an external power supply.

6 TESTING AND INTERFACING

The subsystems were designed and prototyped and tested for its functionality. The force and stress level is tested for the mechanical components and motor. The microcontroller was tested on interfacing for its functionality and I/O read out. The entire prototype system was then assembled for concurrent testing.

6.1. Flex Sensor Testing

In Table 5. we have taken the sensor value for bent and straight flex sensor and taken the average for 1000 samples which is as follows:

(847, 1020-0°,180°)

From the values 847 to 1020, the rotation of the servo is set from 0° to 180°

Flex sensor response when it gets bend, its resistance changes according to the amount of bending on it. Nominal resistance value is given at straight position and highest resistance value is given at 90 degrees.

Table V. Flex Sensor Testing

Sensor value (when straight)	Sensor value (when closed)
847	1018
847	1008
847	1011
847	1009
847	1004
846	1006
846	1009
846	1009
847	1010

6.2 Arduino Uno Testing

To channel is tested for correctness of receiving data with appropriate connection to aurdino pins. The wire from ground is removed and connected to 5V. Analog0 is now 5.0V. Removing the wire from 5V and connected to 3.3V. Analog0 is now 3.3V. Repeated the same procedure with A1, D2 and D3.

6.3 Interfacing Flex with Arduino

A flex sensor is generally a variable resistor that can be used in a voltage divider configuration to determine the equivalent analog voltage. The one end of the flex sensor is grounded by connecting it to GND pin, and the other end is connected to analog Input pin A0 of Arduino. A 10K resistor is connected between analog input and +5V. This configuration includes the flex sensor and a 10K resistor for use as a voltage divider. To display the output, connect an LED to Arduino UNO's Digital I/O Pin 7.

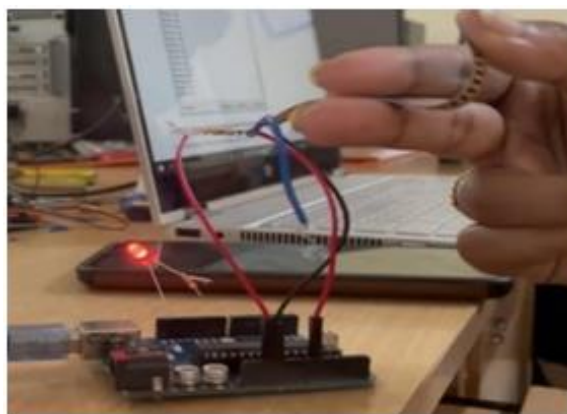


Figure 2: The glow of the LED indicates the working of flex sensor

6.4 Interfacing Servo Motor with Arduino Uno

The yellow wire in the servo motor is the signal wire, and it is connected to Arduino's digital pin 2. The brown wire is the ground wire, and it is connected to the Arduino's ground. The red wire is the power wire, and it is connected to the Arduino's 5V pin.

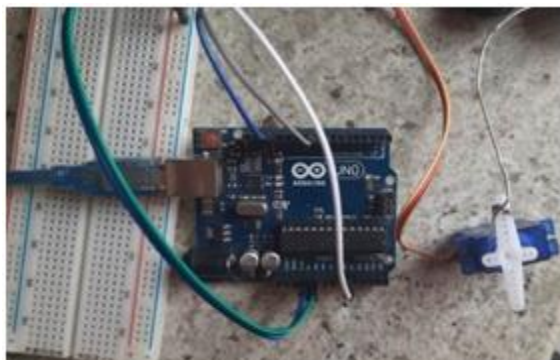


Figure 3: The rotation of the servo motor is captured.

7 WORKING

7.1 . Human Interface

The input is collected from the flex sensors attached to the gloves of the healthy hand. these Analog resistors (flex sensors) work as variable Analog voltage dividers. Carbon resistive elements within a thin flexible substrate is present inside the flex sensor. a resistance output is produced when the flexible substrate is bend. The resistance produced is proportional to the bend radius of the flex sensor.

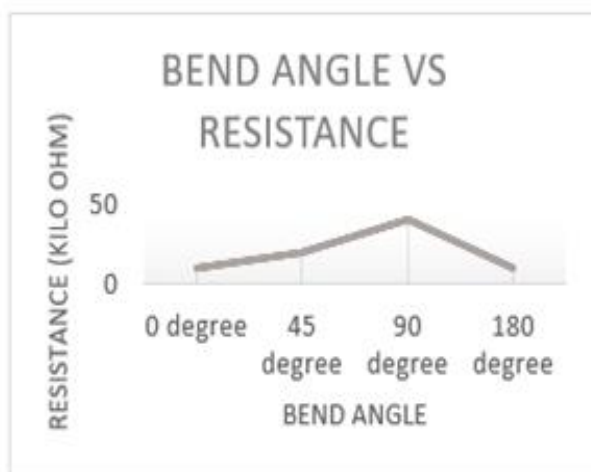


Figure 4: The graph comparing the flex values and servo motor values

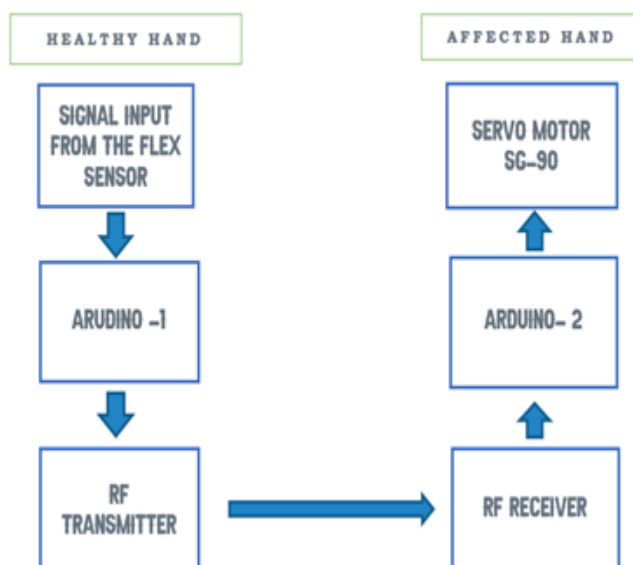


Fig 5: The Block diagram of the design and development of robotic gloves.

As the finger with the flex sensor is bending the resistance created is given to the microcontroller (Arduino Uno) and then converted into the pulse width modulation to run the motor.

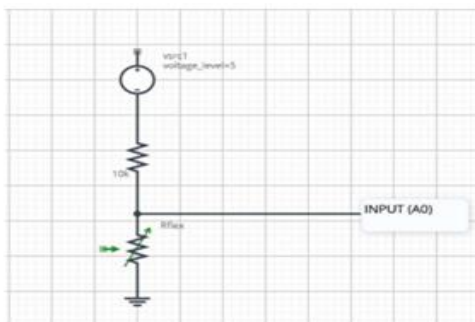


Figure 6: The Flex Circuit

7.2 Transmitter Circuit

This Arduino UNO has 6 Analog pins and 14 digital pins (I/O Pins) out of which 6 of them are PWM pins which are useful to drive, using Arduino IDE, the code can be compiled and uploaded into the Arduino board. The output from the Arduino UNO is transferred into the encoder HT12E connected to a RF module of 433 Mhz.

7.3. Receiver Circuit

The output from the decoder HT12D is transferred into the Arduino UNO to transfer it the PWM pins which will run the servo motors attached to the affected hand thereby causing the movement of the fingers.

7.4. Servo Motors

The threshold for the flex sensors is calculated; using that, the rotation of the flex sensors is also decided. the threshold value for the sensor is 850 when flat, when bend it is 1023. When flat= 0°, bend =180°, these are the values uploaded in the code of the microcontroller to control the servo motor.

8 RESULTS AND DISCUSSION

8.1 Model Development

The healthy hand (the hand with flex sensor is bend) and that signal is sent to the microcontroller resulting in the rotation of servo motor.

The bend made in the index finger left hand of the person in the Figure 4.1 results in the bend in the index finger in the right hand. Figure 4.1 and Figure 4.2 shows the rotation of the servo motor. Figure 4.3 shows the maximum bend of the flex sensor



Figure 4.1 The rotation of the servo motor



Figure 4.2 The bend in the paralyzed hand



Figure 4.3 The maximum bend of the flex sensor

8.2. MODEL EVALUATION

The flex sensor characteristics are tested with an individual servo motor before mounting of components. Different threshold values for each finger are observed. Once again, the circuit board is tested, and the experiment is done. The maximum value of the sensor is the full closer of the fingers, the minimum value is the normal value of the sensor.

a) **Thumb:**

Minimum value: 875

Maximum value: 965

Number of DOF =2

Number of DOF observed in the Rehab glove:1

b) **Index finger:**

Minimum value: 875

Maximum value: 1023 Number of DOF =3

Number of DOF observed in the Rehab glove:1

c) **Middle finger:**

Minimum value: 875

Maximum value: 1002

Number of DOF =3

Number of DOF observed in the Rehab glove:2

d) **Ring finger:**

Minimum value: 875

Maximum value: 1012

Number of DOF =3

Number of DOF observed in the Rehab glove:2

e) **Little finger:**

Minimum value: 875

Maximum value: 1000

Number of DOF =3

Number of DOF observed in the Rehab glove:2

8.3 DISCUSSION

When the person uses the gloves for rehabilitation and does the flexion exercise i.e., fully closing the index finger, the values of the flex sensor and the rotation of the servo motor is recorded. The values of the flex sensor attached to the Index finger and the corresponding rotation of the servo motor are tabulated as follows:

Range for Sensor value: 1-1023; Ranger for Servo value: 1-180 (Index finger)

TABLE 6 The value of sensor and servo motor

Sensor Value	Servo Value
1023	180
1018	180
917	80
927	92
900	60
899	58
880	36
862	14
1002	180

983	159
1023	180
1023	180
1023	180
1023	180
968	141
947	116
878	33
860	23
940	63
1023	180
1023	180
1023	180
921	85
961	133
930	96
867	20
920	84
1023	180
1006	180
1023	180
1008	180
966	139
863	15
855	6
864	16
924	88
958	129
1005	180
1023	180
1023	180
1023	180
1023	180
857	8
845	0

From this tabulation, we can interpret the rotation of the servo motor and the movement observed in the unhealthy hand. Using this prototype, we tested the most important function, flexion of the fingers (full bend of the index finger), the unhealthy hand (index finger) also imitated the movement to a certain extend.

8.4. RESULT

The prototype of the Robotic hand has been designed, assembled, and tested. We were able to achieve the initial stages of building the rehabilitation design. The prototype does mimic the action to a certain extent but its limited to only one finger a time. Despite that, with the movement provided good repeatability for task performed, i.e., flexion of the finger is observed.

CONCLUSION AND FUTURE WORK

9.1. CONCLUSION

This glove design was especially intriguing and challenging, but we have successfully persevered through it. In this project we have designed and developed a robotic glove for Hemiplegic stroke patients. We hope to extend this project in much simpler and more useful, which is beneficial to the doctors and patients.

9.2 FUTURE WORK

Our upcoming actions in the future is to articulate all the fingers on the hand, increasing DOF (degree of freedom) of gloves in the future, the gloves being more comfortable for the patient. Study and work on more advanced glove function with major grasping capacity will be proceeded. Additionally, we will also focus on the below listed points:

1. EMG sensor is to be fixed so that the glove can also give information about the muscle movement (Biofeedback)
2. Instead of using servo motors, linear or soft actuators is kept so that the fine movements of the fingers can also be observed.

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Performance and Change over Characteristics of Hybrid Two Wheelers

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ABSTRACT

Nowadays the major problem for an OEM is vehicle emission and fuel economy. In case of countries like India two-wheelers contributes major portion in emission and this emission level is being controlled by various Bharat Stage norms. The second complete solution for this problem is introduction of electric or hybrid vehicle. In this paper existing two-wheeler is converted into plugin hybrid vehicle. The tests for reduction of emissions and for increase in fuel economy were conducted. In this case the modification for existing two-wheeler in to plugin hybrid vehicle includes BLDC hub motorized front wheel along with the controller unit is used and this motor is powered by lead acid AGM 36 V batteries. The entire navigation of vehicle is tracked by using ublox neo 6 m GPS module and data are stored in SD card unit from this data driving patterns were obtained. The automatic switching between electric motor to fuel mode includes Arduino uno controller which integrates the motor and starting system of two-wheeler. At last based on battery power consumption the fuel economy is calculated along with this emission level are tested and results are discussed.

Index Terms-- BLDC, Ublox Neo 6 m GPS Module, Lead acid AGM 36 V Batteries.

I. INTRODUCTION

In countries like India one of the main contributions for the emission are two-wheelers. According to SAE India 2010 survey the two-wheeler market of the country continues to grow at a fast pace i.e., 76% of vehicle population. The sales of two-wheeler in India reached an all-time high as of 2019 with 21 million units. This results in increase in emission level and fuel consumption. Electric and Hybrid vehicles are one of the solutions to above problems. In case of electric vehicles, the driving range is short because of absence of IC engines.[2]. Here commences the period of the HEV, which operates with

a conventional IC electric propulsion system motor. This combination allows for considerable improvement in driving range, fuel consumption and emission levels.

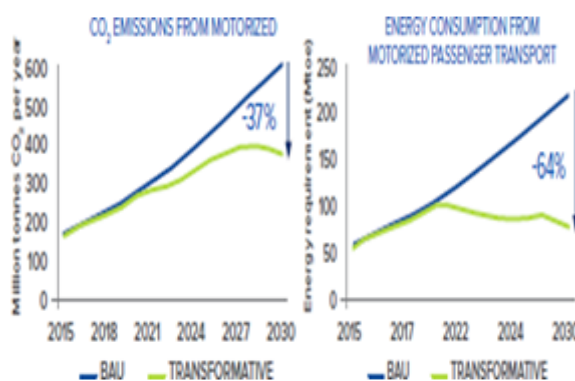


Fig1. Emission and Fuel consumption data (NITI AYOOG Report) [14]

During regenerative braking, the electric motor regenerates electricity and delivers additional power for the vehicle's traction requirements. HEVs can be used in wide application hence we can use HEVs as commercial as well as customer vehicles. In general, HEVs operate in charge-sustaining (CS) mode, which ensures that the battery's state of charge (SOC) is maintained during the journey. Because the charging efficiency of CS mode is reliant on regenerative braking and gasoline, plug-in HEVs (PHEVs) have been proposed as a viable alternative [1]. A plug-in hybrid electric vehicle (PHEV) is a complete hybrid vehicle that can operate in both electric and petrol modes. Larger batteries and the capacity to recharge from the electric power grid are features of these cars. Their major benefit is that they may be used without gasoline daily while simultaneously having the increased range of a hybrid vehicle. [2] In the next 4 to 5 years, the industry's production growth is expected to expand by 7%. Motorcycles are projected to increase moderately in the two-wheeler category, but scooters will continue to expand in double digits, with two-wheelers rising between 9-11 percent in FY' 2020. The introduction of electric vehicles has created significant potential in sectors such as charging infrastructure services, smart charging units, vehicle-to-grid solutions, renewable energy integration with EV charging and storage, lithium battery solutions, and building management systems (BMS).

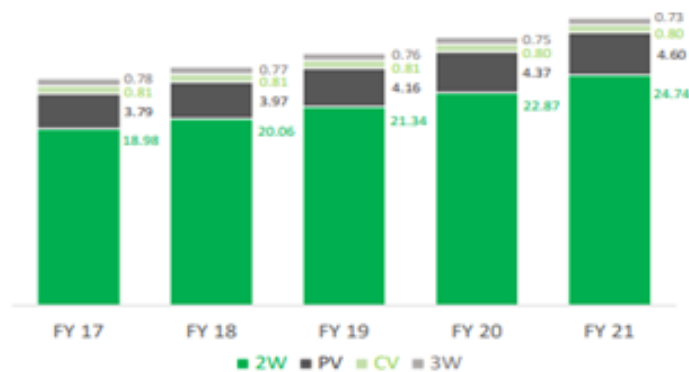


Fig2. Indian automobile industry future outlook (volume in Mn) [14]

II. LITERATURE SURVEY

A. Two-Wheeler Emission

Particulate emissions of Euro 4 motorcycles and sampling considerations were investigated by Barouch Giechaskiel et al (2019) [3], who found that particulate matter emissions were below 1.5 mg/km, well below the 4.5 mg/km limit introduced for Euro 5 powered two-wheelers equipped with diesel or gasoline direct injection (GDI) engines. When compared to observations at the tailpipe, the CVS technique revealed significantly greater particle counts in the 10–23 nm size range. And it's apparent that more focused research is needed in this area before implementing a measuring procedure for any future SPN regulation of such vehicles.

Roland Oswald et al. (2018) [4] investigated technologies for meeting future emission legislations with two-stroke motorcycles and discovered that 50 cc two-stroke engines have a chance to meet EURO 5 emission limits, but performance reduction is unavoidable because each modification to the exhaust system affects gas dynamics.

Mahesh et al (2019) [5] investigated real-world emissions of gaseous pollutants from motorbikes on Indian urban arterials and discovered that the speed-time patterns seen in real-world tests differed from the Indian Driving Cycle (IDC) utilized for motorcycle laboratory testing. The average CO emission factor for BS II and BS III bikes exceeded the emission standard by 7.74 and 7.78 times, respectively. As a result, CO emissions from motorbikes are a significant issue. Two-stroke motorbike emissions of HC and NO_x were also found to be greater. Finally, the ARAI emission factors are out of date, necessitating the use of updated emission factors for two-wheelers.

Short-events like frequent gearshifts and frequent stop-and-go occurring during interruptions and congestion are the main causes of higher emissions on urban roads, according to Choudhary, A et al (2016) [6]. They discovered that short-events like frequent gearshifts and frequent stop-and-go occurring during interruptions and congestion are the main causes of higher emissions on urban roads because they lead to sharp increases or decreases in acceleration and deceleration.

Nishadh et al (2019) [7] investigated air quality, emissions, and source contributions for the greater Bengaluru region of India, finding that transportation is the primary source of PM_{2.5} and PM₁₀ emissions, accounting for 56 percent and 70 percent of total PM_{2.5} and PM₁₀ emissions, respectively, and concluding that unless an aggressive strategy to reduce emissions is implemented, emissions will increase by at least 50 percent in the future.

Gurjar B.R., et al. (2016) [8] examined air pollution trends over Indian megacities and their local-to-global consequences, finding that the transportation sector is the most significant source of NO_x and CO emissions in all megacities, accounting for around 50 to 70% of total emissions. Diesel automobiles appear to be a substantial contribution among all vehicles. NO_x levels over Indian megacities may increase air reactivity (e.g., with ozone and other pollutants), resulting in the formation of more hazardous chemicals. Furthermore, a megacity's specific industry (such as a thermal power plant in Delhi) adds to bad air quality.

B. Plug In Hybrid Two-Wheeler

N S Gopi Krishnan et al. (2015) [9] investigated the design and development of a hybrid electric two-wheeler and discovered that the parallel hybrid electric two-wheeler provides a mileage equal to 107.5 kilometers. The design is more suited to motorcycles and performs admirably as a HEM design idea, with the unusual addition of a separate gear box for the electric motor providing the benefit of fulfilling the two-variable wheeler's speed/torque needs.

Harish N et al (2018) [10] looked at the performance of hybrid two-wheelers and discovered that, when compared to regular bikes, the hybrid bike is more efficient, economical, and produces less pollution. When it comes to reducing gasoline costs, hybrid bikes are a superior option. Hybrid-electric vehicles (HEVs) combine the advantages of gasoline engines with electric motors and may be designed to achieve a variety of goals, including better fuel efficiency and power.

Sabir Ahmed et al. (2014) [11] investigated a novel battery charging and power distribution system for a series-hybrid two-wheeler and discovered that the proposed system eliminates the need to increase the size of the traction battery, isolates the electric loads from the battery under low SOC conditions, and protects the battery against deep discharge, resulting in increased battery life.

Ruthvik Sankar et al. (2017) [12] studied the design and development of a smart hybrid two-wheeler and discovered a total efficiency of 40.8 percent in the Smart Hybrid system, as well as maximum mileage and reduced fuel emissions, with the assistance of an Energy Management system. CO₂ emissions for IC engines were found to be highest in the speed range of 0kmph-20kmph, whereas emissions from electric motors are insignificant. As the vehicle travels at its set speed limit, the lifetime of both systems is lengthened.

Pritesh Doshi et al. (2017) [13] investigated the Hybridization - Bridge for Electrification and discovered that electric powertrains will coexist, although in lesser numbers, and will progressively grow and gain numbers. In addition, the suggested hybrid designs provide both conventional and electric vehicle operations and benefits.

III. VEHICLE MODELLING AND TESTING

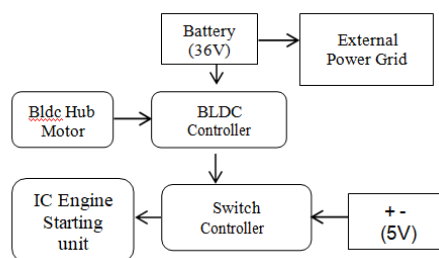


Fig3. Layout of modified hybrid two-wheeler

A. VEHICLE MODELLING

There are several calculation and protocols were used for modification of ordinary two-wheeler to hybrid two-wheeler. Parameters such as torque, power were calculated for selection of suitable battery pack, hub motor and controller along with this protocol like serial peripheral interfacing were used for testing purposes.

1. Torque Calculation

$$Torque = RF \times TTE \times R \quad (1)$$

Where TTE - Total Tractive Effort,

R WHEEL - radius of the wheel,

RF- friction factor (assume loss by 20%).

2. Power Calculation

$$Power = \frac{R_t \times Velocity}{3600 \times \eta_t} \quad (2)$$

Where R_t- overall resistance,

η_t - overall transmission efficiency.

TABLE 1. Specification of Modified Vehicle

Battery capacity	36 V
Hub motor (BLDC)	350 W, 36V
Total Tractive Effort (only RR)	33.69 N
radius of the wheel	0.5334 m
Overall transmission efficiency	0.95 %
overall resistance	33.69 N
Torque	21.56 Nm

Power	344.78 W
-------	----------

Fig4. Modified hybrid two-wheeler



B. Testing Of Vehicle

The modified hybrid two-wheeler is tested in free ride condition and the following parameters are obtained drive pattern, electric to fuel switching condition and emission levels

1. DRIVE PATTERN

The hybrid two-wheeler is used for multiple purpose like commercial as well as personal use which involves frequent stopping and starting, hence data like speed of the vehicle distance covered for each stop are difficult to obtain and for this purpose GPS module is used.

For data collection, the U-blox neo 6m GPS module is utilised, which has a minimum accuracy of 2.0 m and follows the standard NMEA protocol. It has features for measuring instantaneous velocity and distance covered. It has rugged build and can withstand temperatures of -40 ...+85 C. the measured data are stored in secure memory card via SPI protocol.

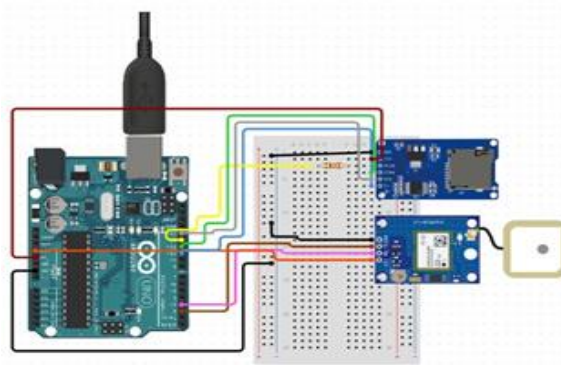


Fig 4. Modified hybrid two-wheeler [15]

2. Hybrid Switching Condition

Electric mode and fuel mode are more efficient when they operate separately but integration of both involves certain criteria. The parameters like speed of the vehicle in electric mode and state of charge of battery should be monitored regularly and they should be updated continuously to 2nd controller for efficient switching between hybrid and electric mode.

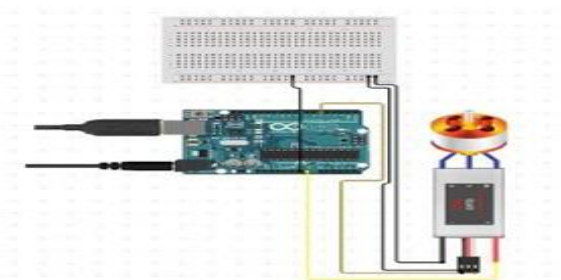


Fig5. Schematic of switching unit [15]

Continue in motor mode

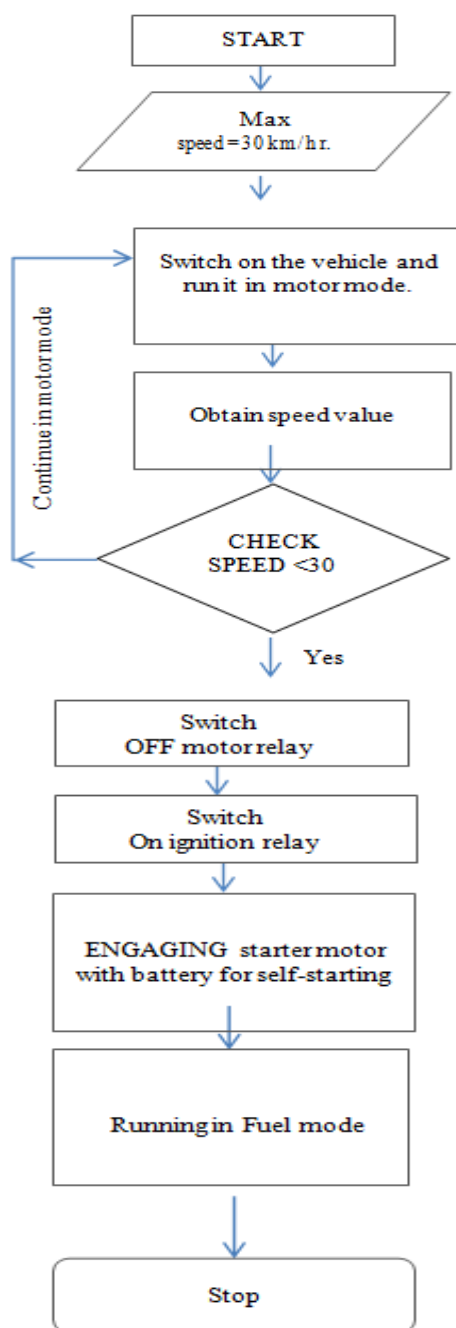


Fig6. Flowchart of switching system in hybrid two-wheeler

Thus by using the above flowchart the required program is created and feed in to controller for switching. Here the speed of the vehicle is obtained during the free ride condition along with this the corresponding voltage value maximum speed value is 25 km/hr, Based on the speed value the switch controller decides whether the vehicle should run in IC or electric mode. for instance if the vehicle speed is less than 30 km/hr. i.e. 22 km/hr then controllers maintains the ride in electric mode. Once the speed is greater than set maximum speed value the controllers changes the control to IC mode where ignition relay is switched on and starter motor is engaged for running in fuel mode.

IV. RESULTS AND DISCUSSION

A. Drive Pattern And Speed Data

TABLE 2. Speed Data Of The Motor

SUPPLY VOLTAGE (V)	VOLTAGE FROM SENSOR TERMINAL (V)	SPEED VALUE km/hr
5	2.9	MAXIMUM SPEED 30

5	3.07-3.09	10-15
5	3.06	20
5	3.05	22
5	3.04	25

The above table shows the speed of the vehicle along with its corresponding voltage value. These values were taken during the free ride operation of the hybrid two-wheeler and these values are feed in to controller for switching operation. Based on the provided condition the controller switches the control between electric and fuel mode.

The velocity fluctuation with respect to time when the vehicle operates in electric mode is shown in Figs 7 and 8 (speed vs time) under two sample conditions. The user's frequent stop-and-start operation of the vehicle is clearly represented in the graph as a rise and fall in the velocity curve.

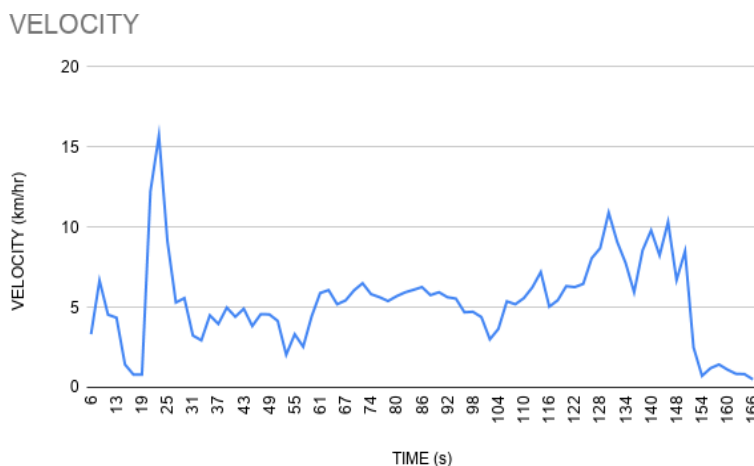


Fig7. Time Vs Velocity for Free Ride (sample 1)

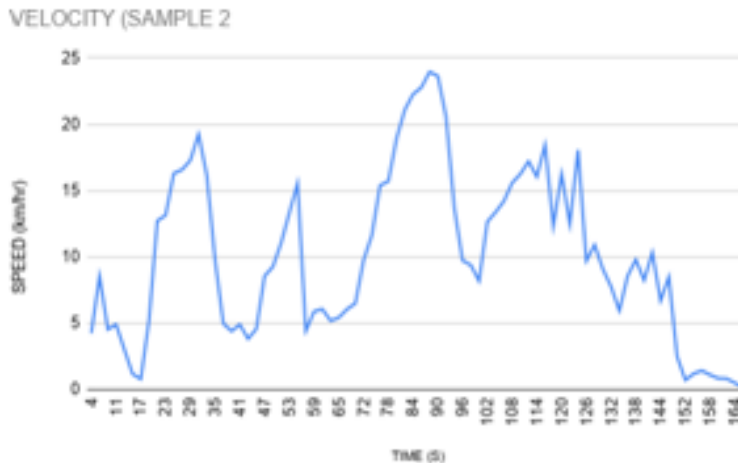


Fig8. Time Vs Velocity for Free Ride (sample 2)

B. Switching Between Fuel and Electric Mode

```

if (linear speed > threshold speed) {
digitalWrite(motorrelay, HIGH);
digitalwrite(ignitionrelay, HIGH)
Serial.print("\t\t vehicle is switched to fuel mode ");
} else {
digitalWrite(motorelay, LOW);
digitalwrite(ignitionrelay, HIGH);
Serial.print("\t\t vehicle is running in electric mode ");
}
    
```

Fig9. Condition used in Arduino for switching

Initially the controller pins for the sensor data, motor relay, ignition relay circuits were assigned i.e. pin 2, pin 7, pin 6 respectively along with their modes. Then interrupt on pin 2 which leads to pulses to the corresponding linear speed (km/hr) of the vehicle

with the of parameters like radius of vehicle, rpm and frequency. Once the exact linear speed is calculated they are compared with the threshold value of speed. Based on the condition the vehicle will operate in either fuel or electric mode. The output from the controller clearly shows the switching between electric and fuel mode by operating relay circuits based on speed values. Thus controller ensures the efficient switching between modes using the defined Arduino code and efficiency of switching can also increase by taking more parameters in account like brake characteristics , battery data etc.

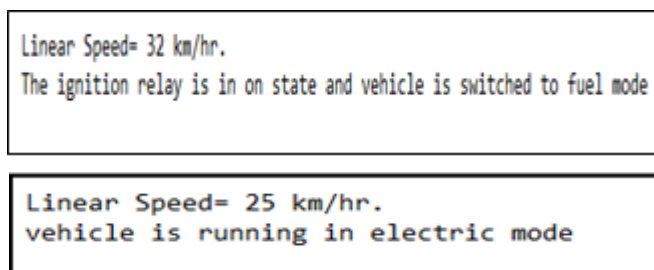


Fig10. Switching Controller Output

C. Pollution From Two Wheeler And Fuel Consumption



Fig 11 Five Gas test for modified two wheeler

TABLE 3. Emission Table Obtained for The Vehicle.

CO	1.37% vol
HC	2360 ppm vol
CO ₂	1.40% vol
O ₂	17.38 % vol
NO	62 ppm vol

The above table clearly shows the pollution level from the modified two-wheeler two wheeler and The fuel consumption of vehicle is found out to be 38km/L or 2.63158 L/100 km. The CO₂ emissions can be calculated from the correlating equation as follows.

$$Y = (2.36 \times X) + 0.035 \quad (3)$$

Where y - is the CO₂ Emissions (g/km)

X- is the Gasoline Consumption (L/100 km) CO₂ emission is calculated as

$$Y = (23.9 \times 2.63158) + 0.035 = 62.9297 \text{ g/km}$$

Every day the usage of two-wheeler for a person is approximately 25 km in this in fuel mode 20 km and 5 km in electric mode would save the environment from pollution up to some extent. For 20 km of ride the mileage is found to be 45 km/L or 2.2222 L/km. and the CO₂ emission is found to be 53.1456 g/km

The total CO₂ emission = Electric (electric) + IC engine (free ride) = 5x0 + 20x53.1456= 1062.912 g/km per day. **The total CO₂ emission** = IC engine (free ride)

$$= 25 \times 62.9297 = 1573.2425 \text{ g/km per day}$$

This shows that the total CO₂ emission per day is reduced around 510.3305g/km.

V. CONCLUSION

The usage of hybrid vehicle increases fuel economy along with reduction in emission level which is clearly evident from the above data. It clearly shows that for a day the vehicle travels around 25 km and out of which 5 km is operated in electric mode. The fuel economy is increased around 6km/L when compared with ordinary fuel run. The emission level is found to be decreased i.e., the total CO₂ emission in case of fuel mode is 1573.2425 g/km per day and in case of electric + fuel mode is 1062.912 g/km per day this shows that the total CO₂ emission per day is reduced around 510.3305g/km. The efficient switching between fuel to electric mode also ensures reduced emission and fuel cost. Here with the help of speed data from the Hall Effect sensor the switching controller (Arduino uno) switches between fuel and electric mode by comparing with the threshold speed value. The efficiency of switching can be enhanced by considering many parameters like brake characteristics, battery SOC etc. The main parameters that all the OEM focusing is emission level and fuel cost. For a day roughly we will use 3 trips hence power consumed for charging a day is 0.756 kWh and for a month is 23.436 kWh. The cost of power consumption for one month is 56 rupees whereas for a same case i.e., 15km usage of vehicle per day in fuel mode cost around 600 rupees for a month. The entire electric unit cost around nineteen thousand and integration of this unit with ordinary vehicle can reduce the parameters like fuel cost along with reduction in emission

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Prediction of Normal and Abnormal Activities from Surveillance Videos

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ABSTRACT

This paper examines and analyzes the security measures that address the difficulties that are faced by the society. The use of surveillance cameras in cities enables researchers to analyze data to ensure automatic monitoring. It is now necessary to ensure safety in public places. Security systems in schools, hospitals, cities, and other public areas have become increasingly compulsory to find violent or unusual activities that can cause economic and social harm. In the last few decades, many methods in machine learning have been encouraged and proposed to obtain functions from the sensor data of certain applications designed for offline processing. With this proposed approach, the human activity recognition system is designed based on a deep-learning to enable accurate and classification of suspicious activity in real-time using video processing. Monitoring is done using a series of video frames taken from CCTV camera footage. This project aims to make a classification system that uses the appropriate machine learning algorithm that classifies videos into their respective category depending upon the activities found in the video. The system can be installed in areas where there is a high risk of criminal activity so that it can be used to intimidate unusual activity.

Keywords: Normal activities; Abnormal; suspicious; Deep learning; Video processing; Classification; CCTV footage; Surveillance.

I. INTRODUCTION

In our daily lives, violence detection techniques are utilized to analyze surveillance camera videos. Computer vision technology plays an important role in this field. Recently, these surveillance equipment and have been placed in various areas like Schools, Colleges, hospitals, banks, markets, roads, and platforms etc. in order to monitor human activities. The crime ratio is also advancing along with the technology advancements. Street and theft crime are majorly faced by all over the world [1].

Finding a suspicious activity all through the day and night for everyday or to find activities in the big data by hand is a daunting task. Mostly, CCTV video feeds are monitored by humans manually. These monitoring people need to watch the various screens without delay for chasing mysterious activities. This process is expensive and wasteful because people are prone to make mistakes and also human administrators cannot monitor multiple screens at once [2].

One solution to this type of issue is to use automated video viewing systems rather than human administrators. To do this, various methods have been developed in recent times to identify real life human activities. These methods are developed into a program or system that helps the user to detect suspicious activity from CCTV footage videos [3]. Several strategies and methods are being developed to detect violent incidents and other harmful patterns in videos.

Therefore, smart automated video monitoring systems for violence detection are increasingly needed today. This motivated us to make significant efforts towards video surveillance systems. To solve the above-mentioned problems, deep learning technique is used which would create phenomenal results in the detection of the activities and their categorization.

In-deep learning approach CNN (Convolution Neural Network) is used to detect abnormalities in the first phase from the input video and classifies them into their respective category. The proposed system gets the sequence of images (i.e. the frames) from the input video to detect anomaly activities like fighting, running, chain snatching, etc. If there is any one of the discrepancies namely chain snatch, fighting, and running takes place in the video, that action is detected and identified in the specified video frames.

Activity recognition from videos has received more attention recently and it has achieved the most promising performance with the help of the robustness of CNN [4]. Currently, the proposed model is trained so that it will be able to predict the behavior of human from CCTV footage videos. The model could predict either typical or suspicious activity of human from the input videos which is used to assist a monitoring process.

The model proposed in this paper will use CCTV footage obtained from surveillance cameras from various streets or public places for monitoring the human behavior on streets or in any public places and warns when

any event occurred is found to be abnormal. Understanding the behavior of humans is a tedious task because of varying background. So many different areas should be subjected to surveillance and activities of the pedestrians have to be monitored. The CCTV footage videos from various sources are used to train and test the model.

The training process of a model can be described as three major parts: Preparation of data, model training & validation and testing of results. The model framework contains the Convolutional Neural Network (CNN) which is used for extraction of high-level quality features from the images in order to reduce the input complexity. CNN can also be used for performing classification, which suits the video stream process appropriately.

This paper is structured further as 4 more sections: where the Section II describes similar activities done in the field of behavioral detection to find abnormal activity. An overview and implementation details of the proposed approach is described in Section III. Result analysis and accuracy calculations are explained in Section IV and finally the conclusion and future enhancements are described in Section V.

II. LITERATUREREVIEW

The literature review suggests different approaches made for detecting human activities from videos. The objective of these related works was to detect any suspicious or anomalous events in a surveillance video.

A approach based on semantics was suggested in [5]. The captured video is processed and background elimination is done with the help of background subtraction method. After this step, the detected foreground objects are differentiated as moving or not using a Haar algorithm. Tracking was performed using the real-time Blob matching algorithm.

The AMD algorithm which stands for (Advance Motion Detection) to identify non-permitted entrance to the area that is under restriction [6]. Initially, the objects are identified with the help of Background-subtraction method and also generally from a sequence of frames of the video, the objects are extracted. The next step is finding the abnormal activity. The main significance of this model is the algorithm used as it functions to process Real-Time videos and its complexity of computing is also seems to be decreased. Though this system stands back when it comes to storage, it can also be combined and executed with some other hi-tech algorithm models for video capturing.

Depending upon the details of the motion between the objects, the activities are identified as suspicious in [7]. Semantic-based proposal have been done to explain abnormal activities. The identification of objects and method of correlation is used for object tracking [5]. The activities are split into their respective classes based on object's motion and time-related data. The suggested framework has less computational complexity.

Anomalous activities from the educational institution were detected by dividing them as different sectors and the optical-flow estimations are done in all the sectors with the help of the Lucas kanade's method. Then, a graphical representation of the magnitudes of optical-flow vectors is created. Some common software algorithms were used to analyze videos to classify the activities as either abnormal or normal [8].

The model is designed to differentiate anomalous activities from normally occurring activities depending upon the objects motion data collected from videos. The Hidden Markov Model is used to study the histograms of the frames of videos. The system then finds similarities among these frames with the normal frames that already exist.

The model has been tested as well as verified on various data sets such as the PETS and UMN datasets [9].

Suspicious activities in videos can be found by locating humans. Humans were found in the video using the background subtraction method. Feature extraction is done by CNN and then given to Discriminative Deep Belief Network. Subsequent comparisons of the details collected by CNN and extracted feature details from a video sample of categorized abnormal activity were performed by DDBN and various abnormal activities were identified in a input video [10].

A deep-learning based Real-time activity detection system was initiated to avoid violence by crowds and sports persons. The frame extraction from videos in a spark environment is done. In case of some abnormality happens in soccer, it notifies the respective security personnel. The VID dataset has been used to detect violent events in soccer stadium [11]. Suspicious activity recognition has various video data processing modules. The proposed model based on Convolutional Neural Network and Long-Short Term Memory made use of the UT Interaction

dataset. Identifying some activities similar to human behavior such as pointing or punching is an issue with the system. [12].

A model was set up to watch out student activities in assessment using Neural networks along with Gaussian distributions. The system has 3 distinct categories: Face recognition, abnormality detection, and undesirable actions identification. The model that has been trained finds if any student is in an abnormal situation whereas the Gaussian-distribution determines if the student commits some undesirable suspicious activity or not [13]. The smart video recognition for analyzing the crowded situation has been proposed in [14]. It is a literature study paper that surveys papers related to surveillance video analyzing done in recent times, different deep-learning methods and algorithms, and about the data-sets that are used for analyzing surveillance videos.

Most of the systems discussed so far are made with the help of computer-vision with the help of different algorithms to obtain an analysis of human behavior in videos. These methods need more pre-processing steps to be done for extracting important details of moving patterns to recognize the appearance of elements in videos [15]. Along with which the method of Background-subtraction is done based on a removing the background elements that are often static that mostly doesn't work in every situations. Methods mentioned above do not work well when handling a crowd. According to a literature review, deep-learning architecture formation could be modeled on abnormal events detection using 2D-CNN. By doing so the system performance could be improvised. The deep-learning process that takes place in the majority of the papers only detects abnormal events. One effective way to inform safety is therefore required in the event of suspicious behavior.

III. PROPOSED SYSTEM

The model proposed here will make use of CCTV footage videos collected from various sources for tracking and recognizing the activities and classify them into their corresponding class of activity.

A. System Architecture

The framework of this system contains various stages they are: dataset collection and splitting, preparation of data, extraction of features, classifying the activities and predicting the classes. The basic structure of the model is shown in Fig.1.

The system categorizes the input video into five classes of activities as follows:

- 1) Walking - Normal class
- 2) Running- Normal class
- 3) Crowd activities - Normal class
- 4) Fighting -Suspicious activity
- 5) Chain-snatching - Suspicious activity

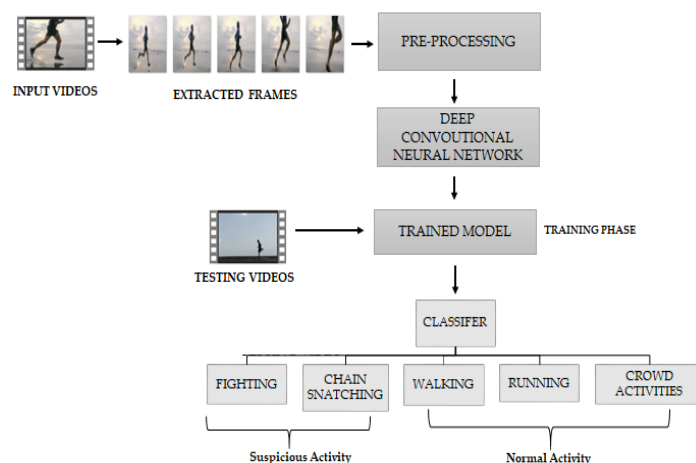


Fig.1 System Architecture

B. Description of Dataset

A large number of video-datasets are ready for use to perform object detection and behavior detection. Apart from these, from the survey done so far we found that, databases that are apt for street-thefts and Chain-snatching are unavailable. Thus, we created the dataset by collecting videos from different datasets available in Kaggle etc. Some of the datasets from which the CCTV video footages are collected are: UCF-crime, Snatch 1.0, Anomaly detection and so on. The dataset consists of videos each with an approximate duration of 15-30

seconds. In our system, we assumed 5 activities, each represented by 20-25 videos. The videos are in .mp4 and some in .avi format. The assumed activities are: Walking, Running, Fighting, Crowd activities, and chain snatching. The dataset shows the suspicious as well as normal behavior of human in various locations. Few glimpses of this dataset are shown in figure 2.



Fig.2 Dataset collection

D. Pre-Processing

Deep-learning architecture is used in the system introduced to perform abnormal event recognition from CCTV footage. The performance that is the accuracy could be greater than other systems and it can also give more satisfactory results with larger number of videos. Before pre-processing, the dataset is split into two sectors namely, the train and the test part. The train split has the part of the dataset needed for the model to fit and the test set has the other part of the data needed for evaluating the final model's fit on the train set. In this proposed system, a split of 80/20 is done. This split would correspond to 80% to train the model and 20% in order to test the model. Before passing any input to a model, we must pre-process it, so as it suits the model's requirement. Or else, the model will not perform well enough. The major aim of this pre-processing is preparing the data for the system so that the computational processing and analyzing becomes easier.

a) Standardizing The Frames

To perform pre-processing, firstly the frame extraction is performed in order to train them. The extracted frames are stored in a separate folder. The entire videos are split up to 8275 no. of frames and they are saved in .jpeg format (as images). Standardizing the images (i.e. the frames) is one of the significant constraints that exist in some machine learning algorithms like CNN. It means resizing the frames present in the video data set to one-dimension (i.e.) the frames should have same width as well as height. So now, the preprocessing is done by resizing each of the frames to 224*224 to make it suitable for 2D-CNN structure. The videos that are to be tested are also extracted as sequence of frames and re-scaled to 224*224 and saved separately.

b) Gray-Scale Conversion

As next step, we convert colored images into gray-scale images for the purpose of reducing computation complexity. Losing some of the unwanted pixels from images in order to decrease storage and complexity is found to be effective. In most of the elements, its colour is not important for detecting and interpreting that image. Gray-scale image act well in identifying some elements. And also the colored images has many details compared to black & white image, so they are converted into gray-scale images and as a result the frames under processing will not be complex and will have less memory storage.

c) Augmentation of Data

One of the common pre-processing methods is to augment the dataset with varied translation of the already available images. Rescaling, zooming, flipping and some other transformations are done typically. They are done to introduce the CNN model to a wider kind of variations of the frames to be processed. This makes it more likely that the model will be able to recognize elements when they appear in different shapes. We generally do this augmentation before model training and also only for the frames to be trained. During the testing process we will be using those images directly with no augmentation.

Some of the affine transformations that are carried in this system are: Zoom Augmentation, Shearing and Horizontal Flip.

- 1) *Zoom Augmentation*–All frames that are extracted are subjected to zoom Augmentation. The class called Image Data Generator in Keras library is used to do the augmentations which accepts a floating value or sometimes a 2 list values: In case of a single number, the range of zoom is considered as [1-Value, 1+Value]. In the other case, one number is considered to be lower and another value as the upper limit.
- 2) *Shearing* - Shear transformation aids in slanting the frame shape. Shearing is similar to rotation but differs

in a way that in shear transformation, the images will be stretched at some angle (called shear angle) while fixing any one single axis. In simple words, it is a process of stretching the images, which cannot be done when we rotate the image. When we provide shear_range=0.2 it means to shear the image by 20%.

- 3) *Horizontal Flip*—By this flipping process, images are flipped in horizontal or vertical direction. For instance, in this system flipping the human images in vertical direction is not done as the resulting image of human will represent in upside-down direction. But flipping it in horizontal direction generates right and left view of a human. So, in case of this system it is enough to use the horizontal flip and using vertical flip will be meaningless.

d) Background Subtraction

Background subtraction is a way to eliminate the background from the frame or an image. To do this we are separating the moving fore-ground pixels from the immovable fixed background. In OpenCV, there are three algorithms to do this operation, they are:

1. Mixture Of Gaussians (MOG) Algorithm
2. Mixture Of Gaussians 2 (MOG2) Algorithm
3. Gaussian-Mixture based (GMG) Algorithm

In short, MOG algorithm is applied to each frame in order to remove the background from foreground moving objects. This is done by considering the expected background colors are the pixels which remains in the same place for long time. The frame is then given to MOG2 algorithm because it contributes improved adapting capacity for scenes that varies often and that will be caused due to illumination changes and also detects and marks shadows, which will be indicated in grayish color. The GMG algorithm will combine static-background estimation and pixel-wise Bayesian Segmentation which removes unnecessary noises present in the frames. Results of the algorithms applied successively to a frame are shown in Figure 3.

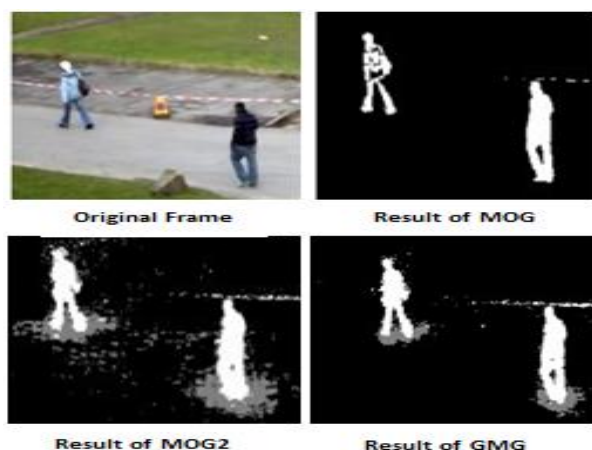


Fig. 3 Background Subtraction

C. Feature Extraction

Features specify the patterns or parts of an object in the frame or image that helps us to identify the object. They include corners, edges, region of interest points. So, feature extraction is an important step which helps us to reduce the number of resources that is needed for processing without losing relevant or significant information. Here, in our system we have used CNN (Convolutional Neural Network) for feature extraction process.

Steps involved in feature extraction using CNN

To give a brief basic about CNNs that when we give the computer an array of numbers (image) as input then the resulting numbers depicts probability of the image to belong to a particular class (i.e. 0.80 for Running, 0.15 for Fighting, 0.05 for a Walking, etc.). In simple words it works similar to how our brain works. The machine performs the classification of images by detecting low-level features like curves; edges etc., and then develop up to deeper details to obtain high-level features by deploying a continuous sequence of convolutional layers.

First layer is the convolution layer, where the matrix-like depiction of the input frame gets to multiply with the Feature- detector element-wise in order to produce a feature map. It retains the important features of the image to identify the specific object. As we go through a set of convolutional layers, the output will represent higher level features. We also apply rectifier function after every convolution operation to increase non-linearity in

CNN. Layers that are present already in the structure (i.e., the ones which are almost near to the original inputted image) will learn lesser filters of the convolution while the layers which are almost nearer to the result predictions) learns higher number of filters. Tuning the perfect value of filters is based on (1) Complicacy of the dataset and (2) the deepness of the neural network.

The output feature map of convolution layer will record precise position of features in input because of this a small movement in the position of the feature will result in a different feature map. To overcome this problem max-pooling layer is used as a second layer after every convolution layer which helps in reducing the image size by retaining the main features of the image. Once after obtaining the pooled-feature map, the immediate step is to flatten it. Flattening is nothing but to transform all matrices of the pooled feature map into one column which will be then sent to the neural network for further processing.

After this, the feature map that was flattened is passed via a dense layer in neural network which is a combination of Input layer, Fully connected layer or dense layer, and Output layer. The dense layer is like the ANN's hidden layer but the difference is it is connected fully. We get the final predicted classes from the output layer. The error in prediction is calculated by passing the information into the neural network and the error is back-propagated to the model in order to improve the prediction. Next to address over fitting problem that usually occurs when training the model, the layer called dropout layer is used where it drop outs certain set of activation. This helps the model to train itself in a more generalized way. After passing through the fully connected layer the final layer uses the softmax activation function because the final figures we got as output usually do not sum up to one in terms of probability. However, it is important that they must be brought down to numbers between 0 and 1, representing the probability of each activity class. The figure 4 shows the architecture of the CNN layers used in the proposed model.

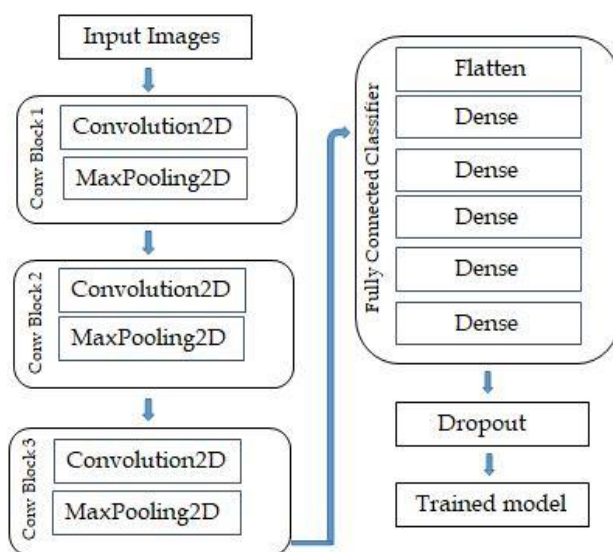


Fig 4. CNN layer architecture

D. Training And Fitting The Model

The model should now be trained to fit the model for future use. While training the model there is a higher chance of the model for getting over-fitted. Over-fitting happens when a model learns the details and noise present in the training data to the extent which will result in negative performance of the model when tested upon new data. In simple terms, a model that is over-fitted performs well on the training set but poorly on the test set, this describes that the model is unable to generalize when it works on new data.

There Are Some Techniques To Avoid And Overcome Over-Fitting, They Are:

1. Using data augmentation
2. Knowing when to stop training

In the proposed system, data augmentation and stopping the training process at correct time are taken as steps to avoid the over-fitting of data. Data augmentation is performed during the pre-processing.

Knowing When To Stop Training

In simple terms, knowing the number of epochs to which the model needs to be trained plays a major role in deciding if it over-fits or not. The exact number of epochs can be decided by analyzing the validation loss rate

and accuracy of training. When the number of epochs gets increased, the training accuracy should also be increased whereas the validation loss rate should be decreased. By doing so, the model can be trained accurately by increasing the number of epochs until both the validation and training accuracy starts to decrease. So at that point of time, the epoch value which corresponds to the early stopping value is chosen as the exact epoch number.

Training and fitting the model in this way will fine-tune the weights that are generated which will be used for classifying the test set. The weight file generated will be stored as .hdf5 file which can be used for predicting the activity class for test set videos by loading the weights.

E. Validating And Testing The Model

Testing is a process done by executing a program for finding if there are any errors in the system. The models that are trained are validated using the test set, so that the model with the best performance can be identified and the training accuracy can be found. The training accuracy (%) and the validation accuracy (%) obtained after compiling and fitting the model are displayed in the below table I.

TABLE I. Training and Validation Accuracy

Normal or Abnormal activity classification	ACCURACY (%)	
	Training Accuracy	Validation Accuracy
	99.55	99.03

F. Making New Predictions

For making new prediction, as an initial step the above trained model is loaded and then the video to be predicted is captured from the file location. Once the video is successfully opened without any errors, the frames of that particular video are extracted. Feature extraction is performed on those extracted frames using the previously trained model and as a final step the activity class is predicted based on the trained weights and the result is displayed

IV. RESULT ANALYSIS

The model is developed and tested. A metric that is commonly used for evaluation of the classifying models is Accuracy. Simply, Accuracy is defined as the fraction of the predictions made by the model which was correct. Accuracy of the system is generally calculated using the formula:

$$\text{Accuracy} = (\text{No of correct predictions} / \text{Total No of. Predictions}) \times 100\%$$

Initially, confusion matrix is calculated. It is an matrix of size N×N where N denotes the no. of classes being predicted. Since there are 5 classes (i.e. N=5) the matrix would be 5×5. After which the True Positive (TP), False positive (FP), True Negative (TN) and False Negative (FN) values are calculated for computing the accuracy of the system using the below formula.

$$\text{Accuracy} = ((\text{TN} + \text{TP}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN})) * 100$$

The figures 5 and 6 show the accuracy calculations done using the predicted video tags and predicted frames respectively.

```

from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report
print(confusion_matrix(actual,predict, labels = ['Running','Walking','Chainsnatch','Crowd','Fighting']))
print(classification_report(actual,predict, labels = ['Running','Walking','Chainsnatch','Crowd','Fighting']))

[[3 0 0 0]
 [3 0 0 0]
 [0 4 0 1]
 [2 0 0 0]
 [1 1 0 2]]

      precision    recall  f1-score   support

Running      0.33      1.00      0.50         3
Walking      0.00      0.00      0.00         3
Chainsnatch  0.00      0.00      0.00         5
Crowd        0.00      0.00      0.00         2
Fighting     0.67      0.40      0.50         5
    
```

Fig 5. Accuracy calculated using predicted videos

CALCULATION:

$$\text{TP} = 9 ; \text{FN} = 9 ; \text{FP} = 9 ; \text{TN} = 9 + 15 + 13 + 16 + 12 = 65$$

$$\text{TN} + \text{TP} = 74$$

$$\text{TP} + \text{TN} + \text{FP} + \text{FN} = 92$$

$$\text{Accuracy} = ((\text{TN} + \text{TP}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN})) * 100$$

$$= 74 / 92$$

Accuracy = 80.43 %

```

y_pred = []
y_true = []
from sklearn.metrics import confusion_matrix
from sklearn.metrics import classification_report
y_pred=d
y_true=act_try1
print(confusion_matrix(y_true,y_pred, labels = [1,2,3,4,5]))
print(classification_report(y_true,y_pred, labels = [1,2,3,4,5]))

```

[[	0	214	163	74	0]				
[	0	20	3	0	0]				
[	0	12	371	2	0]				
[	0	0	36	0	0]				
[	0	1	39	2	0]]				
						precision	recall	f1-score	support	
						1	0.00	0.00	0.00	688
						2	0.08	0.44	0.14	45
						3	0.61	0.95	0.74	390
						4	0.00	0.00	0.00	36
						5	0.00	0.00	0.00	42

Fig 6. Accuracy calculated using predicted frames

CALCULATION:

$$\text{TP} = 391; \text{FN} = 451 + 3 + 14 + 36 + 42 = 546$$

$$\text{FP} = 0 + 227 + 241 + 78 + 0 = 546$$

$$\text{TN} = 486 + 687 + 311 + 823 + 895 = 3202$$

$$\text{TN} + \text{TP} = 3593$$

$$\text{TP} + \text{TN} + \text{FP} + \text{FN} = 4685$$

$$\text{Accuracy} = ((\text{TN} + \text{TP}) / (\text{TP} + \text{TN} + \text{FP} + \text{FN})) * 100$$

$$= 3593 / 4685$$

ACCURACY = 76.69 %

Once the video is classified by the system, a rectangular box around the predicted activity or human action is displayed along with which the label of the predicted activity whether it is running, walking, fighting, etc. is also shown on the output screen. Additionally, the static background pixels that are eliminated are shown as black color and the foreground moving pixels are shown in white color is displayed in a separate output window for better visualization and the predicted activity name will be displayed on the terminal also.

The figures 7,8,9,10,11 and 12 shows the output of the human activity detection system which classifies Walking, Running, Fighting, Chain snatching, normal crowd activities and abnormal crowd activities respectively.

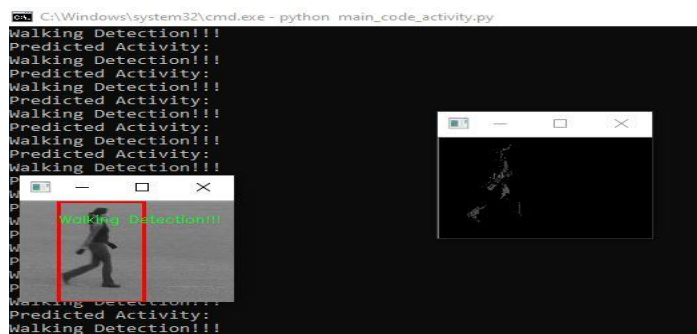


Fig 7. Walking activity detection

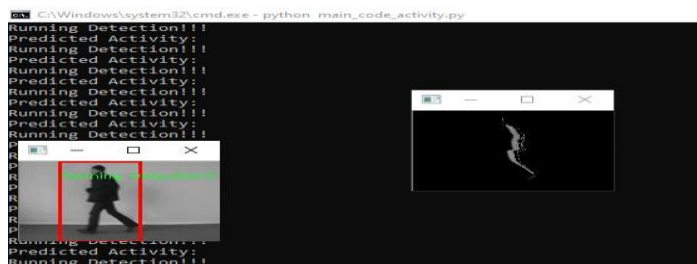


Fig 8. Running activity detection

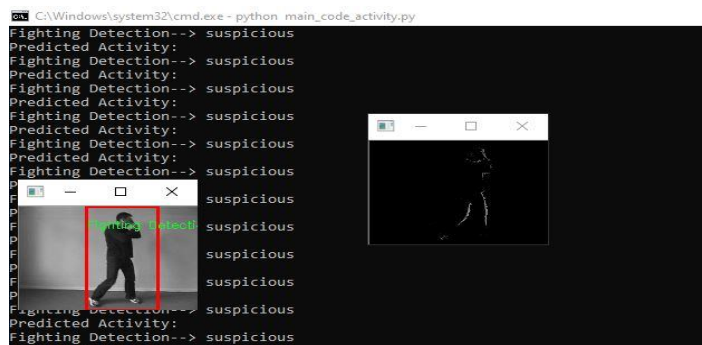


Fig 9. Fighting activity detection

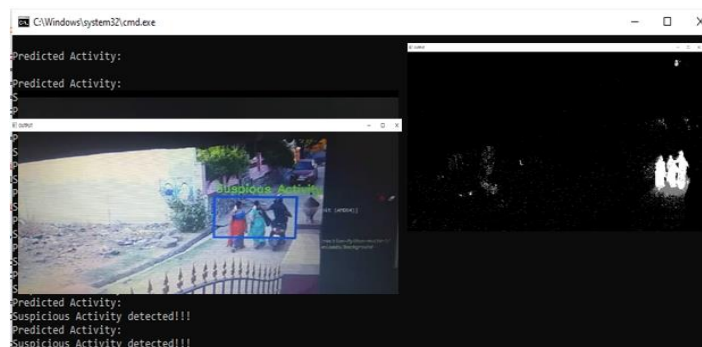


Fig 10. Chain snatching activity detection

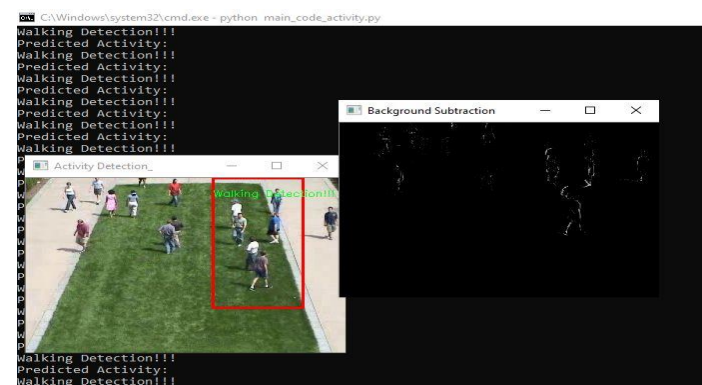


Fig 11. Normal crowd activity detection

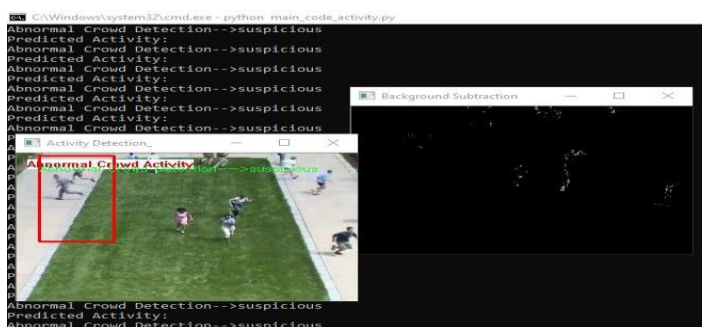


Fig 12. Abnormal activity in crowd detection

V. CONCLUSION

In this paper, we focus mainly on the automatic detection of abnormal or normal activity without more human intervention. The feature extraction and classification process are done with the help of CNN. This system mainly focuses on discovering the features of a video file that make it possible for a computer to recognize the type of activity. Though the system takes less execution time and provides good accuracy, the system can be improvised to be used to warn the officials for taking further actions in case of any suspicious activity that takes place to reduce thefts and illegal activities. The system can be installed in places where there is a higher chance of crime rate where it can be used to alarm the abnormal activity. The system can be further developed in the future to monitor all types of anomalous activities to reduce robberies and thefts and it can also be improvised

by detecting the details of the individual who looks suspicious from the suspicious activity detection. This project can be further enhanced by training more number of videos in order to classify them appropriately and the application can still be fine-tuned to give more accuracy by classifier combination techniques.

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Automatic Speech Recognition and Evaluation System

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ABSTRACT

Automatic speech recognition and evaluation system is an application that converts the user audio into features. The application then evaluates it with an already obtained audio set for the English alphabets using LSTM based RNN. The model aims at taking voice of a user as input and predicting how accurately the user has pronounced a certain alphabet. Librosa, a python library, is used for feature extraction and LSTM based RNN model is used for Prediction and keras is used as platform. The scope of this model is to increase the efficiency of learning English. This model can also be appended in several areas. Some of them are: The model can be integrated with existing systems that are being used for Scribing for the visually challenged. The system can be used by students and various other active learners of the language English.

Keywords: Long Short Term Memory (LSTM), Recurrent Neural Networks (RNN), Automatic Speech Recognition (ASR), Keras.

I. INTRODUCTION

English is known as the global language and thus it's important for the current generation to be proficient in English. The purpose of this project is to help people who learn the language English more efficiently. While learning a new language people tend to add dialects or slang while talking, or sometimes they may even be unaware of the actual proper pronunciation. This application will help the user evaluate their pronunciation and help them correct it by providing the proper pronunciation. By this, the user will be able to improve his or her efficiency in speaking the English language.

The field of machine learning has seen a tremendous amount of research and an exponential growth over the past few decades, particularly in speech recognition. However, in past years, people have mainly focused on utilizing deep learning for speech-based applications. This new space of AI has yielded much better outcomes when contrasted with others in an assortment of uses including discourse, and hence turned into an extremely appealing space of exploration. Automatic speech recognition (ASR) has become more advanced over the past several years. The purpose of ASR is to translate the words spoken by human into a system recognizable language. It extracts the features from the speech signal and classify them using machine learning and deep learning concepts. In the existing systems, Speech recognition system has been developed for small and medium based vocabulary of continuous speech system. It aimed at finding accuracy of the words that has been pronounced. Another such system aimed at finding the accuracy of isolated Tamil words. It used syllable based method or phoneme based method. These kinds of systems are useful for physically challenged people and old aged people who may find it difficult for handling computer devices. Taking the existing models as reference, we would like to propose a new system to predict the accuracy of English alphabets that has been pronounced. The features are extracted from the audio given as input and those are compared with the existing dataset of features and hence the accuracy will be calculated.

II. RELATED WORK

This work helps a person in improving the efficiency in pronouncing the language English. On preparation of this work, other notable works were referred based on ASR and Speech to Text conversion. Other notable works are listed below:

Nivetha S, Rathinavelu A et.al, [1] delivered an application which combines MFCC and LPC features taken for recognition and these two combined together provided a better recognition system with improved accuracy and the drawback is this work involves more than the required number of comparisons.

Dr.V.Ajantha Devi et.al, [2] proposed the most suitable for speech recognition compared to other techniques and the drawback is it can't correctly recognize the words present in the vocabulary.

Umarani S.D et.al, [3] designed the high recognition rate under low signal-to-noise-ratios (SNR) and has a low recognition under high SNR.

Geetha K et.al, [4] suggested a probability to the sequence of acoustic features extracted from the speech signal and the limitations are for a given set of sequences, there are many possible HMMs, and choosing one can be difficult.

C. P. Dalmiya et.al, [5] proposed a reliable time alignment between reference and test patterns is obtained and has a disadvantage that the heavy computational burden required to find the optimal time alignment path.

Bhoomika Dav et.al, [6] proposed the model which extracts MFCC, LPC, PLP and HMM features using acoustic modeling, language modeling and decoder for the reduction of the complexity with the minimum time consumption and the drawback is that the accuracy cannot be high in the case of speaker dependent.

Chadawan Ittichaichareon et.al, [7] suggested an approach two models maximum likelihood and Support Vector Machine which analyze the features of MFCCs and compare the accuracy of both the models. The disadvantage is that both the models does not support the large set of datasets and the accuracy is predicted for only small samples which may also get deviated with large samples.

Rabiner et.al, [8] proposed the system which identifies the string of connected digits with high accuracy and it is based on time derivatives and tested against three modes and the drawback is that string error rate is difficult to compute.

Povey et.al, [9] designed the system for the recognition of the tamil words using HMM and GMM and it has the limitation of recognizing upto trisyllabic words.

H. Venkatesan et.al, [10] suggested an approach for the research on regional languages in the domain of spoken language identification helps to increase the reach of technology to regional language speakers while also contributing to the preservation of regional languages and the drawback is that it is constraint to four languages.

Ishan Bhardwaj et.al, [11] proposed a model for hindi speech recognition with k-means algorithm and the noisy environment has achieved the highest accuracy but drawback is that only ten voices of male and female are taken to predict the accuracy which may fails with larger datasets.

Mondher Frikha et.al, [12] proposed a hybrid model which includes ANN, HMM and both are collaborated to increase the efficiency in the field of speech recognition but it is not examined with the real-time data.

III. EXISTING SYSTEM

These papers indicate that there is a need for a system that is capable of predicting accuracy of the pronounced English alphabet. Even though accuracy of alphabets can be predicted using phonemes it is understood that phonemes are most efficient for predicting accuracy of words than alphabets. Therefore, a system that predicts accuracy on comparison with already recorded and feature extracted human voice is required.

Python programming has been used for the complete development of the application. It is preferred because of its readability, dense syntax and comprehensive and large standard library that has automatic memory management and dynamic features.

Python libraries used are MinMaxScaler (for scaling of values), librosa (for extracting features), tkinter (for front end), pandas (loading and storing the dataset), numpy (to work with numerical data) and keras (to use models like LSTM).

IV. ALGORITHM

- INPUT : Alphabet audio file(.wav file)
OUTPUT: Accuracy of the alphabet
1. Extract the features like mfccs, zcr, rmse, rolloff, spectral centroid, spectral bandwidth and chroma stft from the audio file.
 2. Store the extracted features in the dataset.
 3. For each input in LSTM model:
Load the dataset which contains the features and label of the alphabet
Label the alphabet column and normalize the features.
Split the row values into train and test data
Allot the train data into input and output values.
Repeat the same procedure for test data.
Reshape the input into 3D format (model accepted input).
Build the model and fit the network.
Predict the accuracy.
 4. Display the output to the user.

Fig 1- Proposed algorithm for ASR and evaluation system

MFCC Feature extraction steps:

1. Implementing the Discrete Fourier transforms (DFT).
2. Processing of Mel Filter Bank.
3. Calculating the log energy.
4. Reversing the process of DFT.
5. Calculating delta cepstrum coefficients

V. PROPOSED WORK

Automatic speech recognition and evaluation system contains a collection of audio files that have been recorded using the tool called wavosaur which is an audio editor and editing software, processing and recording sounds, wav and mp3 files. These audio files consist of all the 26 alphabets that have been spoken for less than or equal to two seconds to have the accurate pronunciation of the alphabets. These have been used as a dataset for training the LSTM model.

The features like mfccs, zcr, rmse, rolloff, spectral centroid, spectral bandwidth and chroma stft have been extracted from these audio files in the form of numerical values and then normalized in order to increase the performance of the model and has been stored in a csv file along with the alphabet labels. The model was trained using the predefined dataset and the accuracy was predicted by using root mean squared error value which should be in the range of 0.2 to 0.5 for the well trained model and then tested with the real-world data. The final displayed output is the accuracy of the user's pronunciation.

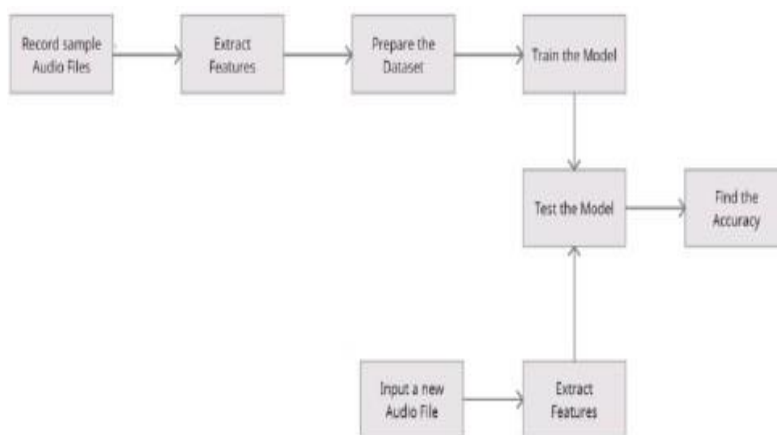


Figure 2 - System flow diagram

VI. Proposed System Architecture

Long Term Short Memory (LSTM) based Recurrent Neural Networks (RNN) model has been used for training, testing and predicting accuracy of the features that have been extracted from the audio files that has been recorded using Wavosaur.

Recurrent Neural Networks is a type of neural network where the input of the current step is the output of the previous step. A picture is given to demonstrate a RNN.

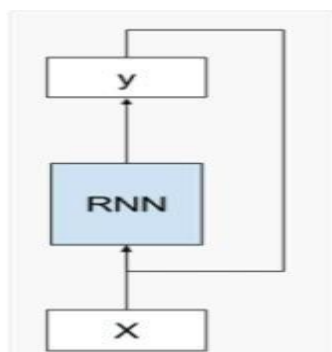


Figure 3 – RNN with a cycle

In figure 2, it is seen that the network takes both the previous time step's output and the previous time step's internal state as input and uses the previous time step's internal state as a starting point for the current time step. Recurrent neural networks are intricately tied to sequences and lists, as seen by their chain-like character. They're the most natural neural network architecture to employ for such data.

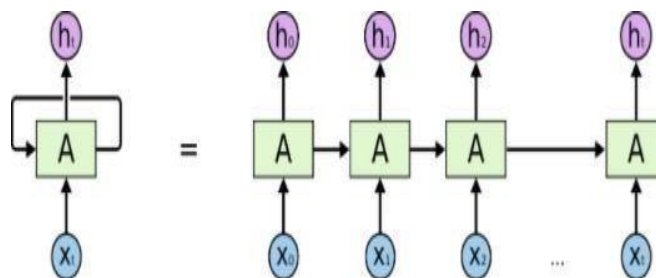


Figure 4 - An unrolled RNN

RNNs can learn to use prior knowledge in situations when the distance between relevant information and the location where it's needed is short. If we apply LSTM, we can close this gap.

Speech recognition, language modeling, sentiment analysis, and text prediction have all benefited from the usage of long short term memory networks, or "LSTMs." RNNs are enhanced versions of LSTMs. RNNs constantly learn from recent occurrences, but it doesn't always require the network to learn from recent information. The aforementioned RNN flaw prompted researchers to create and patent a new variation of the RNN model known as Long Short Term Memory. Because it utilizes gates to regulate the memory process, the LSTM can overcome this problem. The LSTM has a unique design that allows it to ignore irrelevant data. LSTM model learns which information to keep in long- term memory and which to discard.

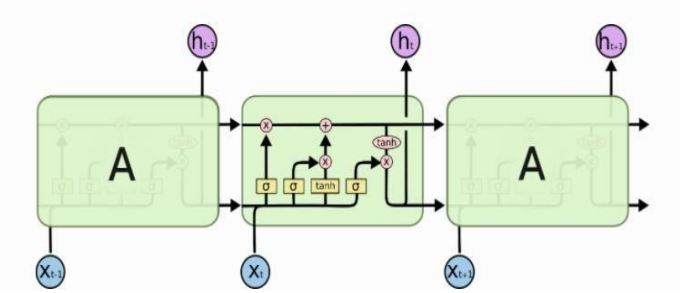


Figure 5 - Repeating model of an LSTM containing four

INTERACTING LAYERS

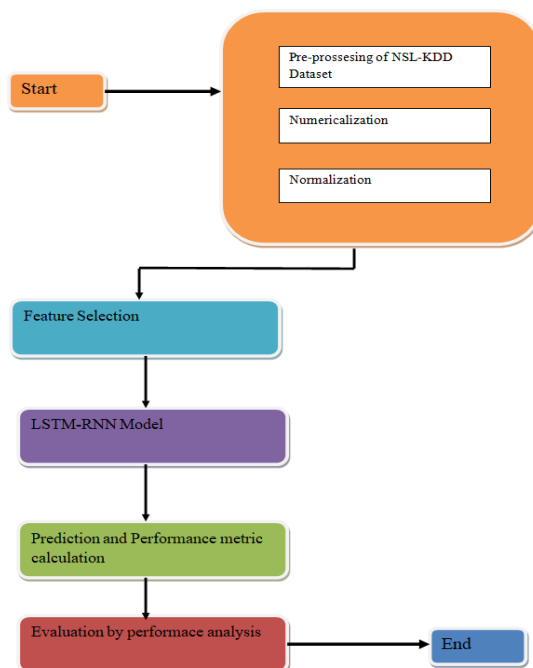


Figure 6 - LSTM Work Flow

VII. Experimental Analysis

The dataset used was not readily available in any data repository or website.

The dataset contains 105 rows and 27 columns.

The columns in the dataset contain features extracted from the audio file (alphabet pronunciation) which were recorded using a tool called wavosaur. All the audio files are of 2 seconds duration. The features from these audio files were extracted using a python library (librosa). The features extracted are chroma stft, rmse, spectral centroid, spectral bandwidth, roll off, zero crossing rate mfcc1, mfcc2, mfcc3, mfcc4, mfcc5, mfcc6, mfcc7, mfcc8, mfcc9, mfcc10, mfcc11, mfcc12, mfcc13, mfcc14, mfcc15, mfcc16, mfcc17, mfcc18, mfcc19, mfcc20 and label.

Chroma stft: This feature is used to analyse the pitch of the audio file.

RMSE: Root mean square error (RMSE) is used determine the quality of predictions.

Spectral Centroid: This feature is used to give a measure of the spectral rate of change that happens locally.

Spectral Bandwidth: This feature is derived from Spectral Centroid. It is used to determine the energy spread across frequency bands.

Roll off: This feature is used to roll off the frequencies above or below a certain pitch of the audio.

Zero crossing rates: This feature is used to differentiate between voiced and unvoiced audio.

MFCC1 – MFCC20: It stands for Mel Frequency Cepstral Coefficients. The shape of the human vocal tract produces different shapes for different alphabets, the sound generated depends on the shape of the vocal tract. MFCC correctly determines the shape using which the sound produced can be classified correctly.

Label: This feature represents the label for the corresponding audio.

Rows of the dataset contain features extracted from the recorded voices of 4 different individuals pronouncing all the alphabets. A person who wants to test the accuracy the pronunciation will have to record the voice and the corresponding features extracted will be added to the dataset in a new row.

Wavosaur is a tool which is used to record, process and edit audio files. The audio file recorded is stored in .wav format. Using wavosaur audio files can be cut, copied, pasted, remixed, crop, delete, undo. The tool gives us a facility to record for certain duration of time conveniently.

Using wavosaur correct representation of audio wave can also be visualised. This gives a better understanding about the feature of audio file like pitch, depth. This tool is also preferred because it easily removes silent sound period from the audio file.

The audio files from wavosaur can be converted into text form using the built in functions and can be used to visualize in excel or matlab.

PRE-PROCESSING THE DATASET:

After extraction of features from the audio files, to scale the data between values 0 to 1, min-max normalization has been performed. Minimum and maximum value from each column is extracted and new values are calculated using the formula,

$$v' = (v - \min_A / \max_A - \min_A) (\text{new_max}_A - \text{new_min}_A) + \text{new_min}_A$$

The same has been achieved using python library sklearn.preprocessing.MinMaxScaler.

True Positives (TP) are properly predicted positive values, indicating that the value of the actual class and the value of the anticipated class are both yes. For example, if the actual class value shows that this passenger survived and the projected class also suggests that this passenger survived.

True Negatives (TN) are accurately predicted negative values, meaning that the real class value is zero and the projected class value is also zero. For example, if the passenger did not survive in the real class and the predicted class confirms this.

False Positives (FP) are when the actual class is not the same as the anticipated class. For example, if the actual class indicates that this passenger did not survive, but the projected class indicates that this passenger will.

False Negatives (FN) are situations in which the real class is yes but the anticipated class is no. For example, if the passenger's actual class value indicates that he or she survived, while the projected class value suggests that the person would die.

		Actual	
		Positive	Negative
Predicted	Positive	True Positive	False Positive
	Negative	False Negative	True Negative

Figure 7- Confusion matrix

PRECISION

26 alphabets indicate all the alphabets pronounced by a single person.

52 alphabets indicate all the alphabets pronounced by two people.

78 alphabets indicate all the alphabets pronounced by three different people.

104 alphabets indicate all the alphabets pronounced by four different people.

The ratio of True Positives to all Positives is known as precision.

Precision also allows to calculate the number of relevant data points. It's critical that one doesn't start treating a patient who doesn't have a cardiac problem but was projected to have one by our algorithm.

$$\text{Precision} = \text{TP}/(\text{TP}+\text{FP})$$

RECALL

The recall is a measure of how well the model detects True Positives.

Recall is a metric that indicates how well the model can detect relevant data. It's also known as True Positive Rate or Sensitivity.

$$\text{Recall} = \text{TP}/(\text{TP}+\text{FN})$$

ACCURACY:

The ratio of the overall number of right forecasts to the total number of predictions is known as accuracy. It is just a ratio of properly predicted observations to total observations, and it is the most straightforward performance metric.

$$\text{Accuracy} = \text{TP}+\text{TN}/(\text{TP}+\text{FP}+\text{FN}+\text{TN})$$

F1 SCORE:

The F1 score is a function of precision and recall. F1 is typically more valuable than accuracy, particularly if the class distribution is unequal.

$$\text{F1 Score} = 2*(\text{Precision}*\text{Recall})/(\text{Precision}+\text{Recall})$$

Table 1- Performance of proposed system

Dataset size (in alphabets)	Precision	Recall	Accuracy	F1 score
26	0.4	0.48	0.5	0.44
52	0.55	0.59	0.61	0.57
78	0.69	0.73	0.73	0.71
104	0.84	0.89	0.92	0.86

Table 1 depicts how the Performance measures like precision, recall, accuracy and f1 score changes with respect to dataset size.

From the table 1 it is inferred that the performance increases as the size of the dataset increases.

Table 2 depicts the comparison of performance measures between an already existing model and the proposed model.

The existing model "Speech recognition: A Review" was developed based on Artificial Neural Networks (ANN).

P1 represents Precision of the existing model R1 represents Recall of the existing model A1 represents Accuracy of the existing model

P2 represents Precision of the proposed model R2 represents Recall of the proposed model A2 represents Accuracy of the proposed model

Table 2 - Performance comparison of existing system (ANN) vs proposed system (LSTM based RNN)

Dataset size (in alphabets)	Existing system (ANN)			Proposed system (LSTM based RNN)		
	P1	R1	A1	P2	R2	A2
26	0.38	0.43	0.45	0.4	0.48	0.5
52	0.55	0.57	0.60	0.55	0.59	0.61
78	0.68	0.70	0.71	0.69	0.73	0.73
104	0.79	0.85	0.89	0.84	0.89	0.92

The proposed model which was developed using Long Short Term Memory based Recurrent Neural Networks (LSTM based RNN) has better performance than the model which is already existing (Figure 8). This is due to the unexplained behaviour of the Artificial Neural network and ANN only stores the data that has been fed into it recently and ignores previous data while RNN can keep track of both past and present data.

A column graph is plotted to depict the performance measures between the two models.



Figure 8 – Performance comparison of existing system (ANN) vs proposed system (LSTM based RNN)

VIII. CONCLUSION

A deep study was conducted and techniques like machine learning, deep learning has been successfully implemented. The motive for the development of this project is to provide a complete ASR model that will be useful for active English Language learners. This will not only serve as a good source of knowledge resource, but also will help in elevating the English vocabulary standards in the society.

It is strongly believed that this project will serve to be useful for students aspiring to be better English speakers. As for the future work, the project is aimed to be more accurate and later developed into an application that will be useful for new learners and it is also aimed at predicting the alphabet that has been spoken.

IX. APPENDIX

AUTOMATIC SPEECH RECOGNIZATION AND EVALUATION SYSTEM



Figure 9 - Screen for uploading an audio file

AUTOMATIC SPEECH RECOGNIZATION AND EVALUATION SYSTEM



Figure 10 - Screen after file selection

AUTOMATIC SPEECH RECOGNITION AND EVALUATION SYSTEM



Figure 11 - Screen after predicting accuracy

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A Survey of Machine Learning Based Approaches for Parkinson Disease Prediction

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ABSTRACT

Parkinson's disorder (PD) is a progressive neurodegenerative disorder, which does not have any cure. Diagnosis of PD at an early stage really aids in the delay of the progression. It requires an accurate and robust system to provide early diagnosis of PD. Machine learning based techniques helps in developing of PD diagnosis system. This paper presents a complete review of the various machine learning technique along with its working principle that helps for the development of PD diagnosis system. This paper highlights the summary of methodologies and also presents a generic framework for the PD diagnosis based on voice signals.

Keywords - Parkinson Disease, random forest, support vector machine, machine learning, stacking, artificial neural network.

I INTRODUCTION

Parkinson Disorder (PD) is a neurodegenerative disorder which is mainly associated with the dopamine receptors. The main generic symptoms related to PD are stiffness, motor related problems and non-motor related problems. There are specific symptoms which are unique for each patient. Speech related issues is one of the common non-motor related problems. PD is a progressive disorder since there is occurrence of death of dopamine receptors. The main diagnosis test is connected with clinical conventional methods which is based on patient history analysis and through examination.

The clinical terminologies associated with symptoms of Parkinson Disorder (PD) are bradykinesia (slower movement), hypokinesia (absence of movement), rigidity of neck, shoulder and wrist and tremor. The main caused of PD are drugs, multiple cerebral infraction, Progressive Super nuclear Paralysis (PSP) and Multiple System Atrophy (MSA). PD is characterized by one the important symptom known as vocal disorders at the initial stages. [1]

PD symptoms is also associated with mental illness namely depression and dementia along with physiological symptoms. The blend of psychiatric and physiological problems will eventually affect the autonomy of the individual which impacts the living of the patient.

Artificial Intelligence (AI) based diagnosis plays a prominent role in early diagnosis of PD thereby delaying the progression of the disorder. Speech is an important biomarker which acts as an important data to build AI models for PD. Machine Learning (ML) algorithms which is the subpart of AI, helps in the diagnosis of PD using speech parameters; it clearly distinguishes PD patients from healthy subjects.

The paper focuses on discussing different Machine Learning (ML) models along with its properties and working principle and it also presents various ML models used in PD prediction or classification.

II MACHINE LEARNING METHODS

1. Artificial Neural Networks (ANN)

ANN is a Machine Learning (ML) algorithm which mimics the human brain neurons. ANN consists of input layer, hidden layer and output layer. ANN is fully composed of neurons. Neurons is the smallest functional unit in the network. Each neuron in the input layer is associated with weights which is optimized in each iteration to procure the accurate outcome. The weighted inputs are sent to the hidden layer which consists of activation function which produces the outputs to the output layer. The output layer provides the aggregated values based on mathematical operations of averaging. The weights and the activation function play a key role in providing the point of convergence to the problem.

2. K-Nearest Neighbors Classifier (KNN)

KNN is a supervised Machine Learning (ML) which provides the result purely based on the distance metric computation. The new data is categorized based on its neighbors present in the actual data. The neighbors of the

new data are found using distance metrics namely Euclidean distance and Manhattan distance. The value of K determines the number of neighbors to be considered for assigning the label for new data. The K value is an important parameter involved in providing accurate decision. The class labels of K neighbors are taken for arriving at a decision. The maximum occurrence of a particular class label in K neighbors is assigned to the new data.

3. Support Vector Machines (Svm)

Support Vector Machine (SVM) is a supervised Machine Learning (ML) algorithm. The SVM algorithm mainly involves in finding the hyperplane which provides the separation plane for the data. Identification of accurate hyperplane is an important process in the algorithm. The points which are closer to the separation plane i.e., hyperplane is known as support vectors. There are two types of SVM, they are linear SVM and non-linear SVM. The kernels which are used for non-linear data are polynomial, Radial Basis Function (RBF), Gaussian kernel and sigmoid kernel.

4. Naïve Bayesian Classifier

Naïve Bayes is a supervised Machine Learning (ML) algorithm which considers the independence among the features in the data. The assumption of independence among features contributing to the prediction of label reduces the cost of computation. This algorithm is mainly suited for dataset of large dimension.

5. Random Forest

Random forest is a supervised Machine Learning (ML) algorithm. It is a decision tree-based classifier. It constructs various decision trees based on the samples of dataset. The samples can be given either by bootstrapping or without bootstrapping. The predictions of various decision trees are accumulated using voting process. The voting process is of two types and they are simple majority voting and weighted voting.

6. Bagging

Bagging is a supervised Machine Learning (ML) which is also known as bootstrap Aggregation. The decision trees are formed and trained in parallel. Bagging comes under the category of homogenous classifiers, since it trains and combines the predictions of same algorithm type model.

7. Boosting

Boosting is a supervised machine learning algorithm. It is an ensemble-based algorithm. The Boosting algorithm mainly improvises the performance of weak learners like decision tree and Support Vector Machine (SVM). The predictions of weak learner are aggregated using simple average method or weighted average method.

8. Stacking

Stacking is a supervised Machine Learning (ML) algorithm which provides the integrated results of the various based learners. It is also known as stacked generalization.

III. Machine Learning Based Methods for Parkinson Disease Prediction

C. Okan Sakar et al [2] have applied Tunable Q-Factor Wavelet Transform (TQWT) along with the leaning algorithms to the voice signals of the Parkinson Disease Patient and has shown that TQWT performs better than state of the art speech signal processing algorithms.

Guruler [3] presents an integration approach for Parkinson Disorder (PD) diagnosis. The integration framework involves the K-means clustering algorithm and Artificial Neural Network (ANN).

Arvind Kumar Tiwari [4] focuses on presenting a system which provides Parkinson Disease (PD) prediction by incorporating feature selection algorithm known as “Minimum Redundancy and Maximum Relevance” which chooses the important features.

Sakara et al [5] presents a system which helps in early diagnosis based on index known as “Unified Parkinson’s Disease Rating Scale”.

Indira R. et al [6] provides a diagnosis system which uses speech features as the data and fuzzy c-means clustering algorithm for prediction.

Shahbakhhi et al [7] presents a system which performs classification of Parkinson’s patients from healthy subjects based on the voice features and using machine learning model namely Support Vector Machine (SVM).

Sellam V. et al [8] presents a classification system wherein Support Vector Machine (SVM) and Radial Basis Function Neural Network (RBFNN) algorithm has been used. The classification system clearly classifies the unhealthy voice and healthy voice based on the acoustic parameters which is extracted from the speech signal.

Ma, C. et al. [9] presented a hybrid system based on Extreme Learning (EL) technique that is mainly kernel based. This technique is integrated with feature clustering technique. This hybrid system clearly distinguishes PD patients and healthy subjects.

Yahia et al [10] has proposed a way to detect Parkinson disease using Naïve Bayes and K- Nearest Neighbours (KNN)algorithm and has used Parkinson Speech Dataset.

Nivedita C et al [11] classified neurodegenerative disorders according to symptoms using artificial neural network (ANN) with back propagation. The six major classes of clinical symptoms of neurodegenerative disorders are memory problems, communication issues, changes in personality, idiosyncratic behaviors, loss of voluntary control and common health issues.

Farhad.S et al [12] proposed to distinguish between clinical sample variables (N = 195) that had Parkinson's disease and were not using Multi-Layer Perceptron (MLP) with back-propagation learning algorithm and Radial Basis Function (RBF) and Artificial Neural Networks ANN)

Table I presents the summary of methodologies of the PD diagnosis.

Table I – Summary of Methodologies

Paper ID	METHODOLOGIES
[2]	Tunable Q-Factor Wavelet Transform (TQWT)
[3]	K-means Clustering algorithm Artificial Neural Network (ANN)
[4]	Minimum Redundancy Maximum Relevance
[5]	Index : Unified Parkinson's Disease Rating Scale
[6]	Fuzzy c-means clustering algorithm
[7]	Support Vector Machine (SVM)
[8]	Support Vector Machine (SVM) Radial Basis Function Neural Network (RBFNN)
[9]	Extreme Learning (EL)
[10]	Naïve Bayes K-Nearest Neighbours (KNN)
[11]	Artificial Neural Network –Back Propagation
[12]	Multi-Layer Perceptron (MLP)

IV GENERIC FRAMEWORK OF PD DIAGNOSIS

Figure 1 presents the generic framework for PD diagnosis. The generic framework of PD diagnosis is designed based on voice signal modality only. This framework will be useful as a workflow for building the system for PD diagnosis. The framework has been formed from the accumulated knowledge extraction from the review of papers. The subjects involved for the data collection will be healthy subject and PD patients.

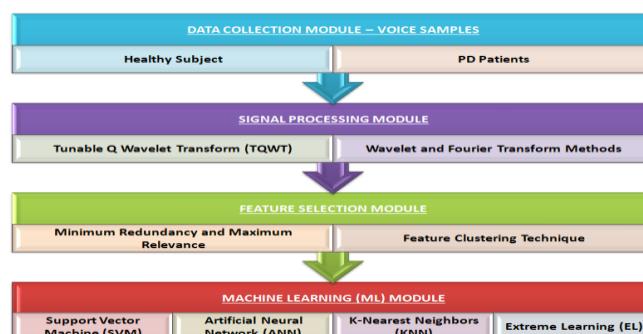


Figure 1-Generic Framework for PD Diagnosis

The framework highlights four essential modules for automated PD diagnosis. The four modules are:

- **Data Collection module:** The voice sample will be collected from healthy and PD patient's .There can be repetitive samples to ensure double validation for recording.
- **Signal Processing Module:** The raw voice samples are processed to remove noise and to extract meaningful information which can be useful to train the Machine Learning (ML) algorithm.

- **Feature Selection Module:** The important features which provide higher discrimination between healthy subject's samples and PD patient's samples are selection using feature selection techniques.
- **Machine Learning (ML) Module:** The Machine Learning (ML) algorithm is trained using the features obtained from feature selection module and the evaluation of ML algorithm prediction is performed and further tuning of algorithms is done based on accuracy parameter.

The techniques highlighted in each module of generic framework are the most accurate techniques which are presented based on the review of research papers.

IV CONCLUSION

This paper presents concise explanation of various Machine Learning (ML) algorithm. This paper also presents the state of the art work which uses ML algorithms for the prediction of Parkinson Disorder (PD). The paper highlights the summary of methodologies from the review and presents the design of generic framework for PD diagnosis which will be useful to develop system for PD diagnosis based on voice samples.

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Comparative Study of Firefly Algorithm and Particle Swarm Optimization for Hiding Sensitive Association Rules

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ABSTRACT

Association rule mining, a data mining technique, is very useful for product promotion and helps online-shops in personalizing their website and cross-sell their products by making recommendations. Though non sensitive data is shared for Association rule mining it is possible to deduce sensitive information from this data. The challenge is to make strategic decisions from the knowledge gained from association rule mining at the same time preserving the privacy of sensitive information that can be inferred from the data. If the confidence of an association rule is above disclosure threshold, then the rule is categorized as sensitive association rule. Prior to releasing the data these sensitive rules should be made uninteresting by reducing the confidence below the disclosure threshold. But modifying the data for reducing the confidence of the rule may result in reducing the utilization of data. But, it is vital to maintain a suitable stability between privacy protection and knowledge discovery. In literature, the techniques for hiding sensitive association rules are classified into Exact, Border Based, Cryptographic, Reconstruction and Heuristic Techniques. Most of these techniques work on binary datasets. These techniques also produce higher side effects in terms of lost rules, ghost rules, hiding failure and amount of distortion to the original dataset. This paper proposes Firefly Optimization based Fuzzy Sensitive Rule Hiding (FF-FSH) technique to hide sensitive fuzzy association rules mined from quantitative database with minimal side effects while maintaining an optimal balance between knowledge mined and privacy attained. The proposed technique is compared with PSO Fuzzy Sensitive Rule Hiding (PSO-FSH) technique and results shows that PSO-FSH Optimization performs better than FF-FSH.

Keywords: firefly; sensitive rules; hiding; association rules; Fuzzy.

1 INTRODUCTION

In the recent years, Data mining techniques has been analysed in another dimension, as it may pose threat to privacy, Data Mining accumulate a very large amount of electronic data maintained by corporations. Business Competitors may share their data with mutual interests for finding useful information hidden in the data.

The main problem that arises in sharing of large amount of data is the confidentiality violation. An organization may lose its business to its competitor if the competitor uses the shared data for their advantage. So, each firm before releasing its own data should ensure to hide its sensitive information. For example, patterns contained in the shared data may contain information about shelf space allocation, catalogue design, discount sales etc. This has raised an alarm about the privacy of the underlying data. Thus, the business and legal concerns for medical databases motivates the need for privacy.

As association rule mining enables to gather sensitive information from the published non sensitive data, just restricting the access to data will not provide required level of privacy. The problem is to protect sensitive information from being mined, without deafening the benefit of the association rule mining. Many approaches have been proposed by researchers for association rule hiding to prevent the disclosure of sensitive information. Hiding a sensitive association rule means making it uninteresting. A rule is not an interesting rule if its confidence is below the threshold confidence. So the data supporting a sensitive rule is perturbed to reduce the confidence of the sensitive below the threshold. But it is essential to maintain a suitable balance between privacy protection and knowledge discovery.

Saygin et al., [2] proved that the problem of perturbing the database with stability between privacy and knowledge discovery as NP-Hard. Most of the research in this area sanitizes the original database heuristically. But the required accuracy and privacy is not achieved when the data is sanitized or perturbed heuristically. Finding optimal solution without compromising privacy and utility is hard. The goal is to find a solution which is closer to optimal solution. So, a new approach is essential for hiding sensitive association rules using Meta heuristics like Firefly Optimization Algorithm.

2. BACKGROUND

Association rule mining is a data mining technique to discover interrelationships among the data in a large database. The main objective is to identify a set of items that co-occur repeatedly within a set of transactions.

Such co-occurrences are called associations. Market basket analysis which serves as basis for association rule mining, finds patterns describing the customer's purchase behavior [2].

An association rule showing the relationship between milk powder and beverage can be expressed as milk powder \Rightarrow beverage [support=0.3, confidence=0.7]. The support quantifies that milk powder and beverage occur together in 30% of all documented transactions. The confidence states that the people who buy milk powder probably also buy beverage in the same transaction. In this case, 70% of all the transactions containing a milk powder also contain beverage. Such knowledge can help retail companies to discover the cross-sale opportunities and enable category management. In addition, it enables companies to recommend items for online retail shops.

The problem of mining association rules can be stated as follows: Let $I = \{i_1, i_2, \dots, i_m\}$ be a set of items in transactional database $D = \{t_1, t_2, \dots, t_n\}$. Each transaction $t_j \in D$ is an item set such that t is a proper subset of I ($t_j \subseteq I$). Let X be a set of items in I called item sets. A transaction t_j supports X , if X is a proper subset of t_j ($X \subseteq t_j$). The support of itemset X , denoted by $\alpha(X)$, is the number of transactions that contain X and is defined as

$$\alpha(x) = |\{t_i | X \subseteq t_i, t_i \in D\}| \quad (1)$$

An itemset X is called a frequent itemset if $\alpha(X) \geq \sigma$, where σ is the minimum support threshold given by the users.

An association rule is an implication of the form: $X \Rightarrow Y$, where $X \subset I$, $Y \subset I$ and $X \cap Y = \emptyset$. X (or Y) is a set of items, called an item set. An association rule can be extracted from the information stored in the transaction databases based on the observations of the customer behavior. In the given rule X is called the antecedent (Left Hand Side (LHS)) and Y is the consequent (Right Hand Side (RHS)) of the rule. Both the antecedent and consequent of a rule may contain single and the whole set of items. Mining a transactional database may result in millions of rule depending on the size and number of items in the database. Finding useful, previously unknown knowledge from these large set of rules is difficult. So, Support and confidence are the quality measures used to evaluate the interestingness of a rule.

The support of the rule $X \Rightarrow Y$ is the percentage of transactions in D that contain $X \cup Y$. It measures the frequency of a rule. In other words, it establishes appropriateness of the frequent rule to the Database D . The support of a rule is represented by the formula

$$\alpha(X \Rightarrow Y) = \frac{\alpha(X \cup Y)}{N} \quad (2)$$

where $\alpha(X \cup Y)$ is the support of the item set $X \cup Y$ and N is the number of transactions in database D . Apriori property states that if $X \subseteq Y$ then $\alpha(X) \geq \alpha(Y)$.

The confidence of a rule describes the percentage of transactions containing X which also contains Y .

$$\beta(X \Rightarrow Y) = \frac{\alpha(X \cup Y)}{\alpha(X)} \quad (3)$$

Confidence is important to establish the interestingness of a rule and identify all the transactions containing the item set occurring in the antecedent of the rule. It then identifies the percentage of the transactions that include the items in the consequent as well. The association rule $X \Rightarrow Y$ is called the strong association rule if $\alpha(X \Rightarrow Y) \geq \sigma$ and $\beta(X \Rightarrow Y) \geq \delta$, where σ is the minimum support threshold and δ is the minimum confidence threshold given by users or experts.

Most of the existing research considers binary dataset for privacy preservation, but real-world data in medical and financial fields involve quantities. If the quantitative attribute has large and varied range of values, it is difficult to work out the accurate association among the different range values of every attribute. This limits the association rules from effectively expressing association between the data. In order to effectively mine association rules, the quantitative data is fuzzified and fuzzy association rules are mined. The sensitive rules are then hidden by modifying the quantitative attribute.

Quantitative Association Rules[20]: As in classical association rules, $I = \{i_1, i_2, \dots, i_m\}$ represents the items appearing in the transaction database D , where $D = \{t_1, t_2, \dots, t_n\}$. Each item i_k will associate with several fuzzy sets. The fuzzy sets associated with i_k is represented as $F_{i_k} = \{f_{1i_k}, f_{2i_k}, \dots, f_{ji_k}\}$, where f_{ji_k} is the j^{th} fuzzy set associated with i_k . As an example, the item salary could look as follows: $F_{\text{salary}} = \{\text{high, medium,}$

low}. Fuzzy sets and their corresponding membership functions have to be defined by domain experts. Each of the fuzzy sets can be viewed as [0,1] valued attribute/item, called fuzzy attribute/item. The membership functions for crisp set can take a value of 1 or 0, whereas the membership functions for fuzzy sets can take values in the interval [0,1]. The range between 0 and 1 is referred to as the membership grade or degree of membership. A fuzzy set A for the element x is defined below:

$$A = \{(x, \mu_A(x)) | x \in A, \mu_A(x) \in [0,1]\} \quad (4)$$

where $\mu_A(x)$ is a membership function belonging to the interval [0,1].

The intersection of two fuzzy sets A and B is denoted by $A \cap B$, and the membership function of $A \cap B$ is given by

$$\mu_{A \cap B}(X) = \min\{\mu_A(x), \mu_B(x)\}, \forall x \in X \quad (5)$$

where X is the universe of discourse and x is the individual element in the universe.

A fuzzy association rule has the following form[20]:

If X is A then Y is B

In this case, $X = \{x_1, x_2, \dots, x_p\}$ and $Y = \{y_1, y_2, \dots, y_q\}$ are item sets which are subsets of I. The two sets are disjoint and thus do not have any items in common. $A = \{f_{x_1}, f_{x_2}, \dots, f_{x_p}\}$ and $B = \{f_{y_1}, f_{y_2}, \dots, f_{y_q}\}$ contain the fuzzy sets that are associated with X and Y respectively. X is A, is the antecedent and Y is B, is the consequent of the fuzzy rule. If a sufficient amount of records approves this rule, then the rule is satisfied. In order to enable the evaluation of a fuzzy association rule, the support and confidence is calculated by replacing the set-theoretic operations by the corresponding fuzzy set-theoretic operations:

$$\text{support}(A \rightarrow B) = \sum_{(x) \in D} T(A(x), B(x)) \quad (6)$$

$$\text{confidence}(A \rightarrow B) = \frac{\sum_{(x) \in D} T(A(x), B(x))}{\sum_{(x) \in D} A(x)} \quad (7)$$

where T is the T-norm specifying binary operation between elements of the set. The usual choice for the binary operation is minimum operator which is used to find the combined support of two items.

Problem Statement : The objective is to transform a database D into database D' such that the all the interesting rules could be mined except for sensitive interesting rules and to minimize the number of new rules that were not part of original rule set and could be mined from D'.

3. LITERATURE REVIEW

Berberoglu & Kaya proposed a method for hiding fuzzy association rules mined from quantitative data[3]. The proposed algorithm makes use of fuzzy set concept for mining rules from quantitative data. For hiding the rule, support value of the item in the Left Hand Side (LHS) of the rule to be hidden is raised. Human expertise is required for specifying the fuzzy membership function. If the membership functions is not defined correctly then the performance of the system will be reduced[4].

Meta heuristic algorithms inspire interactions among multiple agents in nature. Swarm Intelligence based algorithms mimics the swarm feature of biological agents such as birds, fish, humans and others. For example, particle swarm optimization was based on the swarming behavior of birds and fish [6], while the firefly algorithm inspires the flashing pattern of fireflies [7, 8] and cuckoo search algorithm simulates the brood parasitism of some cuckoo species [9].

Dehkordi et al. [9], Narmadha et al. [10], Sathiyapriya et al. [11] and shah et al. [12] used Genetic Algorithm (GA) for hiding sensitive rules. While the GA based approach proposed by Dehkordi et al. and Narmadha et al. hides binary association rules, the algorithm proposed by Sathiyapriya et al. and Shah et al. hides quantitative association rules.

Bonam Reddy and Kalyani[13], Sudha et al.[14], and Sathiyapriya et al.[15] used PSO algorithm for hiding sensitive association rules. Sudha et al. applied rough set for attribute reduction and applied PSO algorithm for hiding. Cheng et al.[16], applied Evolutionary Multi-Objective optimization (EMO) and achieved rule hiding by selectively inserting items into the database. The methods proposed in literature for hiding the sensitive rules has high computational overhead and involves more side effects like losing non sensitive rule and formation of

new rules. Some of the methods fail to hide all the desired rules which are supposed to be hidden in minimum number of passes.

Among all the nature inspired algorithms, firefly is shown to be efficient in dealing with multimodal, global optimization problems. Some probabilistic steps are applied to avoid being trapped in local optima. So, this paper, compares the performance of Firefly and PSO[5] algorithm in hiding sensitive fuzzy association rules.

Firefly Optimization Algorithm (FA), introduced by Xin She Yang [17], is among the most rigorous optimization methods. Yang formulated the algorithm based on the flashing properties of fireflies. The light intensity I at a particular distance r from the source decreases as the distance r increases. These factors make a swarm communication between fireflies to find the new positions of fireflies with more light intensity [18].

Yang compared bio-inspired algorithms in solving some hard problems and concluded that FA can be potentially more powerful in solving NP-hard problems. The behavior of the fireflies is described by the following conditions [19]

All fireflies are unisex and are attracted to other fireflies regardless of their sex.

Degree of attractiveness of a firefly is directly proportional to its brightness.

The brightness of each firefly is determined by the landscape of the objective function

4. PROPOSED ALGORITHM

Algorithm: 1 Pseudo Code for Firefly Algorithm[7]

Objective Function $f(x), x = (x_1, \dots, x_d)^T$

Generate initial population of fireflies $x_i (i = 1, 2, \dots, n)$

$f(x_i)$ establish the light intensity I_i at x_i

Describe the light absorption coefficient γ

while $t < \text{Maximum Generation}(G)$

for $i = 1$ to n do (for all fireflies)

for $j = 1$ to i (for all n fireflies)

if $(I_j > I_i)$ then

In D -dimension, move firefly i toward firefly j

end if Vary the attractiveness with respect to distance r_{ij} using $\exp(-\gamma r_{ij})$

Assess new solutions

Revise light intensity

end for(j)

end for(i)

Rank the fireflies and locate the current best

End while

Post process on the best so-far results.

Firefly algorithms works like any other nature inspired algorithms such as genetic algorithm or simulated annealing. It first launches a random initial state where some random fire flies (solutions) are generated in the problem space. The brightness I of a fire fly at location x , has a direct relationship with problem objective function. The attractiveness coefficient β will be altered with the distance between two fireflies. So, β should be sensed between any two fireflies.

Assuming the number of fireflies in a population be N then the position of i^{th} fly in D dimensional space is given by $x_i (x_i^1, x_i^2, x_i^3, \dots, x_i^D)$. The brightness of the fly represents the relative position of the fly which is given by

$$I = I_0 e^{-\lambda r_{ij}} \quad (8)$$

Where I_0 is the objective of the individual fly found from equation 12. λ means the luminous intensity absorption coefficient, which is generally set to a constant and r_{ij} is the spatial distance between firefly i and firefly j .

A. **DISTANCE:** Distance between any two fireflies i and j at x_i and x_j respectively can be defined as given in the equation (9)

$$r_{ij} = \|x_i - x_j\| = \sqrt{\sum_{k=1}^d (x_{i,k} - x_{j,k})^2} \quad (9)$$

where $x_{i,k}$ is the k -th component of the i -th firefly (x_i)

B. **Attractiveness:** Attractiveness between the fireflies is given by the equation (10)

$$\beta(r) = \beta_0 \exp(-\gamma r^m), (m \geq 1) \quad (10)$$

where r is the distance between two fireflies, β_0 is initial attractiveness at $r = 0$ and γ is the absorption coefficient. Absorption coefficient controls the decrease of the light intensity. The constant m is set to 2 in most applications.

C. **Movement:** The movement of a firefly i which is attracted by a more attractive firefly j is given by the equation (11)

$$x_i(t+1) = x_i(t) + \frac{\beta_0}{1+\lambda r^m} (x_j(t) - x_i(t)) + \alpha(\text{rand} - (1/2)) \quad (11)$$

where $X_i(t)$ is the present position of firefly FF_i . $X_i(t+1)$ is the next position of FF_i after moving toward FF_j , $\alpha(\text{rand}-1/2)$ is random movement of the firefly and rand is a random number generated uniformly distributed in $[0,1]$ and $\alpha \in [0, 1]$.

D. **Encoding Of Fireflies:**

Each firefly represents a transaction value items occurring in the sensitive rule to be hidden and each rule contains of a matrix of values which represent the transaction value of all items in the rule. The objective function is calculated as

$$\text{Obj}(x_i) = \min(\text{LHS}(x_i), \text{RHS}(x_i)) \quad (12)$$

Depending on the objective function fitness value is evaluated. Fitness value gives the information about whether a given solution is attained the required objectives. Interpreting a best fitness value means identifying the right individual. The confidence of the rule is used as the fitness of the firefly. The fitness of the solution is given by

$$F(x) = \frac{\text{Support(AUC)}}{\text{Support(A)}} \quad (13)$$

where A is the items in the antecedent (LHS) of the rule and C is the items in the consequent (RHS) of the rule.

Pseudo code for Firefly Optimization based Fuzzy Sensitive Rule Hiding (FF-FSH):

Step 1: Fuzzify the given dataset.

Step 2: Generate the fuzzy association rules and depending on the threshold confidence value find the interesting Fuzzy rules.

Step 3: Read the sensitive rules from the user.

Step 4: Encode the transactions containing sensitive items as fireflies.

Step 5: Find the distance between the flies using equation 8.

Step 6: Calculate the attractiveness of the flies using equation 9. The fly with least values for the transaction is considered as attractive.

Step 7: The other flies move towards the attractive fly using equation 10.

Step 8: Calculate the fitness and the sum of number of ghost rules, number of lost rules, and number of modifications.

Step 9: If the sum is stagnating the optimal result is achieved where the number of lost rules and ghost rules are low and the sensitive rules are hidden, else go to step 5.

5. EXPERIMENTAL RESULTS

The proposed algorithm is tested using the datasets listed in the Table 1 and compared with the PSO algorithm [15,23]. The Breast cancer dataset[21] published by University of California at Irvine Repository (UCI Repository) and the traffic accidents dataset[22] published by National Institute of Statistics (NIS) were used for experimentation. The experiments were carried out on a PC with Intel core i5 processor with a clock rate of 2.67 GHz and 8 GB of main memory.

Table 1: Dataset Description

Dataset	No. of Transactions	No. of Attributes	Attribute Type
Breast Cancer Wisconsin – Original [21]	69	10	Integer
Traffic Accidents [22]	3,40,184	45	Integer

Terminologies used:

D - Transactional database

R – Original Set of fuzzy association rules that are interesting

R_h - Set of sensitive rules to be hidden

R_n - Set of non-sensitive rules mined from D

R' - Rules mined from perturbed database D' .

Performance Evaluation Metrics:

The performance of the proposed fuzzy Sensitive association rule hiding using Firefly algorithm is compared with the fuzzy Sensitive association rule hiding using PSO[15] and are the parameters used for assessing the proposed algorithm are as follows:

- Number of Lost Rules:** A rule learned from actual database and not sensitive but cannot be learned from perturbed database. $\{lost\ Rule\ q|q \in R_n \cap q \notin R'\}$
- Number of Ghost Rules:** A rule that is not a part of rules obtained from mining original database but can be formed from the modified database. $\{Ghost\ Rule\ q|q \in R' \cap q \notin R\}$
- Hiding Failure:** Gives the count of sensitive interesting association rules whose confidence was not reduced below threshold confidence after perturbation.
- Percentage of modification:** The number of modifications to the data items in the original database expressed in percentage

$$\% \text{ of modification} = \frac{D'}{D} \times 100$$

- Execution Time:** The length of time required to implement hiding algorithm.

The number of rules generated from breast cancer and traffic accidents dataset for varying minimum confidence with constant minimum support of 20% is shown in table 2.

Table 2: Number of rules generated

Minimum Confidence in %	No. of Rules formed- Breast Cancer Dataset	No. of Rules formed- Traffic Accidents Dataset
20	192	1532
30	161	1402
40	133	1061
50	88	976
60	49	753

a) LOST RULES

The number of interesting rules that were lost while hiding three rules and five rules using PSO-FSH and FF-FSH (Firefly Fuzzy Sensitive association rule Hiding) for breast cancer dataset were shown in table 3. Table 4 shows the rules that were lost in accidents data set for different values of Minimum confidence when three and five sensitive rules were hidden.

Table 3: Fuzzy Association Rules lost in breast cancer dataset

Minimum Confidence in %	Breast Cancer Dataset			
	$R_h = 3$		$R_h = 5$	
	PSO- FSH	FF-FSH	PSO- FSH	FF-FSH
20	31	55	36	68
30	27	43	33	54
40	22	40	24	41
50	16	32	17	32
60	10	18	11	21

Table 4: Fuzzy Association rules lost in traffic accidents dataset

Minimum Confidence in %	Traffic Accidents Dataset			
	$R_h = 3$		$R_h = 5$	
	PSO- FSH	FF-FSH	PSO- FSH	FF-FSH
20	321	452	382	531
30	280	390	336	410
40	201	298	265	344
50	176	216	224	295
60	151	174	173	198

As large number of particles move towards global minimum (Zero value) the confidence of more number of rules are reduced below threshold confidence resulting in more interesting non sensitive rules becoming not interesting. So, in FF-FSH the number of rules lost as a side effect of hiding sensitive rules is 14% higher on an average, When comparing the results with PSO based hiding algorithm

b) GHOST RULES

The number of new rules that were generated because of perturbation for hiding two and five sensitive rules in breast cancer and accidents dataset respectively under different confidence setting is shown in table 5 and table 6

Table 5: No. of new interesting rules generated in breast cancer dataset

Minimum Confidence in %	Breast Cancer Dataset			
	$R_h = 3$		$R_h = 5$	
	PSO- FSH	FF-FSH	PSO- FSH	FF-FSH
20	0	35	0	42
30	0	30	0	33
40	0	25	0	29
50	0	17	0	22
60	0	12	0	14

Table 6 : No. of new interesting rules generated in accidents dataset

Minimum Confidence in %	Traffic Accidents Dataset			
	$R_h = 3$		$R_h = 5$	
	PSO- FSH	FF-FSH	PSO- FSH	FF-FSH
20	0	288	0	343
30	0	268	0	308
40	0	182	0	174
50	0	159	0	168
60	0	137	0	149

FF-FSH has an generated 20% more new rules than the original rules that were mined from original database before perturbation. Perturbation using PSO –FSH does not generate any new rule as side effect.

c) Percentage Of Modification

The amount to perturbation to the values in the original dataset is less when PSO algorithm is applied for hiding, when compared to FF-FSH technique as evident in Figure 1. As a result, the number of rules lost in PSO FSH is less than in FF-FSH technique.

D) HIDING FAILURE

Both firefly algorithm and PSO did not register any hiding failure. But firefly algorithms generate new rules which are not part of actual rule set.

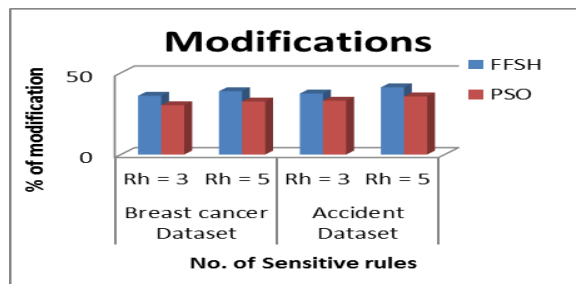


Figure 1 % of entries modified due to perturbation

E) Execution Time

Figure 2 and Figure 3 shows the running time of both PSO and Firefly algorithm for hiding sensitive rules when applied to breast cancer and accidents dataset. The running time was measured for the minimum confidence threshold of 20% and 60%.

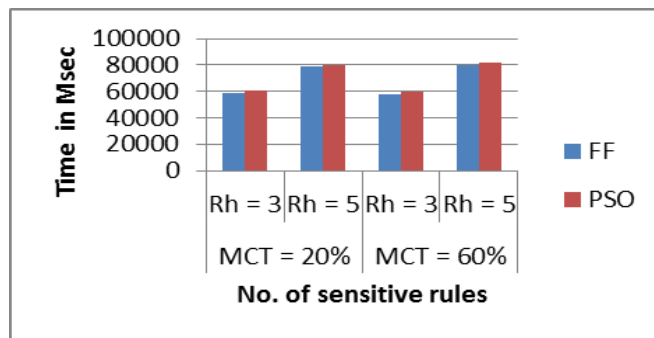


Figure 2 Execution time for breast cancer dataset

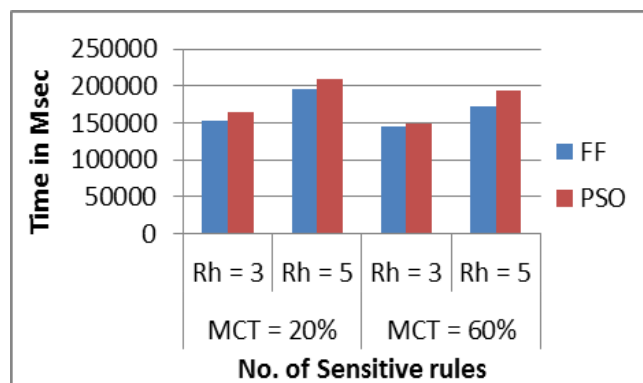


Figure 3: Execution time for traffic accidents dataset

The time required for hiding all the sensitive rules using PSO-FSH is slightly more than FF-FSH approach. PSO-FSH takes 3 seconds additional time on an average for the experiments conducted.

6. CONCLUSION

In this paper, the Firefly algorithm is implemented to hide the quantitative association rules and the performance of the algorithm is empirically compared with the PSO algorithm. Binary association rule hiding involves addition or deletion of items, whereas quantitative rule association rule hiding requires the quantity of items to be modified without altering the knowledge gained from it. The objective is to hide the quantitative sensitive association rules while minimizing the side effects.

The results show that the proposed algorithm generates no hiding failure like PSO algorithm. Using Firefly algorithm results in losing more number of interesting non sensitive rules than PSO and it takes lesser time than PSO. But Data Perturbation using Firefly algorithm generates ghost rules while no ghost rules were generated in PSO. So, from the results, we can conclude PSO performs better than Firefly in terms of generating fewer side effects. In future, methods would be proposed to reduce the data distortion.

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Rhythm of Theory of Constraints and Training within Industry to the Orchestration of Productivity

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ABSTRACT

Purpose: Many industries face uncertainty environment and however, the internal preparedness is the only way to maximize the profit. There are many management philosophies developed over the last century for internal preparedness for facing external events. The use of Training-Within-Industry (TWI) is helping the industry to transfer knowledge and skills from management to the employees so that in improving the job performances. Theory of constraints (TOC) is the one method applied to focus where to apply such technologies. Therefore, the purpose of this paper was to investigate whether TWI and TOC can be integrated to provide a better solution to the industries.

Design/methodology/approach: A concept based research study is applied in this paper. The paper conducted literature review on both TWI and TOC field and found certain similarities and gaps.

Findings: The findings provided a better understanding principles, tools, scope and limitation of both TOC and TWI. Hence, it suggested an integrated approach.

Practical implications: Based on the research findings, a framework has been provided for the integrated approach to apply in real time. The real benefits for the industries are bottom line impact in short time.

Keywords: Constraints; Training; Job; Flow, Roots of Lean; ongoing improvement; productivity

1. INTRODUCTION

Continuous improvement, in volatile, uncertain, complex and ambiguous world, requires modifications, combination and inclusion of various philosophies, tools and techniques. There are many attempts made to fuse the various methods together have shown enormous improvements in Industry. However, in some cases it may lead to confusions rather than the expected benefit because of missing just point called *focus*. Focus is the necessary condition for the business performance and stressed by only one philosophy called Theory of constraints (TOC). However, when current business process itself is wrong, need to look at in the other angle, called Job. The use of Training-Within-Industry (TWI) is helping the industry to transfer knowledge and skills from management to the employees so that in improving the job performances.

When one can try the combo of methods, need to make sure that the philosophies integrate correctly. Otherwise, methods adopted loose its sustainability and become short time fancy. This paper has an **objective** to find an integrated approach of two phenomena TOC and TWI and tries to explore the possibilities of integration at appropriate stages of a business.

2. Previous Attempts Of Integration Of TOC With Other Philosophies

Dettmer (1995) discussed the use of Quality management system in the theory of constraints. In quality improvement process, Doggett (2004) compared three root cause analysis tools TOC-CRT, RCA and Fishbone diagram and then Yuniarto (2012) compared TOC CRT with various other root cause techniques. Lee and Chang (2012) compared and emphasized the integration of TOC, RCA and Six sigma towards quality improvement.

Moore & Scheinkopf (1998) compared in detail the lean and six-sigma. Dettmer (2001) explains how each one treats the variability and uncertainty and how they treat costs. While Lean aims to reduce fixed and variable costs, for TOC the cost reduction is limited, and the generation of throughput is not. TOC accepts the variability and instability of demand and operations whereas six-sigma tries to reduce always. However, a series of emphasizes were given by various authors to integrate TOC, Lean and Six-sigma (Pirasteh & Farah, (2006); Todd (2009); AGI (2009); Moura (2010); Hudson et al (2014); and Dias et al (2019)) to get better continuous improvement in any industry. Elsukova (2015) suggested integration of lean accounting and throughput accounting.

An industrial engineer in Turkey named Yeysides, E. summarized (Sullivan, T)

"Every system has at least one bottleneck which limits the system's ability to get more [of its goal]. So every system needs the TOC viewpoint to manage the constraints.

Every system has unnecessary steps which don't add any value to the final products. So every system needs to use Lean tools to eliminate them.

And finally, every system has variations which prevent it from working steadily. So every system needs Six Sigma techniques to find and get rid of them."

Here we may add one more point "Every system has lack of Job method, Job Instruction and Job relations for the business improvement. So, every system need TWI techniques to improve the job".

Unlike other integrations, it is not just methodological integration, but philosophical. According to Goldratt, "A problem is not precisely defined until it can be presented as a conflict between two necessary conditions". Here we define the **research problem** as if we integrate two philosophies or not. How can it be?.

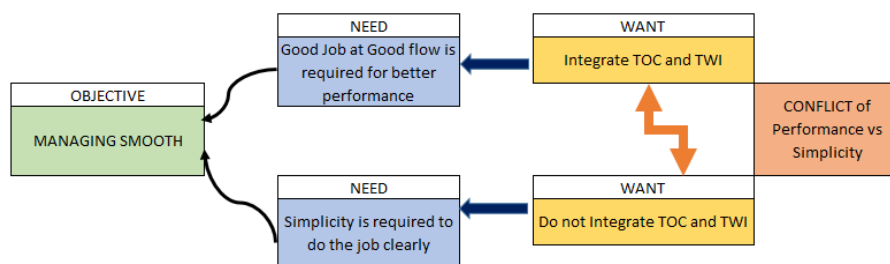


Figure 1. Conflict of Integration or not

Assumptions or hypotheses: To break the conflict (fig. 1) between two actions, it is needed to look into the assumptions verbalised carefully (Dettmer, ____). The following assumptions are created by intuitions and **will be validated** with the theory of such philosophies.

TOC and TWI should NOT be integrated because

- The integration increases more complexity of the solutions
- The integration mostly takes the management in opposite directions
- The integration creates contradiction among the departments
- Individual philosophies are always working fine
- Measuring the performance will become impossible

TOC and TWI should be integrated because

- Individual philosophies have its own limitations.
- Exchange of tools and techniques will be the contribution to the science of management.
- Delivering the solutions will be much faster than before.

3. Historical Perspective

Scientific management or called by Taylorism is a theory of management was so old philosophy in improving economic efficiency, especially labour productivity. Though there are large level of criticism it received on its philosophies, the techniques and forms are still used by many industries. In contrast to this most of the scientific management techniques evolved during the World War II. Especially the optimization techniques which were called then management science.

However, the standard systems identified in production environment was Assembly line from Ford and Just-In-Time from Toyota. Toyota production system and world class manufacturing yield many ideas to some authors to develop new philosophies such as Lean management in 80s and 90s.

Stamm et al (2009) discussed the evolution of manufacturing methodologies under the paradigm shift from Taylorism to Toyotism and compared TQM, TPM, TOC, Lean and Six Sigma.

However, one classical philosophy was forgotten by many is Training –within-Industry (TWI). TWI, developed by Charles R. Allen, may well be the ground zero of these modern manufacturing philosophies that have developed into the most promising methods in industry today. Especially it is considered as the real root of right applications of lean management (Huntzinger, 2002; Dinero, 2005, Dinero, 2011, Wrona and Graupp, 2006, Kato and Smalley, 2011)). According to Jacobs (2003), many of the fundamental concepts of contemporary structured on-the-job training come from TWI.

TWI programs were developed in 1940 in the United States to support the World War II production effort, specifically for training the millions of people hired with no experience to replace workers who had entered the army (Wagner, 2009). It was established by the National Defense Advisory Commission and eventually was moved under the Federal Security Agency to function as a part of the new War Manpower Commission on April 18, 1942. (Labor Division, War Production Board, Training Within Industry Service, January 1943, *The Training Within Industry Program, Bulletin No. 1* (Washington D.C.: U.S. Government Printing Office), p. 3.) It would remain under the War Manpower Commission throughout the rest of its existence, which ceased operation in September of 1945. Many companies were receiving increasing orders for existing and new products, which exceeded their ability to respond. TWI was one of the first emergency services to the need of increased the production levels in all types of industry.

TWI established a nation-wide network of industrial professionals to teach valuable techniques to the manufacturers of war products in US. The network would be made up of a volunteer staff of people, some full-time and some part-time. *The real job had to be done by industry, within industry.*

Eventually they were shared with Toyota, Japan starting in 1951-53. (<http://artoflean.com/index.php/documents/twi-material/>). TWI Job Instruction enjoyed the longest run inside of the company stretching over 40 years. Job Relations was a close second before it was discontinued. Job Methods was only taught for a couple of years during the 1950's inside of Toyota. It was replaced quickly by the Shigeo Shingo P-Courses starting around 1955 for productivity enhancement. The P-Courses were eventually replaced by an internal Kaizen Methods Course. Job methods were often credited for the role in development of Kaizen alias Continuous improvement projects in Japan (Robinson & Schroeder, 1993).

TWI did give Lean a vehicle to enhance supervisor skill sets and it influenced the development of the Kaizen training course however that is certain. (http://artoflean.com/wp-content/uploads/2019/01/Mr_Kato_Interview_on_TWI_and_TPS.pdf). If people want to succeed with lean or TPS they have to emphasize people development and making leaders capable of delivering improvements. TWI is a great starting point even today and a hidden strength of Toyota's production system.

Major classifications of TWI system are Job instruction, Job relation and Job methods and they are respectively solution to knowledge transfer from management to worker, problem solving by common sense solutions and process improvement through team work.

Not less importantly, a new paradigm shift happened during 80s in management science by the name of Theory of Constraints (TOC). TOC shows how a systemic approach can be used to process improvement. "Flow where you can, Pull where you can't"... Taiichi Ohno. **Pull** is the **second choice**... the lean tools are countermeasures to implement *pull* until you can create *flow* (<https://medium.com/@mark.tesla2/for-the-lean-experts-54bbe347900b>). TOC emphasizes the balancing the flow but not on balancing line.

Major classifications of TOC are Production planning (Drum-Buffer-Rope), Buffer management in supply chain (Dynamic-Buffer-Management), Critical Chain Project management (CCPM), Throughput accounting and TOC thinking process.

Why these two? It is not because of both are less known and less applied in contrast to what it actually deserves. But by synchronization viability.

4. A Short Review On TOC And TWI And Its Implementation

TOC: Any improvement is at the bottom line, all others are just ego trips. Noreen et al., (1995); Mabin and Balderstone (1998); Mabin and Balderstone (2000) have reported success of TOC implementation by surveying over 100 published case studies in various industries such as automotive, semi-conductor, furniture, etc. The improvements were on average, the inventories were reduced by 49 percent, due date performance improved by 60 percent and financial performance improved by 60 percent. Gupta & Snyder (2009) and Tulasi & Rao (2012) have done extensive reviews on theory of constraints.

TWI: Learning contains no value unless the person can actually do it and do it correctly-TWI. Gold (1981) and Dinero (2005) elaborated the Job instruction four step process. Further, Hannah (2004) showed a case study in rail industry for improving intermediate skills using TWI in UK and proved that it will improve individual and organizational performance. Fujifilm credits TWI JI and JR in successfully addressing decreased productivity and increased overtime associated with the use of temporary workers during peak season. Productivity increased 35% over 2 years and scrap was reduced by 57%.

Ingersoll Rand transformed its training process for new hires using TWI JI resulting in 60% less time to proficiency and a 50% increase in employee retention. Cummins Mid-range Engine Plant struggle with low quality, lengthy training times, poor safety record, and lack of employee engagement led them to TWI JR, JI, and JS. A substantial turnaround was seen in all areas. Ingersoll Rand transformed its training process for new hires using TWI JI resulting in 60% less time to proficiency and a 50% increase in employee retention (<https://www.twi-institute.com/resources/case-studies/>).

Job instruction got renamed as Managerial coaching, a developmental approach that has received significant recent attention (Ellinger et al., 2010). Managerial coaching is defined as a supervisor or manager serving as a facilitator of learning by enacting behaviors that enable employees to learn and develop work-related skills and abilities (Beattie, 2006; Ellinger and Bostrom, 1999).

Some of the literatures on recent studies with discussions on comparisons of TOC with others are given in the following table. In TOC, many researches done on throughput accounting for the justification against conventional standard accounting systems. Second, project management applications are compared mathematically with optimizations techniques. Compared to TOC, TWI had too limited academic researches and that too only on Job instruction alone.

Table 1. Select literatures on TOC and TWI in last couple of decades

TOC				
Thinking process	Production	Supply chain	CCPM_Project	Throughput Accounting
Watson, K. J., Blackstone, J. H., & Gardiner, S. C. (2007)	Schrageheim, E., & Ronen, B. (1990)	Dalal and Athavale, 2012	Herroelen, W., & Leus, R. (2001)	Hsu and Chung (1998)
Naor, M., Bernardes, E. S., & Coman, A. (2013).	Guo, Y. H., & Qian, X. S. (2006)	Kulraj, 2014	Leach, L. P. (1999).	Aryanezhad and Komijan (2004)
Dalton, M. A. (2009).	Thürer, M., Stevenson, M., Silva, C., & Qu, T. (2017).	Menon, 2013	Raz, T., Barnes, R., & Dvir, D. (2003).	Lee and Plenert (1996)
Taylor, L. J., Murphy, B., & Price, W. (2006).	Schrageheim, E., & Dettmer, H. W. (2000).	Rahman (2002)	Herroelen, W., Leus, R., & Demeulemeester, E. (2002)	Coman and Ronen (2000)
Librelato, T. P., Lacerda, D. P., Rodrigues, L. H., & Veit, D. R. (2014)	Todd (2009)		Steyn, H. (2002)	Myrelid, 2015
Musa, P. F. (2000).	Gupta, M., & Snyder, D. (2009).		Lechler, T. G., Ronen, B., & Stohr, E. A. (2005).	Mohanty, 2009
			Bevilacqua, M., Ciarapica, F. E., & Giacchetta, G. (2009)	Gronskis and Sapkauskiene, 2011
TWI			Hall, N. G. (2012).	Tollington and Wachter, 2001
Job Instruction	Job relation	Job methods		Rajesh (2014)
Ellinger et al., 2010	Hines (1994)	Robinson & Schroeder (1993).		Ortiz-T. et al. (2014)
de Jong & Versloot (1999)	Sathiyapriya, T., & Vivek, N. (2013).	Misiurek (2016)		
Macneil, C. (2001)		Moore, R. (2011)		
Hermanussen, J., Wierstra, R., de Jong, J., & Thijssen, J. (2000).		Kato, I., & Smalley, A. (2010)		

MacNeil, C. M. (2002)		Allen, D. K., & Laure, P. (2006)		
Graupp, P., Steward, S., & Parsons, B. (2019).				
Matsuo, M. (2014)				
DePaolo, A. (2012).				

5. Philosophical Comparison Of The TOC And TWI

Philosophy is an engine which decides the direction of an ongoing improvement in any business process. There are certain challenges in improvement process are addressed by TOC and TWI in same way. Fundamentally, all changes are happening through people and if one assumes that some people are bad and get away with them then it may not pave the scope of improvement. TOC and TWI emphasize that the people are inherently good. Further, TOC clarifies that certain assumptions regarding a person are bad and so one need to get rid of it. HR policy of right person at right place is right?

Next one aspect is convincing others for change. Both the philosophies are not deviating from Win-win policy for both the parties under negotiation. TOC clarifies that If we want our win to be bigger, we have to ensure that the other side's win will be bigger. Win-lose or Lose-win including lose-lose (compromise) are considered as bad strategies.

A wrong paradigm of certainty assumptions for finding the super optimum solutions is erased and shifted to acceptance of uncertainty in the world in the search of robust solutions by TOC way. On other side, TWI is a born child to uncertainty because of world war. Though there is uncertainty everywhere, as far the controlling mechanism, TOC assumes most of thing is in our hand whereas TWI does it by action.

Finally the complexity. As Deming described “If you want a system to be used, keep it simple”, both TOC and TWI have inherent simplicity. Both rely neither complex formulations nor indigestible theories by less than a genius. As per TOC, the complexity in picture is not antonyms to the simplicity in terms of controllability.

On top of the points stated, both are certainly common sense programs but not in common practice.

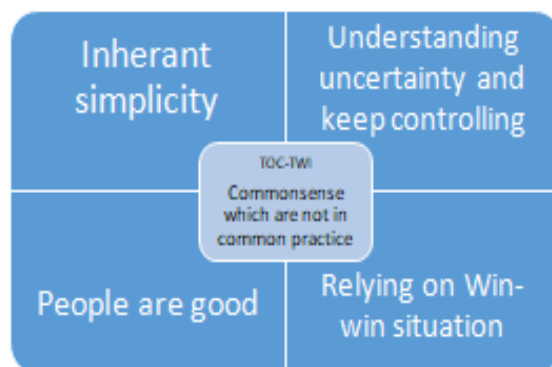


Figure 2: Commonality of TWI and TOC philosophies

However both TWI and TOC are fundamentally different in point that former one is operational and later one is systemic approach. TOC can be said global picture and focus the area of change and TWI is local actions towards the change.

Both TOC and TWI have another common advantage is speed of improvement which is enormous compare to any practice of inherently sophisticated. However, the improvements are not reaching the bottom line or goal of an organization without TOC focus. TOC says concentrating many improvements is equal to no concentration. However, TOC has smaller hand in micromanagement such as training, the TWI rightly suited there.

For TOC and TWI integrations hurdles, the stated reasons were: The integration increases more complexity of the solutions. The integration mostly takes the management in opposite directions. The integration creates contradiction among the	NOW, Actually the integrations does not jeopardize the simplicity. Common principles actually shows the exact direction. One philosophy (TOC) is at global level and other one (TWI) is at local level. Inclusiveness
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departments. Individual philosophies are always working fine Measuring the performance will become impossible.	is obvious. Joint philosophies are suggested by Goldratt and Dettmer. TOC measurement is dominating one and TWI might not contradict.
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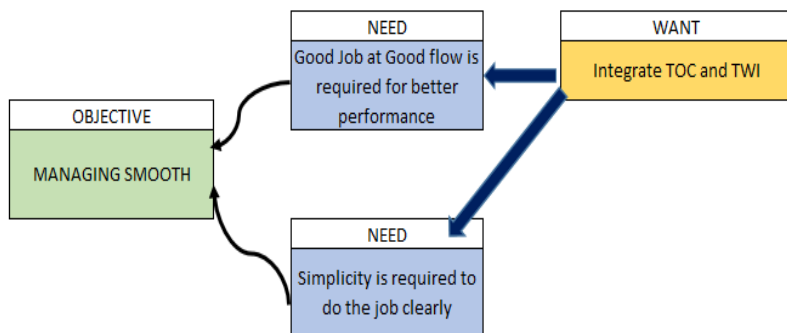


Figure 3. Breaking the conflict

TOC is absolutely science of business ie. Learning. Learning contains no value unless the person can actually do it and do it correctly-TWI. Therefore, integration of these two are logical and useful.

6. IMPROVEMENT PROCESS

Every effort will improve the firm is the mantra of TWI and it tries to improve what we are grateful for. However, this improvements does not guarantee the translation to the firm goal and some time it may worsen the situations. Any local efficiency improvement may lead to overproduction, non-synchronization of flow and non-availability of important resources. Therefore the first step of improvement process is goal setting. A TOC thinking process tool, Goal tree can be drawn to identify the system goal, its critical success factors and its necessary conditions to be met. These necessary conditions leads to at least one objective of improvement. TWI says the improvement process press start every day whereas TOC slightly varies as ongoing improvement and focus on where to focus.

Another difference is in application of improvement process. TWI says repeated application of Plan-Do-See will bring the improvement. TOC says three parts *What to change*, *What to change to*, and *How to cause change*. Actually there is no conflict exists between two programs. The third part of TOC (*How to cause change*) nicely integrates TWI application (plan-do-see). It should NOT be misunderstood that *plan* part of the TWI same as what to change, what to change to.

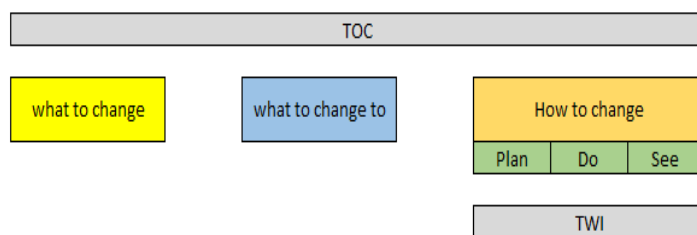


Figure 4. Representation of place for integration

Table : I illustrating the component matching of TOC and TWI

		Goal or Why	What to change	What to change to	How to cause change
Thinking process	TOC	Goal tree (or Strategy-Tactic tree)	Current reality tree	Future reality tree	I/O mapping (prerequisite), Transition tree
	TWI		Spot	If..only.. tree	Plan-Do-See
Tools	TOC	Throughput accounting			DBR, DBM, CCPM
	TWI		Job methods (Green card)	Job Instruction (Blue card)	Job relations (Yellow card)

7. Commitment Process

TOC says that operationally flexible and removing internal policy constraints that are almost impossible for competitors to imitate constitute a strategy. However, TOC Does not directly address the need for cultural change (Thomson, 2003) and acknowledges the need for other improvement methods in change process (Lee & Chang, 2012). TWI says the fact (<https://medium.com/@mark.tesla2/for-the-lean-experts-54bbe347900b>) as given below.

Pattern -> action -> habit -> behaviour -> culture -> Katas. TWI has three parts Job instruction, job relation and job methods these will define the basic patterns, shows the actions, and instruct till it becomes a habit, when many leaders have such habit it becomes culture and then yields results.

The pillars of TWI are standing on the management commitment. Therefore TWI has an action system to get the management commitment and to monitor the same. But TOC depends on necessity driven and if a Jonah (consultant) is not present, there is a possibility of less motivation even though there is an assurance of bottom line improvement. Though both TOC and TWI practice is mostly internal solution seeking, TWI is more on it. There is a system called Chocolate card and it motivates the managers to concentrate on their process improvement. It makes them regular practice such as brushing teeth. Management follow-up is the solution to make any system improvement successful.

8. Implementation Process

Change or resistance handling: The following TWI resistance are identified for the Job training employees.

- Sense of inferiority, lack of confidence, timidity.
- Stubbornness
- Distraction
- Laziness
- Carelessness

Either top management or floor workers might have any type of resistance. According to TOC, the resistance is not human behaviour, but harmony. Any threat to security gives rise to emotional resistance. Emotional resistance can only be overcome by a stronger emotion (Detmer, 2007) and win-win situation (Goldratt and Goldratt-Ashlag, 2010). If you want to win in a change, the opponent win must be big. Win-win situation is necessary condition to remove the resistance, but is not sufficient conditions to remove all layers.

In addition to the statement "Let each employee get along; Tell them change will affect them-Why-Accept" by the TWI (Blue card), sufficient actions are actually prescribed as

Layers	TOC resistance	TWI Solutions to peel the layers
0	LAYER 0. "We/I don't have a problem."	<ul style="list-style-type: none"> • Make them to understand "NO PROBLEM, IS A PROBLEM" • Go to workplace regularly • Be patient, use all of your senses to observe, not just your eyes
1	LAYER 1. "You don't understand my/our problem(s)."	<ul style="list-style-type: none"> • Win confidence and friendship.
2	LAYER 2. "...we don't agree on the direction of the solution."	<ul style="list-style-type: none"> • Point out results. • Arouse interest and compare their results in other fields where they do well.
3	LAYER 3. "...your solution can't possibly produce the level of results you say it can."	<ul style="list-style-type: none"> • Talk over and point out effects. • Show them how they have improved.
4	LAYER 4. "...your good solution is going to cause some bad things to happen."	<ul style="list-style-type: none"> • Be careful and tactful with advice. • Give friendly encouragement to share negative feed backs
5	LAYER 5. "...there are some significant obstacles	<ul style="list-style-type: none"> • Make person do job over.

	that prevent the implementation."	<ul style="list-style-type: none"> • Be a good listener
6	LAYER 6: Unable to verbalize the fear.	<ul style="list-style-type: none"> • Explain how to avoid dangers. • Develop confidence. • Transfer to other work. If fear cannot be overcome.

TOC says that Gain agreement; agree to overcome the risks. Positive results may motivate the people. Since uncertainty (murphy) is reality as accepted by TOC, the result may be negative too. TWI emphasize management to shield team member from mistake consequences. Only if happens, any change is real.

TOC has no patients to wait for results. Changes must be faster. However, TWI understands the need of slow change. Since TOC is systemic, the changes is expected to be on both policy and system.

Change Mechanism

The Change Matrix Cloud Process (CMCP) which applies combination Goldratt's change matrix and Evaporating cloud.

It has two purpose one is to understand why we and others sometimes do things we should not do and the second one is capitalize on this new-found understanding to slow down our thinking so that we do not repeat mistakes in deciding when to change, what to change, what to change to, and how to cause, communicate, and/or measure the impact of a change

https://www.tocico.org/resource/resmgr/white_paper/Change_Matrix_Cloud_Process_.pdf.

9. Implementation scope of combined of TOC and TWI in Process of Ongoing improvement (POOGI)

Table: Policy changes comparison

TOC	TWI
1. Identify the wrong policy 2. Replace the suitable policy Check for any violated constraints and go back to step 1 if necessary	Too many procedures (Red tape) kill improvements. Change one condition and a whole situation is affected. The experimenting must be done where the work is done

Table : Problem handling: Five focusing steps of TOC vs TWI Steps

Step	TOC steps	TWI steps
1	Identify the system's constraint(s).	Fact identification
2	Decide how to exploit the system's constraint(s).	Decide the action
3	Subordinate everything else to the above decision(s).	Action to support, Provide resource
4	Alleviate the system's constraint(s).	
5	Warning! If in the previous steps a constraint has been broken, go back to step 1, but do not allow inertia to cause a system's constraint.	

Though looks like similar, the TOC approach is much more systemic than the TWI. Further the term *constraint*, can NOT be substituted by any words such as Fact, Bottleneck, issues. So it is wise to accept the TOC focusing steps in the integrated model.

10. Integrated Model Of TOC-TWI Combined Program

In the following way, the integrated model could be executed.

Step1: Use TWI to get the Commitment from the management towards Process of ongoing improvement. Apply Chocolate card with minor modifications.

Step 2: Use TOC to identify the focus of the organization. Identify the Goal, Critical success factor, Strategy and tactics.

Step 3: Use TOC to identify the system constraint which directly connects the business improvement. Use TWI-Yellow card to get along with more people in DISCOVERING THE PROBLEM.

Step 4: Use TOC-Throughput accounting. Identify the measures of success of POOGI in terms of Dollar ie., throughput-margin, Operating expense and Investments and set the harmony among the department.

Step 5: Use TOC principle of exploiting the system constraint. Verbalise the problems presented as conflicts between two necessary conditions. Here, apply TWI-Job relations-Yellow card for both DISCOVERING PROBLEMS and DEALING WITH PROBLEMS. Then apply Green card- Job improvement methods. Use TWI forms to record the improvements on the constrained resources. Pause and celebrate a while.

Step 6: Verbalise the problem by TOC for identification of policy constraints and replacing them with good policies. Apply TWI-Chocolate card wherever necessary. Apply TOC thinking process tools to develop new convincing solutions and Apply TWI change management policies by Blue card to implement the same. Make these policies universally fit.

Step 7: Use TOC subordination to the constraint. Make the entire system to work according the need and speed of system constraint. Apply TWI-Chocolate card and Yellow cards wherever necessary. Also choose right TOC tools such as CCPM, DBM or DBR.

Step 8: Train the trainers. Apply TWI- Job instruction-Blue card to train the supervisors for subordinating the next step. Identify the skill gap of the employees using TWI forms.

Step 9: Use TOC elevation step on the system constraint. Apply TWI- Job instruction-Blue card in this Step to train the employees. Apply TWI-Chocolate card to ensure this step is done more carefully.

Step 10. Monitor the performance by TOC charts such as fever chart, Inventory-Buffer chart, and time-buffer charts. Ensure these improvements reflect in Bottom line measurements.

Step 11. If these are not sufficient, go back to elevation step to break the constraint. Never give up.

Step 12: If the improvement is sufficient, then pause and celebrate as suggested by TWI. Never stop as suggested by TOC. Go back to step 2 in search of constraint.

Step 13: Fix one strategic constraint on resource. Only then Throughput-margin per constrained resource time unit becomes permanent constraint to be exploited ever and in a way the sales could subordinate it ever.

Step 14. Let the Throughput improvement is subordinated by Operational Expenses and Investment I for further ongoing improvements.

Step 15. Use TWI methodology to train TOC among the organization in various departments and make TOC-TWI culture.

OR

TABLE: Integration-Job breakdown used in a TWI Job Instruction Based on Wrona and Graupp (2006) and Misiurek (2016)

STEP	Method	Man (Implementer)			
	WHAT	HOW	WHY		
	MAJOR STEPS	KEY POINTS	REASONS	SEE	EXTRA STEP
1	GET MANAGEMENT COMMITMENT	Use TWI to get the Commitment For POOGI. Apply Chocolate card with minor modifications.	Lack of management support will not improve the system	Check the level of commitment	Understand resistance to change and peel it off.
2	IDENTIFY THE FOCUS	Use TOC to Identify Goal. Draw the goal tree. Identify Critical success factor. Identify Strategy and tactics.	Focusing everywhere will not improve the system. Making money now and future is the goal of any for-profit organization with necessary conditions of caring employees and satisfying the customers now and future		

3	IDENTIFY BUSINESS CONSTRAINT	Use TOC to identify the system constraint. Use TWI-Yellow card for DISCOVERING THE PROBLEM.	System constraint is directly connects the business improvement. Need to get along with more people in problem discovery. Yellow card is the Job relation tool in TWI.	Check if correct constraint is identified	
4	IDENTIFY THE MEASURES	Use TOC-Throughput accounting. Identify the measures of success of POOGI in terms of Dollar. Throughput-margin, Operating expense and Investments. Set the harmony among the department.	Wrong measurements leads to wrong direction of the solution. Throughput accounting is the best tool for managers to take appropriate decisions.	Ensure measurements are aligned with global and local levels	
5	EXPLOIT SYSTEM CONSTRAINT	Use TOC to Verbalise the problems. Apply TOC Thinking process-CRT. Apply TWI-Yellow card for DISCOVERING PROBLEMS. Apply TWI-Yellow card for DEALING WITH PROBLEMS. Apply Green card. Use TWI forms to record the improvements.	Un-verbalised problems cannot be solved. Then apply Green card- Job improvement methods. Recording the improvements on the constrained resources will help to see the progress.	Check if any improvement such as time saving, quality improvement, easy to work, utilization on the constraint.	Pause and celebrate a while.
6	IDENTIFY AND REPLACE POLICY CONSTRAINT	Use TOC to Verbalise the problems. Use TOC Thinking process-Evaporating cloud. Identify of policy constraints. Replace them with good policies. Apply TWI-Chocolate card and yellow cards. Apply TOC thinking process tools. Apply TWI by Blue card. Make these policies universally fit.	Management commitment and Job relations are necessary to do policy changes. TOC thinking process tools will develops convincing solutions. TWI change management principles will remove the resistance. Policies should not contradict between the inner units of the organizations.	Check will it impact the system constraint	Go back to step 5 if required
7	SUBORDINATE THE CONSTRAINT	Use TOC to make the entire system to work according the need and speed of system constraint. Apply TWI-	Proper subordination by non-constrained units and management (or supervisor) to the constraint will improve the flow. Input control,		

		Chocolate card and Yellow cards wherever necessary. Choose right TOC tools such as CCPM, DBM or DBR.	buffer size and time buffer are the controlling measures of TOC.		
8	TRAIN THE TRAINERS	Apply TWI Blue card to train the supervisors for subordinating continuously. Use TWI forms to identify the skill gap.	Training is the key for sustaining the practice. Skill gap identification is the task of supervisor.		
9	ELEVATE THE CONSTRAINT	Use TOC elevation step on the system constraint. Use throughput accounting for investment analysis. Apply TWI-Blue card to train the employees. Apply TWI-Chocolate card to follow ups.	Elevation requires investment for technology, new recruitments, training on multiple skills and management follow ups.	Check the improvement at constraint	Do the steps 8 and 9 if required
10	MONITOR THE PERFORMANCE	Use TOC charts such as fever chart, Inventory-Buffer chart, and time-buffer charts. Use Throughput accounting.	TOC measures will impact the bottom line directly such as Throughput, Net profit, ROI and Cash flow.	Check the improvement at bottom line.	Pause and celebrate a while. Go back to step 3
11	DECIDE FURTHER	Never give up on failure. Never stop on success.	TOC principle. Go back to break the new constraint.	Fix the problems not the persons.	
12	FIX THE STRATEGIC CONSTRAINT	Iterate many time. Fix one strategic constraint on resource.	Only then Throughput-margin per constrained resource time unit becomes permanent constraint and which is to be exploited ever and in a way the sales could subordinate it ever.		
13	CREATE TOC-TWI culture.	Use TWI methodology to train TOC among the organization in various departments.	Culture can be created through Training, Practice, Caring and continuous follow-ups.		

11. Advantages Justification

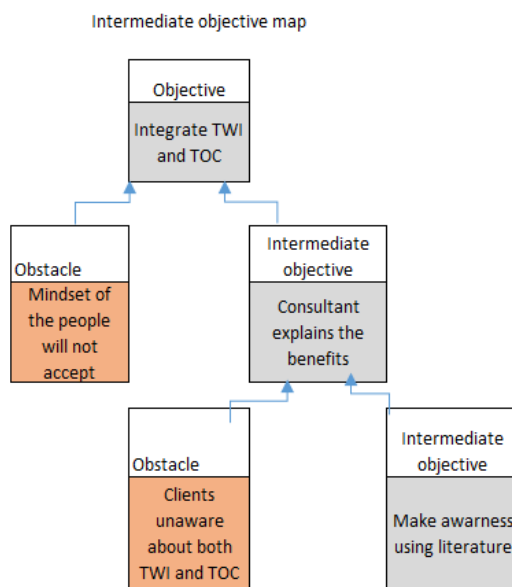
Primarily, one of the authors has used this approach in some of the manufacturing companies in India and found enormous improvement in the bottom lines. However, this is not claimed as statistical evidence since an experimental alone can prove powerfully. Such experimental research, a factorial design to find the individual effect and interaction effects, requires more sampling units. In this case sampling units are industries with certain qualifiers and willing to experiment the money with methodology proposed by the researchers. That is really difficult but may be possible too in future research.

TOC is often criticized for the shorter hand on safety and security which could not be discriminated as constraint and non-constraint and of course not measurable directly. TWI fulfil this gap as suggested by Mollo et al (2019). Further, TOC doesn't directly address the quality issues with any tool. TWI lends its hand by Job Instruction to ensure the quality and by Job Methods to improve the quality. TWI has simplicity in standardization than the quality management policies.

Apart from improvement promise of combined approach, there is scope for visibility light on both the methodologies. Now TOC certifications and TOC conferences pave the development for the academicians, implementers and consultants in terms of numbers and quality (<https://www.tocico.org/>). TWI too has certifications (<https://www.twi-institute.com/>). In future TOC-TWI will be the joint certification programs.

12. CONCLUSION

There is no longer waiting time in uncertain world for results. Time to act now and see the results soon in the bottom line. This paper has given conceptual scope of the combinations of TOC and TWI programs for the said purpose. TWI focuses Job, TOC focuses Flow and now, TOC-TWI focuses Good Job on Smooth Flow. TOC-TWI keeps the firm's goal in mind and replace the policy constraints by right policies, make all the people involved in the inclusive decisions on the improvement process according to meaningful rules and measurements. TOC-TWI provides opportunities to the employees to grow within organization (worker becomes trainer) and Grow the organizations in the way make the opportunities for promotions. There will be Energy, Enthusiasm and Excitement. There won't be any self-fooling of false successes and honest results motivates further trials with never giving-ups. Finally, TOC-TWI system will become Believable, Acceptable and Usable, however as both TOC and TWI suggest anything is neither perfect nor super optimum solution including this combo.



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APPENDIX

Comparison of TOC Vs TWI

Sl.no	Concept	TOC	TWI
1	Usability	Inherent simplicity	Inherent simplicity
2	Assumption	People are good	People are good
3	Conflict resolution	Evaporating cloud	Yellow card (Job relation)
4	management philosophy	Systemic	Operational
5	Improvement	What to change? What to change to? How to cause change?	Repeats of Plan-Do-See
6	Change resistance	Any threat to security gives rise to emotional resistance. Emotional resistance can only be overcome by a stronger emotion Analogy of pot of gold in mountain when a crocodile nearby in the river	Let each employee get along Tell them change will affect them-Why-Accept
7	Speed of results	Faster	Faster
8	Problem handling	1. Identify the system's constraint(s). 2. Decide how to exploit the system's constraint(s).	Determine the objective => Fact-Decide-Action-Results Program development=>

		Subordinate everything else to the above decision(s). 4. Alleviate the system's constraint(s). Warning! If in the previous steps a constraint has been broken, go back to step 1, but do not allow inertia to cause a system's constraint.	Spot-plan-Action-Results (Chocolate card)
9	Keywords	Flow, Constraints, throughput	Job
10	Management commitment	6. Necessity driven	Management follow up (Chocolate card)
11	Focus	7. Goal tree	What we are grateful for
12	Perfection	Trying to optimize within the noise not only doesn't help, it hurts.	There is no perfect solution
13	Improvement	Non-constraint improvements are not good to the firm	Every effort will improve the firm
14		10. Ongoing improvement	Press restart everyday
15	Action	11. Transition tree	Improvement sequence
16		12.	The Time to ACT is NOW (yellow card)
17		13. Involve many people	Involve everybody
18		14. Keep firm's goal in mind	Keep firm's goal in mind
19	Rules	5. Identify and eliminate/replace the policy constraint	Keep firm's rules in mind
20		16.	Everyone capable of Joining the effect
21	Inclusive decisions	7. Future reality tree, Negative branching, Never ignore anyone suggestion	Never ignore anyone suggestion
22	Motivation	8. Grow the organizations so that make the opportunities for promotions	Provide opportunity and identify the motivating factors Worker becomes trainer
23	Honesty	False success is no success, Everyone knows that the best salesman in his/her company is the one who violates all the rules 19.	Be honest in results
24	Support	Gain agreement; Agree to overcome	Shield team member from mistake consequences
25	Policy	4. Identify the wrong policy 5. Replace the suitable policy Check for any violated constraints and go back to step 1 if necessary	Too many procedures (Red tape) kill improvements. Change one condition and a whole situation is affected. The experimenting must be done where the work is done
26		6. Do not invest more	Provide resource
27	Change	No time to wait results. Changes must be faster	Rome is not in built in a day
	Resistance	There are 6 layers of resistance LAYER 0. "We/I don't have a problem." LAYER 1. "You don't	Fear : Explain how to avoid dangers. Develop confidence. Transfer to other work. If fear

		<p>understand my/our problem(s)." LAYER 2. "...we don't agree on the direction of the solution." LAYER 3. "...your solution can't possibly produce the level of results you say it can." LAYER 4. "...your good solution is going to cause some bad things to happen." LAYER 5. "...there are some significant obstacles that prevent the implementation." LAYER 6: Unable to verbalize the fear. 8.</p>	<p>cannot be overcome. Sense of inferiority, lack of confidence, timidity. Give friendly encouragement. Show them how they have improved. Stubbornness Win confidence and friendship. distraction Talk over and point out effects. Be a good listener. Be careful and tactful with advice. Laziness Be firm. Arouse interest and compare their results in other fields where they do well. Carelessness Point out results. Make person do job over. Be firm.</p>
28		Never give up	Never give up
29			Energy, Enthusiasm and Excitement
30			
31	Method improvement	DBM, DBR, CCPM,..	(Green card) Job methods
32	Effort movement	No stopping rule	Pause and celebrate the effort
33	Solution approach	<p>Verbalise the problem. A problem is not precisely defined until it can be presented as a conflict between two necessary conditions. Gain agreement; Agree to overcome</p>	Persistence and determination
34	Tools	Scientific methods	Actions
35	Technology	Usage at right place	Simple Forms and Cards
36	Final solution	Common sense solution, but was not in common practice	Common sense solution, but was not in common practice
37	Types of usage	Productivity and bottom line improvement	Skill for productivity, quality
38	Measurement	Throughput accounting (Global efficiency)	Local efficiency
39	Certification program	https://www.tocico.org/	https://www.twi-institute.com/
40	Proverbs	<p>Tell me how you measure me, I behave accordingly. If it is illogical, then don't blame me for illogical behaviour. 2. It is important to remove the cost accounting from the mind of the managers. 3. It is a mistake to strive for accurate answers when the data is not accurate. 4. Every system was built for a</p>	<p>If the learner hasn't learned, the teacher hasn't taught 2. NO PROBLEM, IS A PROBLEM 3. WORK FROM THIS OUTLINE - DON'T TRUST TO MEMORY. 4. It is not difficult and if you follow instructions you can't fail A Leader gets Results through People</p>

		<p>purpose.</p> <p>Constructive criticism means that there is something correct in the criticism</p> <p>The Goal is nothing new. It is just verbalizing clearly what we already knew, just common sense</p> <p>All the problems are symptoms except only one core problem or root cause.</p> <p>3. Well connected (dependent) system is NOT more complex than isolated components.</p> <p>A chain cannot be stronger than its weakest link</p> <p>The policies were very logical at the time they were instituted. Original reasons have since long gone, but the policies still remain with us.</p> <p>Whenever we witness a conflict, it is a clear indication that someone has made a faulty assumption, a faulty assumption that can be corrected, and by doing so the conflict removed.</p> <p>1. Accurate scientists don't accept that conflicts exist in reality</p> <p>3. Concentrate on the arrow you dislike the most</p>	<p>6. THERE IS ALWAYS A BETTER METHOD</p> <p>Remember there will always be a better way. Keep searching for further improvements.</p> <p>We can't afford to be 'too busy' to find time to continually search for improvements</p> <p>Improvements must be made now!</p> <p>10. The answers to Why? And What? identify unnecessary details to be eliminated."</p> <p>The answers to Where?, When?, and Who? give leads for combining and</p> <p>12. rearranging.</p> <p>3. The answers to How? supply leads for developing 'the one best way' today by simplifying.</p> <p>14. "Work out your ideas with others"</p> <p>"Operators have good ideas too; often just as many as we have -- --sometimes more!"</p> <p>5. "Improvements are of no value unless put to work."</p> <p>Put the new method to work ---- use it until a better way is developed</p> <p>18. There is no substitute for practice</p> <p>In the field of human relations, the workplace is the laboratory.</p>
41	Principles	14.	<p>1. standards must be set</p> <p>2. good instruction must be established</p> <p>3. continued training must be maintained</p> <p>9. 4. Training must not end too soon.</p>
42	Methods	15.	<p>1. Preparation</p> <p>2. Presentation</p> <p>3. Application</p> <p>Testing</p>
43	Father	16. Eliyahu M. Goldratt	4. Charles R. Allen
44	helping someone to do a better job of what he's trying to do	17.	<p>Coaching:</p> <p>1. Give reasons and advantages.</p> <p>2. Get understanding of the principles.</p> <p>3. Select a problem and work on it together.</p> <p>4. Ask him to work another problem alone.</p>

			5. Give credit for good results and good effort
45		18.	The objective of a TWI program, and the objective of coaching, is not to solve a problem, but to develop ability to solve any problems when they come up. All of this means a personal working Relationship
46		19. Multi-tasking will kill the productivity. Do the activity only when needed.	Fix priority of the Job
47		20.	Believability, Acceptability, Usability

Transition from Just Home to a Smart Home: A Study on Factors Influencing IOT Products in Making Home Smarter

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ABSTRACT

The research focuses on Internet of things and people's adoption towards smart home systems and factors that influenced at the time of purchase of IOT based products. IoT has become a part of home, industrial and smart city projects, it expands the scope of adoption in most of the electronic goods that are sold in the market. The study is focused on Coimbatore city with a sample of 80 customers who are familiar and purchased at least two IOT based home products. An exploratory factor analysis has been done to find out the main factors that influenced them at the time of purchase. The respondents feel that IOT is the future and it has improved their living experience. Convenience and sustainability are the dominant reasons for choosing IOT based products and they also feel applications of IOT will be more in home-based security products. This study contributes towards understanding the factors that influence the adoption of home-based products.

Keywords: IOT, Smart Home, factor analysis, IOT enabled products and type of houses

I. INTRODUCTION

The world is evolving toward the integration of things/products with software interfaces to provide more comfort and a quicker reaction to the task they do. To complete their tasks with the requisite ease, the Next Generation is moving toward Machine-Machine Interactions and Human-Machine Interactions. The integration is built through the Internet, and the data is accessed and assessed for various improvement processes. According to a Deloitte report, the installed IoT devices in India is around 60 million, the number expected to rise to 2 billion by 2020. People are consuming the Internet of Things for their smart applications and to extract the maximum performance from their products. The Internet of Things is a new modernistic state of technology that allows physical devices and entities to interact and collaborate effectively to provide smart solutions to problems using the Internet as a common medium. The Internet of Things is combined with Artificial Intelligence to enable Humans to interact with non-living things in order to achieve Smart Solutions for a variety of human needs.

II. REVIEW OF LITERATURE

Smart home refers to a fact wherein the IoT technology is applied to the residential premises. The IoT-based smart home products are emerging as a profitable market and offering a high opportunity for businesses looking for new sources of growth (Kim J, Park, & Choi, 2017). It was defined as "a residence including a communications network which connects the essential electrical appliances and services and allows it to be operated, monitored, or accessed remotely" by the UK Department of Trade and Industry (DTI) in 2003. Internet of Things gadgets are a subset of the bigger concept of home automation, which includes lights, heating and cooling, media, and home security systems (Ahmad Bilal Zia, Kshamta Chauhan, 2020). Internet of Things (IoT) can influence organizational purchasing behavior (Osmonbekov T, Wesley J. Johnston (2018)). And also it identifies the elements of environmental attitude that can influence Indian customer's ecological behaviour (Singh N and Karnika Gupta (2011)). While perceived risk in IOT usage was not found to be an influential factor overall, there was a substantial difference in online behaviour between male and female related to risk perception at the gender level (Talal Osmonbekov, Wesley J. Johnston (2018)). The major elements impacting consumers' purchasing decisions in organised retail outlets in Jalandhar (Mithilesh Pandey and Rajesh Verma (2015)), is to take into account the unique needs of major smart environments, such as the smart home, health, cities, and smart factories, and compare them to present IoT communication solutions (Gomez C (2019)). IOT had impacted Farming and farmers started adopting IOT, as well as how trust in the technology influences adoption productivity. (Jayashankar P (2018)). This article explains how combining the Internet of Things (IoT), Big Data, and Cloud computing produces a recipe for achieving long-term growth and development (Benkhelifa E (2014)). Main enabling factor of this promising paradigm the integration of technologies and communications solutions (Atzori L (2010)). IOT was designed to revise the BLI (Brand Luxuriousness Index) scale originally developed by Vigneron and Johnson (2004) and to identify key factors important to the management of perceived luxuriousness (Kim J (2012)). IOT are used in assessing home conditions, managing home mechanical components, and controlling home entrance via RFID cards and servo locks (Miorandi, D., Sicari, S., De Pellegrini, F., & Chlamtac, I. (2012)). In any event, the central theme is to increase home security

through the Internet of Things this is a perspective of the greater space through technology, not a small device in the house (Thierer, A., & Castillo, A. (2015). According to Khanna and Anand (2016) the emergence of the Internet of Things and other technologies has opened up new opportunities for smart cities too.

III. RESEARCH OBJECTIVES

To determine the key factors that influence in purchase of IOT based home products.

IV. RESEARCH METHODOLOGY

PHASE 1

Ten experts who are all the practioners of IoT concept and two retailers who sell IoT products were identified and where asked to deliberate on the factors that determine the purchase of IoT based home products. Forty two statements evolved from the deliberation and in second round of brainstorming around twenty statements were identified.

PHASE 2

A questionnaire with demographic details, type of house and square feet of houses were included in the questionnaire along with twenty statements. A five point likert scale was used to measure the 20 statements. Pilot testing was done with a sample of 25 respondents. Finally 14 statements are included and found as the best fit for the study.

PHASE 3

Retailers shared the database of customers who purchased IoT products and they were contacted through phone. A non-probability purposive sampling was adopted in selecting the sample. The respondents were selected based on knowledge and purchase of any two IOT products. Finally 80 respondents have provided the data for the study.

V. DATA ANALYSIS AND DISCUSSION

TABLE 1

	AGE	
	Frequency	Percent
18-29	39	48.7
24-35	29	36.2
35-50	10	12.5
>50	2	2.5
Total	80	100
	GENDER	
	Frequency	percent
Male	58	72.5
Female	22	27.5
Total	80	100
	EDUCATION	
	Frequency	Percent
High School	2	2.5
UG Degree	28	35
PG Degree	50	62.5
Total	80	100
	MARITAL STATUS	
	Frequency	Percent
Single	17	21.2
Married	57	71.2
Divorced	1	1.2
Widowed	5	6.2
Total	80	100

The Age Distribution of Respondents and their Percentage Share in the Sample Populations is shown in the table1 above. The age group 18-29 has the highest response size, at 48.7 percent (39), followed by the age group 24-35, which has 36 percent (29). The target population is largely influenced by people between the ages

of 18 and 35. Out of 80 responses, 72.5 percent (58) are male and 27.5 percent (22) are female, according to the Gender table. This demonstrates there were more male sample respondents than female responses when it comes to purchase of IOT products. Out of the complete test sample of 80 people, we discovered that the majority of the respondents have a PG degree (50 percent), followed by a UG degree (28 percent).

TABLE 2

	EMPLOYMENT STATUS	
	Frequency	Percent
Freelancer	20	25
Government Employee	5	6.2
Private Employee	6	7.5
Retired	1	1.2
Business	48	60
Total	80	100

The Employment status of the respondents and their percentage share is shown in the above table 2. The Highest response size is given by business sector in employment status at 48 with (60 percent). The lowest response size is given by retired people at 1 with (1.6 percent). This shows that Business people who are aware of IOT products because of knowledge acquired in Industry purchased the IOT products.

TABLE 3

TYPES OF HOUSES			
S.no	House Type	Frequency	Percentage
1	Independent Bungalows	27	33.75
2	Duplex	12	15
3	Gated Villas	17	21.25
4	Premium Apartments/Flats	21	26.25
5	Studio Apartments	3	3
	Total	80	100

It can be inferred from the above table Respondents who have bought Independent bungalows have installed IOT products (33.75 %) followed by the premium apartment. The lowest response size is given by studio Apartments at 3 with (3 percent).

TABLE 4

Sq.Ft of respondent houses			
S.no	Sq. Feet	Frequency	Percentage
1	Less than 1000	3	3
2	1001 – 2000	22	27.5
3	2001-3000	50	62.5
4	3000 and above	5	6
	Total	80	100

Square feet of the houses owned by the respondents are significant for the purchase of IOT based home products. Respondents who own 2001-3000 sq. feet who are around (62.5 percent) own IOT products. This shows IOT has penetrated to Upper Income

TABLE 5

TYPES OF IOT OWNED BY RESPONDENTS PRODUCTS (Multiple Choice)			
S.no	IOT products at Home	Frequency	Percentage
1	Smart TV	62	77.5
2	Smart Refrigerator	12	15
3	Smart Door lock	2	0.25

4	Fitness Tracking	70	87.5
5	Home Voice Control Devices	27	33.75
6	Smart Lighting Systems	8	1
7	Air Quality Monitor	Nil	Nil
8	Smart Security Systems	15	18.75

A majority of respondents have fitness tracking watches (87.5%) followed by smart tv (77.50%), home voice control devices started penetrating into markets, smart security systems also becoming a sensational product among the respondents.

TABLE 6

REASONS FOR PURCHASING IOT PRODUCTS			
S.No	Factors Responsible in purchasing IOT products	Mean (5- SA to 1 SDA)	Rank
1	Always wanted my Home to be Connected	4.14	4
2	I am first to buy IOT products	2.24	12
3	It saves lot of time because of implementation of IOT in electronic products	3.7	8
4	Connectivity with mobile and other gadgets	4.17	3
5	I can monitor with the touch of a button	3.6	10
6	Pride of owning IOT based products at home	4	5
7	IOT products are easy to use	4.5	2
8	I always wanted energy efficient devices at home	3.8	7
9	It has improved my living experience	4.2	2
10	I want to have a true "smart home"	3.9	6
11	IOT provides lot of quality information	3.2	11
12	The future of home is truly smart home	4.6	1
13	People look at me that i am a knowledgeable and tech savvy	3.8	7
14	I am careful the way i plan my money in making purchase for my home	3.7	8

Table 7 Measure of Sampling Adequacy

KMO TEST		
Kaiser-Meyer-Olkin measure of sampling adequacy		0.765
Bartlett's Test of Sphericity	Approx. Chi- Square	645.478
	Significance level	0

KMO measure of sampling adequacy which quantifies the degree of inter correlations among the variables and appropriateness of factor analysis, in the above table KMO value is 0.765 which confirms that the data is adequate for factor analysis

Table 8 Factor Analysis

FACTOR ANALYSIS		
Factors Emerged after Rotation	Statements	Loadings
Convenience	It saves lot of time because of implementation of IOT in electronic products	0.689
Eigen Value - 4.2111	IOT products are easy to use	0.619
Variance - 26.835	Connectivity with mobile and other gadgets	0.538

	The future of home is truly smart home	0.515
Sustainability	It saves lot of time because of implementation of IOT in electronic products	0.72
Eigen Value - 3.8928 Variance - 22.602	I always wanted energy efficient devices at home	0.697
	IOT provides lot of quality information	0.595
Smart Buyer	I am first to buy IOT products	0.661
Eigen Value - 2.422 Variance - 16.034	Pride of owning IOT based products at home	0.543
	I want to have a true "smart home"	0.523
	It has improved my living experience	0.511
Utilitarianism	People look at me that i am a knowledgeable and tech savvy	0.649
Eigen Value - 1.673 Variance - 13.303	I am careful the way i plan my money in making purchase for my home	0.642
	I can monitor with the touch of a button	0.585

The factors that emerged using factor analysis are convenience, sustainability, smart buyer and utilitarianism.

Convenience: Four statements have supported the convenience factor and it suggests that IoT devices are incredibly convenient and also it increases personal and home safety, remote home monitoring makes it much easier to ensure security and also connected through their mobile phones.

Sustainability: Three statements have emerged and supported the sustainability factor and it suggests that it saves energy, time and also provides lot of information. Particularly people who own a fit trackers are sensible with the data and IOT provides relevant information at the right time.

Utilitarianism: Four statements have supported the factor Utility because the respondents feel that generally they buy products which are useful to the family and mainly it improves the productivity in the form of efficiency and utility.

VI. RESEARCH FINDINGS

- 1) Majority of the respondents are in the age group of 18-35 with a degree/post-graduate degree, married and run a business. They possess an independent bungalow/villa with square feet of more than 2000.
- 2) They have installed or own a smart watches, smart television, security system and home voice controllable system which are embedded with IOT.
- 3) Respondents ranked the statements with the top rank to future of smart homes will be based on IOT followed by IOT products are easy to use, convenience and improved the living.
- 4) Exploratory factor analysis have been confirmed with four factors convenience, sustainability, smart buyer and utilitarianism with total cumulative variance of 78.774 with a high KMO value.

VII. CONCLUSION

The present study has been aimed to investigate the factors that are responsible in buying home based IOT products. The results of the study show that upper middle class respondents have started buying home based IOT products and they feel IOT are convenient, safe and also easy to use. They also feel proud of owning the

IOT products and felt the utility of the product has significantly improved in saving lot of their time, energy and living experience. The results of this study also offer implications to the manufactures in identifying key factors that are responsible for purchasing the IOT products. Marketers can focus their purchase points for improving sales and also bringing out new products for home usage.

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Crop Recommendation System

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ABSTRACT

Recommendation Systems focus on providing the consumers with the closest matches of items that suites the tastes of the consumer. The tastes are identified, based either on the history of purchases made by the consumer (content based) or by accounting for the association born out as a result of their comparison with their closest companions. These companions are the ones who shared similar interests to that of the consumer (collaborative filtering). In this paper, we propose Recommendation System for Crops (CRS), that recommends the appropriate crop(s) for plantation in a particular region, taking into consideration the nature of soil, the climatic conditions, the amount of rainfall, the temperature levels and the water stress impact measures of the region under examination. The system has shown 77% prediction accuracy, proved by validation tests conducted against predictions of classifier models, which are built out of data, gathered by processing image datasets (maps) of Indian territory.

Keywords: Recommendation Systems; Content Based; Collaborative Filtering

INTRODUCTION

Image Processing and Data Mining are the key concepts used here in determining the most suitable crop(s) for plantation in a specific region. The textual data relating to agriculture aren't available at a point in time but rather as average values estimated over a timespan. This makes textual data less consistent in comparison to live GIS image data, which is available through constant monitoring via satellites. The data available as live images are a reliable source of information. The maps of India highlighting the various features, relating to crop growth, have been used as the base data set for a point in time. This data serves as a novel example for analyzing the effectiveness of the system which can be extended for the GIS datasets. Image segmentation using color as the distinctive parameter is performed by clustering technique. K-Means Clustering has been employed as an Image Processing technique to build the usable dataset by overlaying the results obtained from different maps. Classification technique of Data Mining is performed using the feature information of each location as data and the crops favorable for cultivation in that region as the target class. Classifier models based on Ensemble Learning, Support Vector Machines (SVM) with RBF as kernel function, Random Forest, K-Nearest Neighbors and Naïve Bayes were then used for prediction. The Classifier Models used have been briefly discussed in the next section.

CLASSIFICATION ALGORITHMS USED

Classification is the process of assigning class labels to the new data elements, based on the training data elements and the categories to which those training data elements belong to. For e.g., labelling a mail as Spam or not Spam, classifying pictures of animals as Dogs and Cats, etc., based on available feature information.

1. Naïve Bayes Classifier

It uses a probabilistic approach based on Bayes Theorem of Probability to assign class labels to the data elements. It holds a strong assumption that the features are completely independent of each other. The feature vectors in the dataset built have some partial correlation. For e.g., it can be seen clearly that the factors like Temperature and Rainfall are to an extent dependent on each other. More is the rainfall, lesser is the Temperature and vice versa.

2. SVM

Support Vector Machine is a classifier model which tries to construct hyperplanes, with maximal margin for a clear distinction, that segregates the entire space for assigning to different class labels. It makes use of kernel trick, the transformation of lower dimensional data onto higher dimensional space for easier segregation, generally for non-linear separation problem. It doesn't perform well on large datasets, considering the long time required for training.

3. K-Nearest Neighbors

K Nearest Neighbors Classifier, based on the parameter K , assigns a class label to the data points, by opting the class label, which is the majority of all class labels obtained by K nearest data points in the training data. It is easy to visualize and is also effective due to the shorter training time needed.

4. Bagging

Bagging classifier is a type of ensemble learning method, which makes use of the Bootstrap technique to create random sub samples of dataset (with replacement), train each of them using some other classifier like Decision Trees or K Nearest Neighbors and then use the average or majority predictions for the new data value.

5. Random Forest

Random Forest is similar to bagging model in most sense except for the number of features that are considered for classification. Only a subset of are considered to determine the best split. Several weak classifiers therefore combine here to form the strong classifier.

RELATED WORK

This section gives an overview of the related research work in the context of relevant technologies.

S. Latu [1] showcases the adverse impact of economic development activities on the coastal ecosystems in exemplar developing countries, in the Pacific area, and proposes GIS Visualization strategies for moving beyond subsistence and economic development aspirations to socially, economically and environmentally sustainable development activities.

N. Li et al. [2] talks about how ontology's and semantic technologies offer support to the documentation and retrieval of dynamic information in GI Science by providing flexible schemata instead of fixed data structures which bring down the level of the results.

Neha et.al. [3] developed an ontology for cotton crop in India which can be extended for further making a more robust knowledge base system.

R Jeberson et al. [4] refers to as how GIS web services may be implemented to tackle the natural calamities such as tsunami, flood, earthquake etc.

Y. Jain et al. [5] gives an overview of GIS based agricultural system, which can provide support to the farmers during various phases of farming. A knowledge base is made use of to provide support to the farmer for better reasoning.

V. Kumar et al. [6] proposes a semantic web based architecture to generate agricultural recommendations, using spatial data and agriculture knowledge bases. Knowledge base sends recommendations to the farmers based on climatic conditions and geographical data.

J. Konaté et al. [7] developed a framework for providing recommendation of crops and the recommendation of farming practices based yield, crop life cycle, soil nature, growing season, etc.

Kiran Shinde provides a Fertilizer Recommendation System consists of logic computes all the possible combination of fertilizers to meet the crop requirements and the combination with lowest cost of fertilization will be recommended. It proposes the use of data mining techniques to provide recommendations to farmers for crops, crop rotation and identification of appropriate fertilizer. The results from the recommendation system are optimized with respect to parameter consideration.

With enormous amount of data now available through the Web, opportunities exist to integrate these data to support complex applications. On the other hand, our crop recommendation system is more real time and dynamic as it uses real time images to be processed. The regions in the images are initially segregated and divided into areas of interest which are then mapped to the crop pertaining to that particular region based on past history which plays a major role as future recommendations can be aided from the history of rainfall, soil pattern, fertility, diseases that infected the particular crop, alternate crops that can be cultivated during the interim period and also provides ease of usability to the user by offering language flexibility based on the local region languages as input to be given to the system. Various queries are resolved by the system and result of a query is the recommendation of suitable and possible crops to be grown in that particular region.

SYSTEM IMPLEMENTATION

The simulation of the application covers a wide range of modules done primarily in MatLab, Python, R, Orange and Adobe Photoshop. Photoshop was used to stretch out the images manually to uniform orientation and dimensions. MatLab has been used for the image preprocessing works that was a major part of the project. The audio processing from speech to text and text to speech has used Python and the built-in Google Speech Cloud API. R and Orange software have been used to take advantage of the built-in classification and validation packages. The implementation procedure has been discussed in detail below.

1. Indexing the Image Datasets

1.1 Preprocessing of Images

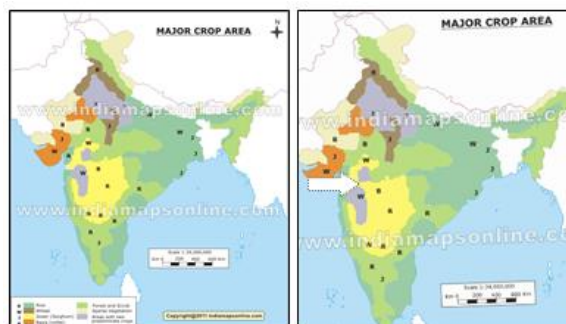


Fig. 1 Map Preprocessing

The dataset of map images played the key role in the application. The India map images that were taken into account were those of soil distribution, climatic conditions, temperature values, rainfall quotient, water stress levels and cropping patterns.

The application demanded them to have perfectly same orientation and dimensions to align the pixels in a way such that each pixel in each map corresponds to the same specific location on all the other contributing map images. The images were carved out by the translation and rotation techniques available in Photoshop software and fitted to the dimensions, 1200x1400 (width x height). It was ensured that only the region into consideration (here, the Indian Territory) came into picture.

1.2 Segmenting Maps based on Color by K-Means Clustering

The preprocessed maps were then subjected to a detailed procedure for extracting the individual portions based on color. The different colors correspond to the possible set of values for the given feature. For instance, for the feature Crop, the crop names like Rice, Wheat and Bajra may be mapped to colors Red, Green and Blue portions of the map. The individual segments are obtained by K-means clustering and stored in the disk.

1.2.1 Conversion from RGB to Lab Color Space

Lab color space is a 3-axis color system with dimension L for luminance and a and b for the color dimensions. The color differences are projected in a better manner using the Lab Color Space in comparison to the RGB model. The conversion to Lab color spaces makes it convenient for handling the chromic part of the image in an efficient manner without any impact on the luminosity.

1.2.2 Subsequent Processing Step

The chrominance part of the image embedded in the second and third dimensions of the original matrix is reshaped into a matrix with number of rows being equal to the total number of pixels (no. of rows x no. of columns) in the image and the number of columns being equal to 2 (for the two color component values).

1.2.3 K-Means Clustering

The system performs K-Means clustering on the processed dimensions based on the value of k provided by the user and returns the cluster identifiers and their corresponding centers. Each of the individual segmented portions is written to the disk for further processing.

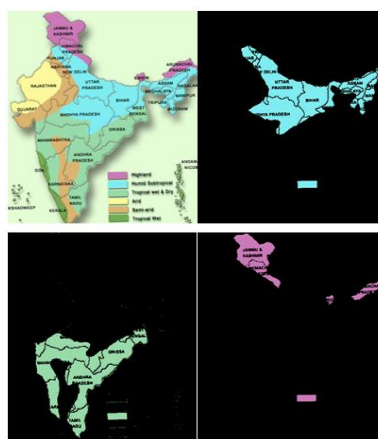


Fig. 2 Clustered Climate Map of India

1.2.4 Elbow method: Optimal k value

The within group sum of squares has been plotted against the number of clusters. The within group sum of squares is defined as the differences within a group due to presence of foreign members (originally member of another group). The objective is to find the elbow point i.e. the point where the change in within group sum of squares has become stagnant and thereby, increasing the number of clusters doesn't yield any better result.

The value for number of clusters fixed manually was 20 in this case which endorses the results obtained from the elbow method.

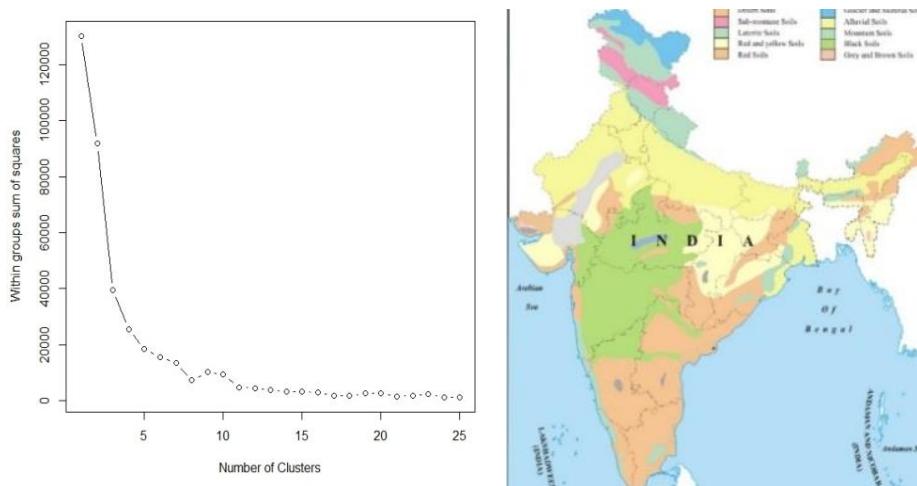


Fig. 3 Elbow Thresholding

1.3 Mapping Clusters to Feature Values

Manually, the list of the cluster identifiers and their corresponding feature values are generated as key value pairs for each of the maps. The program proceeds with the matrix read (which contains the cluster identifiers as index in place of the actual pixel values) as input and produces as result the data set consisting of the values for each of the individual feature values for each pixel. Those pixels which generated NULL values (unmapped values), even for one feature are discarded during this step. The sample dataset has been shown below.

Table 1 sample dataset

Soil	Climate	Temp	Rain	Water	Crop
GlacierSkeletal	Arid	26	20	ExtremleyHigh(>80)	SparseVegetation
GlacierSkeletal	Semi-arid	26	20	Low<10	SparseVegetation
GlacierSkeletal	Arid	26	20	AridLowWaterUse	SparseVegetation
GreyBrown	Arid	26	20	Low<10	SparseVegetation

1.3 Generated Dataset

The generated dataset consisted of 3,83,481 rows of data accounting for 18.9 MBs.

2. State-Wise Feature Distribution

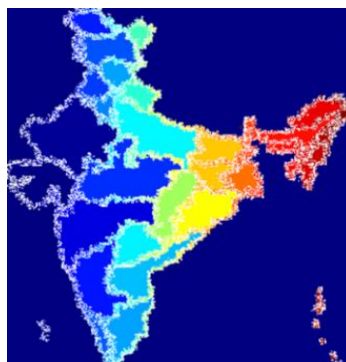


Fig. 4 India Map after Water Shed Transformation

The application also aimed at producing the distribution ratio of various feature percentages in each of the states. For this purpose, the states had to be identified. This decision called for the use of edge detection and watershed

transformation followed by segmentation. Then superimposing the state outlines on to the different feature maps produced the distribution in each state. Then, using the superimposed maps, the individual feature proportions were estimated and the percentages for each feature value were computed.

2.1 Watershed Transformation

The watershed transformation is applied here to separate the states, that is obtaining a clear separation based on colors. This involved converting the image form RGB to grayscale. The edge detection algorithm like Sobel was applied to detect the edges and bring about a separation between the states. Then using the watershed transformation, the different states were obtained as contrastingly colored regions.

2.2 Superimposition of features onto State outline

The clustering approach is yet again used to identify the individual states of the map. The states were now available. The features were superimposed on the state outlines to obtain the feature value distribution in that particular state. The individual feature values were separated out and their percentage composition of the entire state space was jotted down.

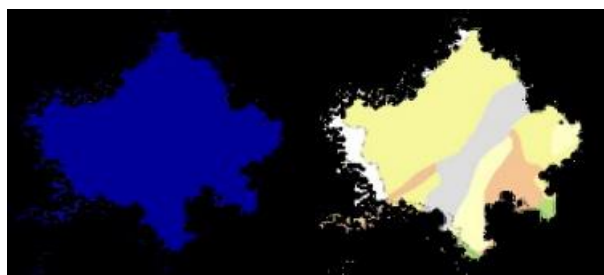


Fig. 5 Rajasthan – Climate Feature Value Extraction

Soil Details

Mountain	=>	0.054971 percent
GreyBrown	=>	24.0433 percent
GlacierSkeletal	=>	0.14588 percent
Red	=>	11.0174 percent
Alluvial	=>	50.2326 percent
Sub-montane	=>	0 percent
Sub-montane	=>	0 percent
RedYellow	=>	12.5988 percent
Black	=>	1.9071 percent

In addition to the overall statistical distribution of a state, a table stating the maximum proportion value presence of each feature has been built, for e.g. the average rainfall in Rajasthan is generally in ranges of 20 to 60 cm, to which the state is mapped to, in the table, along with the proportion presence.

Rajasthan 20 41.8747

3. Input-Output Modules

3.1 Input modes

3.1.1 City Name - Input speech processing

The Google Speech API (in Python) has been used here to recognize the voice input by the user. As already told, the need for voice recognition is for ease of the general user, the farmer in our case who is unaware of the technologies. The local language could add a better value, here, the language supported is English only.

```
Enter the city name:  
You said: Coimbatore  
Did the entry match: 1 for Yes and 0 for No1
```

The input is given by the user through a microphone which is then converted to textual form by the speech engine. The farmer is prompted to check whether the text is the same as that was spoken. If yes, the contents are then given to the classifier for further processing.

3.1.2 Latitude and Longitude: Input Parameters

A mapping from the latitude and longitude values as input to the appropriate pixel values has been performed. The city name to latitude and longitude conversion is done by means of an index built from the existing dataset.

3.1.3 State Name

This makes use of the state wise feature distribution, the specific portion where the values with maximum proportion value for each feature is taken into account for predictions.

3.1.4 Feature Vector

The values of the features for a new region is given as input to the system. The system using the classifier model predicts the resultant crop(s).

3.2 Output text-to-speech conversion

The result of crop(s) suggested is transmitted as voice back to the user. This is done by using a module in MatLab which is a part of the System's Speech Synthesizer. The appropriate volume levels can be set on the object and speak function propagates the text information as voice back to the user.

SYSTEM ARCHITECTURE

The system architecture is as shown in Fig. 6. The system with the Input/output modules and the processing system has been depicted.

The input to the system is the dataset of map images depicting the different features.

The output from the system is the recommended crop(s) and the state wise feature distribution.

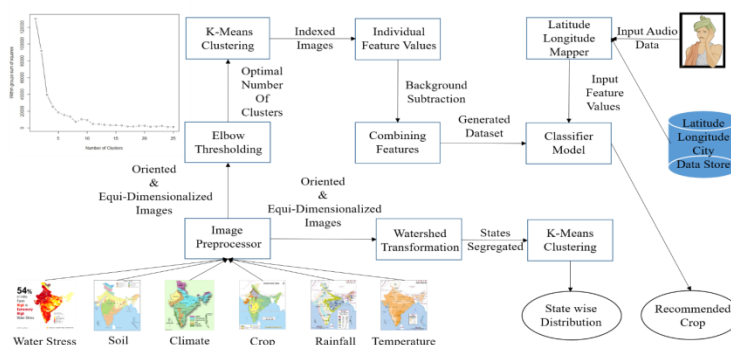


Fig. 6 System Architecture

EXPERIMENTAL RESULTS

An extensive experimentation was done using the generated data set to determine the performance accuracy obtained from each of the classifiers.

The entire dataset was split into training set (67%) and test set (33%). The classifiers used were Naïve Bayes, K-Nearest Neighbors, SVM (Linear), SVM (RBF kernel), Random Forest and Ensemble Learners. The training data set was used to train each of the classifier models. The models built were then tested using the testing data set. The classification report and confusion matrix obtained as a result of the process were recorded. The classification report consisted of the following three different metrics for analyzing the classifier model:

1. Precision
2. Recall
3. F1

The description and the computational procedures for each of the performance measure is shown in Table 2.

The Scikit-learn library in Python has been used for performing the computations for each of the classifiers. The results obtained are tabulated in Tables 3,4,5,6 and 7.

The Confusion Matrix is a N x N matrix, N is the number of class labels, which depicts the True Positive, True Negative, False Positive and False Positive values.

From the results, it can be seen that the ensemble and random forest model perform better than Naïve Bayes (NB) and K Nearest Neighbors (KNN), and gets a score of 77% predictive accuracy. This can be attributed to the

dependencies between the features and the large amount of data that disrupts the predictive power of NB and KNN.

Table 2 Computation of Performance Metrics

Performance Metric	Explanation	Computation
Precision	System's ability to not recommend a wrong crop for a region	$\frac{\text{True Positives}}{\text{True Positives} + \text{False Positives}}$
Recall	System's ability to identify all correct crop mappings	$\frac{\text{True Positives}}{\text{True Positives} + \text{False Negatives}}$
F1	Weighted harmonic mean of Precision and Recall with $\beta = 1$ (F_{β})	$2 * \frac{1}{\frac{1}{\text{recall}} + \frac{1}{\text{precision}}}$

Table 3 Naïve Bayes Classifier

6404	137	228	1614	254	1146	495
100	4126	231	14	1	1675	14
137	1005	26484	2542	3614	1098	496
564	29	2614	13368	166	780	1
524	46	5874	701	26796	60	117
56	990	1850	627	275	12337	113
994	260	557	172	523	1339	3001

	Precision	Recall	F 1 Score	Support
0	0.37	0.58	0.45	10278
1	0.3	0.9	0.45	6161
2	0.52	0.35	0.42	35376
3	0.58	0.6	0.59	17522
4	0.64	0.63	0.63	34118
5	0.56	0.34	0.42	16248
6	0.27	0.23	0.25	6846
avg/total	0.53	0.5	0.5	126549

Table 4 K Nearest Neighbors

6404	137	228	1614	254	1146	495
100	4126	231	14	1	1675	14
137	1005	26484	2542	3614	1098	496
564	29	2614	13368	166	780	1
524	46	5874	701	26796	60	117
56	990	1850	627	275	12337	113
994	260	557	172	523	1339	3001

	Precision	Recall	F 1 Score	Support
0	0.73	0.62	0.67	10278
1	0.63	0.67	0.65	6161
2	0.7	0.75	0.72	35376
3	0.7	0.76	0.73	17522
4	0.85	0.79	0.82	34118
5	0.67	0.76	0.71	16248
6	0.71	0.44	0.54	6846
avg / total	0.74	0.73	0.73	126549

Table 5 SVM (kernel = RBF)

6970	270	168	1633	250	616	371
116	4094	447	5	6	1481	12
231	333	27772	1841	3652	1175	372
533	29	2331	14223	110	295	1
513	26	5052	767	27375	75	310
80	1107	1678	692	297	12284	110
1083	396	690	26	79	1154	3418

	Precision	Recall	F 1 Score	Support
0	0.73	0.68	0.7	10278
1	0.65	0.66	0.66	6161
2	0.73	0.79	0.76	35376
3	0.74	0.81	0.77	17522
4	0.86	0.8	0.83	34118
5	0.72	0.76	0.74	16248
6	0.74	0.5	0.6	6846
avg / total	0.76	0.76	0.76	126549

Table 6 Bagging (with KNN)

7354	268	156	1268	244	600	388
128	4152	436	7	1	1425	12
277	339	27766	2541	3113	1020	270
1241	26	1636	14230	107	281	1
512	30	5476	792	26906	87	315
279	1144	1707	642	219	12148	109
1072	408	673	27	69	1140	3457

	Precision	Recall	F 1 Score	Support
0	0.68	0.72	0.7	10278
1	0.65	0.67	0.66	6161
2	0.73	0.78	0.76	35376
3	0.73	0.81	0.77	17522
4	0.88	0.79	0.83	34118
5	0.73	0.75	0.74	16248
6	0.74	0.5	0.6	6846
avag/total	0.76	0.76	0.76	126549

Table 7 Random Forest

7021	269	152	1618	253	599	366
128	4140	442	3	2	1434	12
221	331	27918	1912	3613	1034	347
536	25	2163	14390	101	306	1
486	16	4836	752	27614	102	312
77	1143	1692	706	285	12235	110
1080	406	654	29	69	1145	3463

	Precision	Recall	F 1 Score	Support
0	0.74	0.68	0.71	10278
1	0.65	0.67	0.66	6161
2	0.74	0.79	0.76	35376
3	0.74	0.83	0.78	17522

4	0.87	0.81	0.82	34118
5	0.73	0.75	0.74	16248
6	0.75	0.51	0.61	6846
avg/total	0.77	0.77	0.76	126549

CONCLUSION

The use of map image datasets has proved to show significant results. The audio processing at input and output can significantly bridge the gap between the less aware farmers and the powerful technologies available. Future work may focus on obtaining proper datasets that are specific to a smaller bounded location in place of the impractical generalization that has been assumed here by means of image datasets. Better classifier models can be used. Feature ranking and inverse Feature Ranking by having rows as columns and vice versa can be done to determine the best features. These huge volumes of data generated can be classified and handled in a better way using Hadoop based Systems such as Spark, Storm etc. Extending the model with appropriate dataset and parallel processing will be fruitful for the application

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Design of Intelligent Cane for Assisting Visually Impaired Using Cloud Technologies

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ABSTRACT

Visually Impaired are also a part of an active society. Enhancing the day to day lifestyle of visually impaired is one of rapid ongoing research area. Numerous wearable devices are being developed to support every activity of them. This assistive technology with help of artificial intelligence support has brought wonderful innovative solutions. The proposed design incorporates artificial intelligence technology in developing an assistive device that turns a cane into an intelligent cane. ZigBee Wireless Protocol acts as a backbone of the proposed architecture. ZigBee architecture uses a coordinator, router and end device. An user interface consisting of six buttons are designed on the cane, which communicates with the android mobile device through ZigBee protocols and ZigBee MicroSD card. Edge Computing happens at the ZigBee coordinator to perform all kind of analytics required. Every response is sent as a voice message back to the user via head phones. The design involves low cost and low power consumption.

Keywords: Assistive technology, Wearable devices, Artificial Intelligence, ZigBee protocol, Edge Computing

1. INTRODUCTION

1.1. Visually Impaired

Visually Impaired persons are also an essential part of the society. A society can be called as “Accessible” when it is rich in all six accessibility namely: Architectural Accessibility, Communication Accessibility, Methodological Accessibility, Instrumental Accessibility, Programmatic Accessibility and Attitudinal Accessibility. This proposal focuses on achieving the accessibility in the following order as Attitudinal Accessibility, Programmatic Accessibility, Instrumental Accessibility, Methodological Accessibility, Communication Accessibility and Architectural Accessibility.

1.2. Role of Artificial Intelligence

Artificial intelligence is defined as a branch of computer science domain dealing with the intelligent behavior in computers. AI teaches a computer system to learn the proper way to perform a task. Machine learning exhibits assistive range of applications and wearable technology that use Artificial Intelligence to recognize and verbally narrate the world around the visually impaired. Cognitive assistance tools help to improve localization and navigation for the visually impaired through vision API cognitive services. These technologies raised the count of more wearable assistive devices for visually impaired (MyEye, Aira, AiServe, Horus). Tools and technologies with greater perceptions using computational intelligence and vision support the visually impaired as the basis for this new horizon. This has led to the necessity to use advanced algorithms that can reliably interpret visual information, refining it enough to understand the content of the text and the attitude of the listener. Their level of access to the computer, digital documents, and internet is comparatively low than that of a sighted person. Hence it is vital to provide an effective Human-Machine Interactive System to bring their level up. Smart phones with AI vision technology have made improvements over the life style of visually impaired.

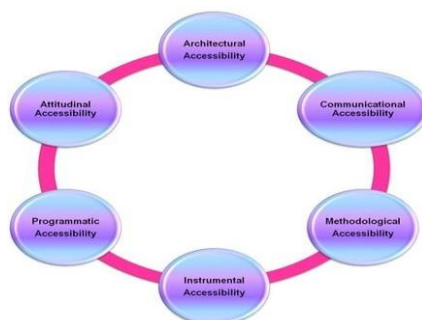


Figure 1 Accessible Society

1.1. Assisting devices

The visually impaired individual really finds it very difficult to self-navigate outdoor even in the well known environment. Wearable aid for the visually impaired people uses machine learning and artificial intelligence to better analyze data from sensors. Companies like Microsoft, NavCog, Horus, AiServe, and MyEye are working

on software projects combining vision aids and artificial intelligence. Microsoft makes use of apps rather than wearable devices like NavCog. It is a research work in collaboration with IBM based on Bluetooth technology and smart phone cameras. Horus and MyEye are two companies that work with wearable AI technology for the visually-impaired. Horus's shape is reminiscent of a MP3 player, while MyEye is a finger-sized device that magnetically attaches to glasses. A number of wearable assistive devices are available for visually impaired. These devices are as diverse as the technology used and the location on the body. Some of the major diverse groups are assistive devices that are placed over the body area's like fingers, hands, wrist, abdomen, chest, feet, tongue, ears to transmit visual information to the visually impaired.

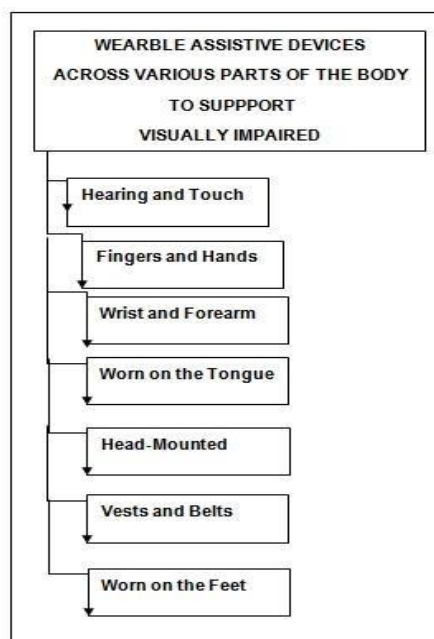


Figure 2 Wearable Assistive devices

2. LITERATURE SURVEY

According to India Today's Statistics and facts about visual impairment and tips to protect your eyes on World Sight Day 2017, about 285 million people are visually impaired worldwide. Out of which 39 million are blind and 246 million have low vision (severe or moderate visual impairment). 90 per cent of the world's visually impaired people live in developing countries like INDIA. According to Times of India, India has largest blind population in 2007. Of the 15 million blind people in India as per the survey, 26% of who are children, suffer due to corneal disorders. Same Times of India has published the statistics of visually-impaired children going to schools in 2016. The survey regarding schooling facilities for children with disabilities revealed that out of a total 12,99,902 schools in the country, only 2,74,445 (21.11%) adhere to inclusive education for disabled children.

Velázquez [1] focuses towards the various categories of wearable devices for visually impaired. These wearable devices can be used to assist the visually impaired in their day to day activities. It is concerned towards role of assistive technology. Research on supportive systems for visually impaired is classified into two main areas namely information transmission and mobility assistance.

Senjam et al [2] aims in creating awareness, usage and barriers in accessing the assistive technology among visually impaired. A study tool consisting of 42 assistive technologies was developed. There was good awareness of only 2 of the 42 devices, moderate awareness of 10 and poor awareness of the rest. But patients reported moderate usage of 3 out of the 42 devices and poor usage of the remaining devices. The awareness and utilization of assistive technologies for visual impaired was poor. Awareness about assistive technologies can be promoted for better utilization.

Senjam et al [3] has brought to lime light that lack of awareness, lack of training and financial constraints were the major reason for under utilization of Assistive Technology. Other highlights were the survey report in India stating the distribution of difficulty percentages among visually impaired children and reasons for using tactile based assistive technology instead of visual based assistive technology among children. Assistive technology for education was broadly classified into 7 types namely reading, writing, mathematics, sciences, mobility, games and leisure, and daily living equipment.

Okonji [4] gives a gist of survey of awareness about assistive technologies among visually impaired of Nigeria. It demands the need for government agencies, service providers, and ICT development practitioners to implement a barrier-free digital environment. This in turn states the importance of assistive technology. The development of simple computer assistive technologies could reduce cost, promote availability and enhance affordability for visually impaired.

Hung et al [5] focuses on wearable shopping aide for visually impaired by making a comparison with modes like shopping alone and shopping with a companion. This paper gives importance to the research that revolves around the study of designing and developing a suitable prototype for a smart shopping aid wearable device to help visually impaired people. The features taken for comparison are task performance accuracy rate, task performance time,

System Usability Scale (SUS) result, the shopping mode of using the wearable device and the functions of the wearable device and feedback from the participants. The goal of the proposed approach is to design a wearable device that can satisfy the daily needs of the visually impaired people.

Fernandes et al [6] reviews assistive spatial orientation and navigation technologies for the visually impaired. Review covers technologies like direct sensing, Dead reckoning, Triangulation and Pattern recognition. Navigation is viewed from the perspective of Speed, Distance, Obstacles, Object Recognition and Environment description. Paper suggests more on research especially for creating assistive technology to assist the orientation and navigation of visually impaired. Researchers can focus more in the direction of creating integrated products using sensing technology which will achieve massive usage among visually impaired.

Veeranjaneyulu et al [7] helps researchers to distinguish the existing equipments like Cane, Assistive shoe, Spectacles for detection of obstacles with equipments being developed by using different techniques like IoT enabled smart cane, GPS/GSM based smart cane, Wearable devices like Assistive shoes, and blind vision spectacles, which detects the obstacles as a survey. Importance of machine learning algorithms and deep learning networks like ANN, CNN, RNN for designing Smartphone based navigation technology, Electronic Travel Aids, sensor based smart canes.

Hu et al [8] gives an overview of assistive devices for blind and visually impaired. The survey covers sensor based assistive canes for obstacle detection like Ultrasonic sensor with GPS receiver, Adaptive mobility devices, Infrared sensor, RFID network, FMCW radar, Kinect sensor, Infrared sensor with brilliance and water sensors, Ultrasonic sensor with colour sensor and cds photo resistor, etc.

Phillips [9] highlights the importance of a set of criteria that need to be satisfied while developing an assistive device to support social interactions for visually impaired. The design criteria include functionality of the wearable device, usability, less or no cognitive demand and aesthetics. Functionality refers to features that are designed to meet the needs of visually impaired during social interactions. Usability refers to ease of use of wearable device by visually impaired. Less or no Cognitive demand confirms that the device must not interfere with other perceptual function. Aesthetics refers to the subtle and socially acceptable device. These features of Multimodal Assistive System, Social Interaction Assistant, Haptic Face Display, The vOICE and BrainPort.

Kiuru et al [10] has developed an assistive device based on the frequency-modulated continuous wave (FMCW) radar principle. This device transmits and receives radio waves. The distance and direction of possible obstacles in front of the user can be calculated from the received signal properties. This information is conveyed to the user by means of haptic feedback and/or by sound signals.

Tapu et al [11] has given a complete survey of wearable assistive devices for visually impaired. The wearable assistive devices for visually impaired are broadly classified into two major groups namely sensorial networks electronic traveling systems and video cameras based electronic traveling systems. There are five categories of sensorial networks electronic traveling systems namely infrared sensors, ultrasound sensors, GPS, RFID and BLE Beacon. Few examples of sensorial networks electronic traveling systems are Binaural, GuideCane, SmartCane, BatCane, Necklace Sonar, EPFL multi-sonar, CyARM, Smart Robot, RoboCart, Blind Shopping, Chumkamon, Museum Tourer, Navcog, Shoptalk and SUGAR. There are three categories of video cameras based electronic traveling systems namely monocular video based systems, stereo camera based systems and RGB-D camera based systems. Few examples of wearable assistive devices using monocular cameras are Arianna, Mobile Vision, Smart Vision, Trinetra, etc. Few examples of wearable assistive devices using stereoscopic cameras are Smart Walker, Robot Vision, SVETA, Smart Vision Stereo, etc. Few examples of wearable assistive devices using RGB-D cameras are Object Sonif, KinDectect, Kinect Cane, INSANA, NAVIG, etc.

Ullah [13] has designed an algorithm for obstacle detection in a path for visually impaired using a smart phone. The algorithm involves two major steps namely obstacle detection and alternate path finding. Camera of the smart phone is also used for accessing the images to identify obstacles. Mean square Error calculation is used for obstacle detection of every floor type. Later alternate path finding is done dividing the picture of the region into 3 frames region of interest (ROI) containing obstacle, left ROI and right ROI. The obstacle detection step is done over the left ROI. In case of again obstacle found in that path, right ROI is detected for obstacle.

Arora et al [14] has developed a prototype for object detection. It consists of passing of an image from a camera through raspberry pi to a digital image processing system. /later object detection algorithm is applied and passed to a deep neural network processing unit. It identifies object (obstacles) in the image. Convolutional neural network is used because of fewer computations it involves.

Paiva & Gupta [15] has proposed an algorithm to detect obstacles. It initiates by sending an input image for obstacle detection using histogram, followed by connected region area calculation and gray difference.

Long et al [16] has proposed a sensor fusion system to detect obstacles for visually impaired. The proposed technique is based on a low-power millimeter wave (MMW) radar and an RGB-Depth (RGB-D) sensor. Mean Shift algorithm is used to obtain the in-depth information about the obstacle. The proposed approach also detects multiple obstacles. The designed technique involves simultaneous obstacles detection from the input images by MMW radar and RGB-Depth Sensor (Real Sense R200). MMW radar determines range, velocity, and angle information on objects using a frequency-modulated continuous wave principle. Feature extraction, the depth and position information on the obstacles is determined using Mean Shift algorithm. A deep learning method called Mask R-CNN or Single Shot MultiBox Detector (SSD) is used to determine objects in color images.

Chai et al [16] has classified assistive technologies into three groups' namely visual enhancement, visual substitution and visual replacement. Visual Substitution involves electronic travel aids which involves obstacle detection. The survey visualizes the list of assistive technologies for different ground plane obstacle detection.

This section has elaborated the innovative wearable devices being designed to enhance the supportive systems. The importance of assistive technology is various applications like navigation, shopping, etc.

3. Existing Developments in designing Assistive Devices for Visually Impaired

This section briefs about various existing developments in designing assistive devices for visually impaired namely Seeing AI, Drishti, Google Glass, eSight3, OrCam, Enchroma, Intoer and BrainPort V100.

Seeing AI is an iPhone app that uses Artificial intelligence to interpret the things around a visually impaired person. Seeing AI is powered by Microsoft. It is a complete multi-tasking app. It recognizes people around along with their emotions. It also supports scanning of barcode of a product, ingredients and directions to use it. Another attractive feature of this app is its ability to take a picture of text and read it back with the device's screen reader.

Accenture's wonderful venture for visually impaired is **Drishti**. Accenture has developed an artificial intelligence powered solution to enhance the productivity of visually impaired people in the workplace. Drishti is a wireless pedestrian navigation system. It is a smart phone based assistance involving artificial intelligence techniques like natural language processing. It was tested with 10 visually impaired professionals through collaboration with the National Association for the Blind in India. Drishti has an integrated wearable computers, voice recognition and synthesis, wireless networks, Geographic Information System (GIS) and Global positioning system (GPS).

Google Glass is a product that was developed by Google Inc. in 2012 for Direction recognition among visually impaired. The major components are RGB camera and gyroscope. It acts as a mobile phone with all required functionalities. It sends response information to the user through bone-conduction earphone and display screen.

ESight 3 is a product that was developed by eSight Co. in 2017 for people who are not completely blind. eSight acts like the virtual reality display device with a high speed and quality camera is loaded in this glass to capture what the user is browsing. The obtained videos are first subjected to image-enhancement processing and then shown in two OLED screens.

OrCam is a product that was developed by OrCam Technologies Ltd. in 2015 to help visually impaired in terms of text reading, face recognition, product and money identification. The main components are RGB camera and portable computer. It is fixed on eyeglass frame. It communicates with the user via the audio signals.

Enchroma is a product that was developed by Enchroma, Inc. in 2013 for Colour contrast enhancement. This was purely developed for the colour blindness. Enchroma indicates the original waves using the specially designed lenses to help the persons of colour vision deficiency see the real colour.

Intoer is a product that was developed by Hangzhou KR-VISION Technology Co., Ltd. in 2017 for Obstacle detection, scene, money, puddle, staircase, traffic signal and zebra crossing recognition, navigation among visually impaired. The environmental information illuminated by the natural and structural light are recorded using the infrared binocular camera. It produces the special encoded stereo to inform the user via the bone-conduction earphone.

BrainPortr V100 is a product that was developed by Wicab, Inc. in 2015 for Obstacle detection and scene recognition among visually impaired. It is composed of the RGB camera mounted on a pair of glasses, hand-held controller and tongue array containing 400 electrodes. The outside information is converted into electrical signals that are sent to the tongue array on the tongue of the user.

4. Proposed architecture of Intelligent Cane

The proposed architecture is designed as a solution to enhance the state of living for visually impaired. ZigBee Wireless Technology is standard used for connecting wireless sensors and control systems. ZigBee is a packet based protocol used for providing secure, reliable and low power wireless networks. The benefits of this technology include industrial automation, home automation, office automation, medical monitoring, lower power sensors, monitoring and controlling purposes, healthcare and so on. The main attractive features of ZigBee technology are low power consumption, low cost, simple protocol, scalability, reliability, high security and global implementation.

ZigBee architecture consists of three main components namely ZigBee coordinator (ZC), ZigBee router (ZR) and ZigBee end

device (ZED). Every ZigBee network should contain atleast one ZigBee coordinator. The responsibility of ZigBee coordinator is handling and storing of the information of the system. ZigBee routers act as intermediary devices that allow data to pass through other connected devices. ZigBee End Devices are those End Devices with limited functionality. The number of routers, coordinators and end devices depends on the type of network such as star, tree and mesh networks. The features of ZigBee can be compared to that of WiFi and Bluetooth as in Table 1.

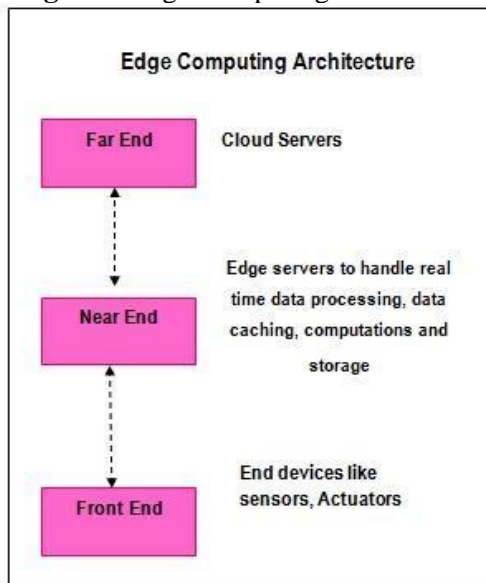
ZigBee wireless technology is known for its list of applications in the field of Chronic Disease Monitoring, Personal Wellness Monitoring, and Personal Fitness. It will wirelessly transmit the activity of the user based on the position of the sensors. ZigBee Technology helps to create a scalable network of low-power wireless nodes specifically designed to sense and monitor the health and wellbeing of visually disabled. The ZigBee Technology is suitable for applications possible that demand very low power use, flexible network topologies, data communication and security.

Table 1 Comparison of WiFi, Bluetooth and ZigBee

Features	WiFi	Bluetooth	ZigBee
Physical Layer Standard	802.11	802.15.1	802.15.4
Application	Web Email, Videos	Cable replacement	Monitoring and Controlling
Network Size	32	7	100s to 1000s
Network Architecture	Star	Star	Mesh
Attractive features	Speed	Low cost	Reliability, low power, low cost, Scalability

WEI YU et al [12] visualize the role and importance of edge computing. A comparative survey of characteristics of IoT, Edge and cloud computing is portrayed. Edge computing is a distributed environment with edge nodes of limited storage and computational capability but very fast response time and very effective in processing Big Data. An edge computing architecture consists of three layers namely front end, near end and far end. Front end consist of end devices like sensors, near end involves edge servers to handle real time data processing, data caching, computations and storage. Far end involves cloud servers. Edge Computing architecture is shown in figure 3.

Figure 3 Edge Computing Architecture



Integrated ZigBee and Edge Architecture for Intelligent Cane in Assisting Visually Impaired

Visually Impaired person can use two types of canes namely Support cane and Probing cane. Support Cane provides physical stability. A Probing cane is lightweight cane. Canes support visually impaired in their day to day life. So this cane is transformed into an intelligent cane using Artificial Intelligence. This intelligent cane consists of buttons of different shape and size. A circle button for making a call, a square button for obstacle detection, a diamond button for time and alarm setting, a heart button for food ordering, a plus button for hospital and finally a note like button for navigation. The ZigBee sensors in these buttons form the front end of Edge architecture that communicates with the mobile device which acts as the near end of the edge architecture. The proposed design consists of three major components namely ZigBee End Device (Intelligent Cane), ZigBee Coordinator (Android Mobile Device) and ZigBee Router (Headphone). Sensor information is also transmitted to the ZigBee coordinator for necessary processing. The mobile device also acts as edge node of edge architecture to perform required analytics at the input received by the ZigBee receiver. The mobile device in turn gets connected to headphones to send voice guidelines. This complete setup is encapsulated inside ZigBee Architecture with Edge Computational capability.

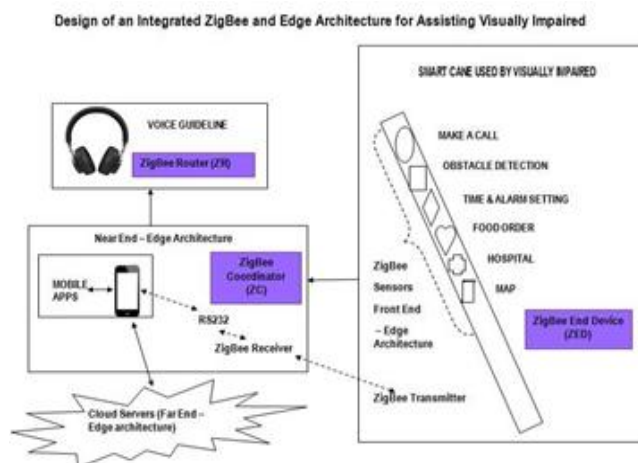


Figure 3 Proposed Design for an Intelligent Cane

5. Working of Intelligent Cane in Assisting Visually Impaired

The working of the proposed integrated architecture is described as six scenarios as below:

Scenario 1: Make a Call

It narrates when the user operates the circle shaped button representing to make a call. Immediately the sensor senses the information and transmits to the receiver and passes to the mobile device via RS232. The app sends a voice message through the headphones to tell the name of the contact to make a call. As the user responds with the name, call to the contact is made.

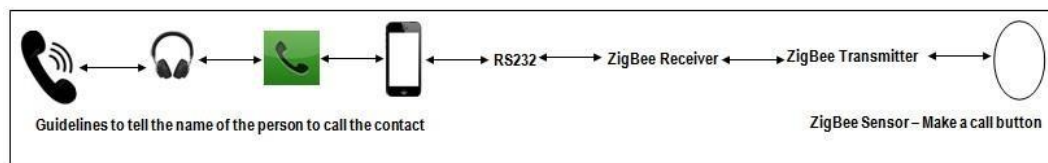


Figure 4 Working of Scenario – Make a Call

Scenario 2: Obstacle Detection

Polańczyk [18] has proposed an obstacle avoidance procedure and Lee algorithm based path replanner for autonomous mobile platforms. This proposed algorithm involves three major stages namely camera motion estimation, build map of obstacles and path planning. Stage 1 involves camera motion estimation algorithm. The sequence of flow of camera motion estimation algorithm is as follows in figure 5. This scenario takes place when the user operates the square shaped button representing for obstacle detection. This obstacle detection algorithm helps the user to identify the obstacle on the path and send the required guidelines as voice message through headphones

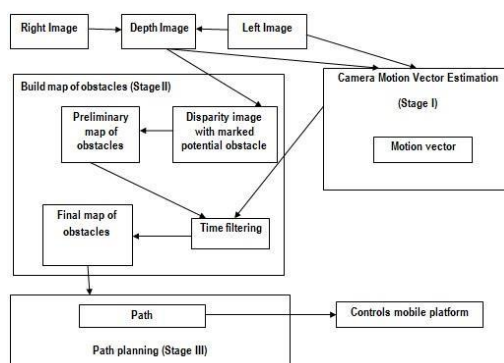


Figure 5 Obstacle Detection Algorithm

Scenario Summary Table			
Scenario 1 Make a call	ZigBee - XBEE RF module	The XBEE module requires minimal power and provides reliable delivery of data between remote devices.	Minimal power consumption Reliable communication
Scenario 2 Obstacle Detection	Ultrasonic sensors	Obstacle Detection Algorithm * Camera Motion Estimation * Build map of obstacles * Path Planning	Obstacle detection works in a suitable way for Visually impaired
Scenario 3 Time & Alarm Setting	Dongle (SDZ- 531 and SDZ- 536) Or MicroSD card ZigBee (SDZ-539) equipment built into the mobile device to work with ZigBee protocol	Either the dongle or the MicroSD card ZigBee communicates with the android device to open the suitable app via Amazon Alexa	Low Energy Consumption
Scenario 4 Food Order			
Scenario 5 Hospital			
Scenario 6 Map			

The obstacle detection algorithm starts with identification of ambient obstacles. It is followed by transformation of co-ordinates of the scenario into two dimensional map of obstacles. The formula for transformation is as follows:

where X_m , Z_m - point coordinates in map, X_c , Z_c - point coordinates in real world, X , Z - camera current position in map, β - direction of current camera movement. This results in creation of preliminary map of obstacles. These entries should be filtered in order to avoid misjudgement of an obstacle. Spatial filtering is adopted. The probability that only one point was detected on the obstacle is considered as very low thus such a point can be neglected.

Scenario 3: Time & Alarm Setting

It narrates when the user operates the diamond shaped button representing an alarm setting. Either the dongle or the MicroSD card ZigBee communicates with the android device to open the suitable app via Amazon Alexa. User can orally give instructions to set an alarm in the mobile device. The app sends a voice message through the headphones to tell the alarm set and its duration.

Scenario 4: Food Order

It narrates when the user operates the heart shaped button representing ordering food through any food ordering app. Either the dongle or the MicroSD card ZigBee communicates with the android device to open the suitable app via Amazon Alexa. User can orally give instructions to order food with the mobile device. The app sends a voice message through the headphones to details of the arrival time and cost of food ordered.

Scenario 5: Hospital

It narrates when the user operates the plus shaped button representing hospital services through any suitable app. Either the dongle or the MicroSD card ZigBee communicates with the android device to open the suitable app via Amazon Alexa. User can orally give instructions to check hospital services with the mobile device. The app sends a voice message through the headphones to details of the hospitals nearby.

Scenario 6: Map

It narrates when the user operates the note shaped button representing location identification through any suitable app. Either the dongle or the MicroSD card ZigBee communicates with the android device to open the suitable app via Amazon Alexa. User can orally give instructions to check the distance between the source and destination, time to travel, etc. The app sends a voice message through the headphones to details of the distance, time to travel, etc.

DISCUSSION AND CONCLUSION

This proposed approach states a unique solution in wearable assistive technology for visually impaired. It is of low cost so that it can be available at affordable cost with low power and low energy consumption. This can increase the percentage of users and can help researchers in designing the same prototype with many more features in future.

The proposed approach is an innovative and low cost design solution to enhance the life style of visually impaired. Existing wearable assistive devices were surveyed to understand the complete role need for artificial intelligence techniques for designing an effective for today's demand.

The proposed design will lead to a prototype of low cost, low power consumption and an intelligent cane for visually impaired to easily execute functionalities like making a call, obstacle detection, time and alarm setting, food ordering, hospital services and finally for navigation.

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Social Distance Monitoring Using Machine Learning Techniques

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ABSTRACT

The ongoing Covid-19 pandemic is a global disaster that disrupted the normal life of the people and caused more than 2 million deaths worldwide. Among various precautionary measures, Social Distancing is proved to be an effective measure in contracting the infection spread in the society. Now, as many cities in our country are moving back to normal cautiously, people have been instructed to follow social distancing rules as they venture out. It is important to monitor the social distance and wearing masks at public places and take actions accordingly. If most people follow them, then more places can be opened safely. However, if there are many violations then it may be safer to close. This is exactly what happened in Andhra Pradesh where schools and colleges were reopened after seven months in November but were closed within the week since too many people were flouting rules related to wearing masks and socially distancing. The state Government detected this by using officers to monitor. But manual monitoring may not always be an efficient and effective solution. So, we employ AI and machine learning techniques to monitor if people are following social distancing guidelines. Most of the cities already have cameras installed at public places which can be used to monitor and facilitate social distancing. The monitoring system analyses these footages, to monitor the social distance between the individuals in real time and can act based on the analysis performed on these footages. The aim of the paper is to build a social distancing tool to avoid transmission of contagious diseases through Computer Vision, Pattern Recognition using Machine Learning. The proposed tool has following features: Identify humans in the frame with yolov3 (You Only Look once). Calculates the distance among individuals who are identified in the frame. Shows the number of people who are at 'High risk', 'Low risk' and 'Not at risk'.

Keywords - Social distancing, Computer vision, Pattern Recognition, Machine Learning

1. INTRODUCTION

In the fight against the novel COVID-19 virus, social distancing has proven to be one of the most effective measures to slow down the transmission. People have to limit their interaction with each other which greatly reduces the chances of the virus being spread from close contact. In the past AI and Machine learning has shown promising results on several day-to-day life problems. This report explains how python and computer vision can be used to monitor real-time social distancing at public places especially when there are many social interactions being taken place.

2. LITERATURE SURVEY

The emerging technologies can assist in practice of social distancing. In recent paper [1] has identified how emerging technologies like AI, thermal, computer vision, ultrasound, and visible light can enable or alert the people to force them to follow social distancing. This work explained the basic concepts, models, practical scenarios, and measurements for social distance monitoring.

In paper [2], focus is towards the object identification, along with human identification, can be achieved by retraining the existing deep learning models on a dataset consisting of people in contact with surfaces or by creating boundaries within the image itself and monitoring breaches. Live camera footage can be fed to one of the lightweight object detection models such as MobileNets and objects can be detected even using lower-end hardware.

Paper [3] adopts object tracking model using the MobileNet Single Shot Multibox Detector (SSD) for detecting people. Distance between persons are calculated by finding the distance between central points of the person and later considering the boundary overlaps. When detected to be unsafe based on this calculation either alert or a warning is sent to the concerned persons. Also this system detects presence of people in restricted areas.

In paper [4], the model detects the physical distancing in three steps: people detection, picture transformation, and distance measurement. Trained models available on the TensorFlow object detection model Zoo on the COCO dataset that includes 120,000 images. Among all the models, the Faster R-CNN Inception V2 with coco weights was selected as people detection through model evaluation due to its highest detector performance indicator. The picture transformation was implemented to project the pictures captured by the camera from an arbitrary angle to the bird's eye view. For the transformation matrix, the OpenCV library in Python was used. Finally, the distance between each pair of people is measured by estimating the distance between the bottom-

center points of each boundary box in the bird's eye view. The actual physical distance, i.e., two feet, was approximated as 120 pixels in the image.

In another work [5] they compared the performance of most popular object deduction models such as Fast RCNN, Faster RCNN and YOLO on PASCAL-VOC and MS COCO datasets. In order to maintain balance of speed and accuracy, yolov3 alongside the Deepsort are utilized to detect and track the pedestrians and followed by calculating violation indexing for distance between the people greater than threshold value (minimum distance advised by WHO). The approach used in this work is interesting, but the result does not contain any statistical analysis and any privacy concern rather than violation index.

In paper [6] a pre-trained YOLOv3 is used for human detection. Later the information about their bounding box is calculated and used to track the social distance the concerned individuals. The basic idea behind the calculation of centroid of the bounding box is Euclidean distance calculation. By utilizing a centroid tracking algorithm to keep track of the person who violates the social distance threshold. This work mainly explains the application of transfer learning along with the pre trained model to boost the overall accuracy and efficiency of the model. The accuracy of 92% were achieved by the detection model without transfer learning and 98% were achieved by the detection model with transfer learning.

In paper [7] Deep learning concepts are used for detecting the social distance between people. This detection tool was developed with an intention to spread of coronavirus pandemic with a video feed. Especially in case of pedestrian social distancing detection, object detection pre-trained model based on the YOLOv3 algorithm was involved.

In paper [8] distance between individuals were detected using a monocular camera. Whenever there is breach in crowd, the proposed system sends a non-intrusive audio-visual cue. Overcrowding is also better handled by measuring the social density and looking up for reaching its threshold limit.

3. SYSTEM DESIGN

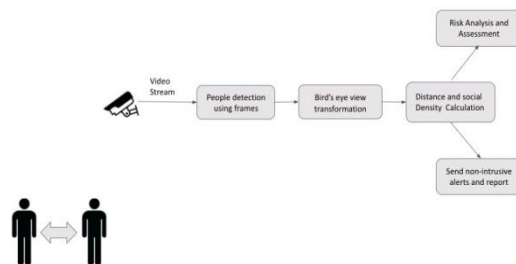


Figure 1 system design

4. EXISTING SYSTEM

The existing systems uses faster R-CNN based approach where Faster R-CNN is based on its predecessor architectures such as R-CNN and Fast R-CNN. In faster R-CNN based approach ROIs are generated by selective search technique. Faster R-CNN involves the region proposal network, which generate region proposals by using uses CNN models such as VGG-16, Inception v2 and ResNet. From the Faster R-CNN architecture, the region proposal network accepts an image as input and outputs an ROI. Each ROI consists of a bounding box and an object score. Faster R-CNN accepts two inputs and performs classification, namely the list of ROIs from the previous step (the region proposal network) and a feature volume computed from the input image, and outputs the final bounding boxes.

Faster R-CNN model outputs the bounding box for each person in the frame. Each person location was estimated in frame by taking bottom center point of bounding box as person location in frame. The people in the frame will be identified and tracked. The real distance between each person was estimated using an effective mathematical principle such as Triangle Similarity. This principle is based on the following process: (1) Focal length determination (2) Distance estimation. Finally the Pairwise Social Distance was estimated using Euclidean distance formula and the result or alert was based on threshold distance.

5. PROPOSED SYSTEM

Our proposed system uses single stage object detector (YOLO stands for You Only Look Once) which is often considered a competitor of other existing models. It is known for its speed among object detection algorithms. It can run at more than 170 FPS on a modern GPU. YOLO struggles with smaller objects. The architecture is constantly evolving from its earlier variants (Yolo v2). The idea of YOLO is that the model is focusing on two

parts namely inference and training. Inference part is concerned with processing an input frame and computing results. The training part is concerned about the process of learning the weights of the model from the training dataset. Due to its simpler architecture, YOLO runs a lot faster than faster R-CNN. Unlike faster RCNN, it's trained to do classification and bounding box regression at the same time.

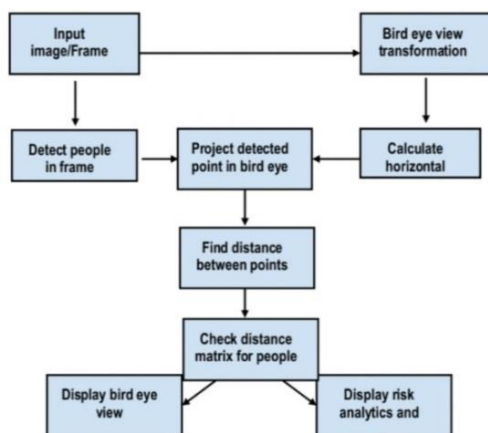


Figure 2 Flow chart

5.1 Bird eye view transformation

The transformation method involves selecting seven points. First four define ROI where we wish to observe social distancing and mapping them to the corners of a rectangle within the bird's-eye view. This assumes that every person is standing on a similar flat ground plane. Next three points will define 2m (unit length) distance in horizontal and vertical direction and people should form parallel lines with ROI.

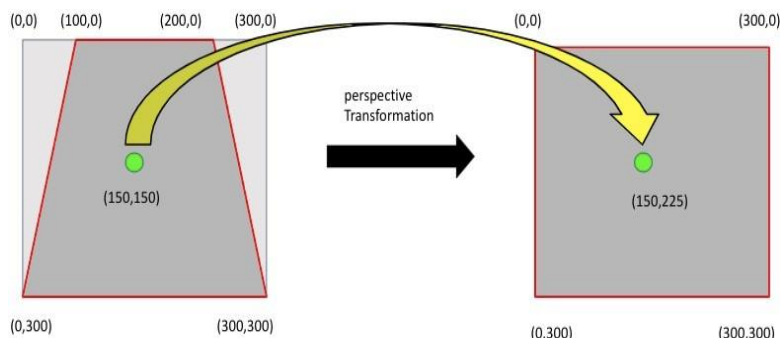


Figure 3 Perspective transformation

For bird eye view transformation, we used the technique called perspective transformation. as the input video could also be taken from an arbitrary perspective view, the primary step is to remodel perspective of view to a bird's-eye (top-down) view, because the input frames are taken from one camera, the only transformation method involves selecting four points within the perspective view which define ROI where we wish to observe social distancing and mapping them to the corners of a rectangle within the bird's-eye view. This assumes that each person is standing on the identical flat ground plane. This top view or bird eye view has the property that points are distributed uniformly in horizontal and vertical direction (scale for horizontal and vertical direction are going to be different). From this mapping, we are able to derive a transformation which will be applied to the complete perspective image.



Figure 4 Perspective Transformation input format and scaling

$$\begin{aligned} \text{source_points} &= [(100,0),(200,0),(0,300),(300,300)] \\ \text{dest_points} &= [(0,0),(300,0),(0,300),(300,300)] \\ \text{transformation matrix} &= \begin{pmatrix} 3 & 1 & -300 \\ 3.8\text{e-}16 & 3 & -6.3\text{e-}30 \\ 1.3\text{e-}18 & 6.7\text{e-}3 & 1 \end{pmatrix} \end{aligned}$$

Figure 5 Transformation Matrix in Perspective Transformation

5.2 Detect pedestrians

The second step is to detect pedestrians from the real time video stream and draw bounding boxes around each pedestrian detected in the footage. YOLO draws bounding boxes around each person based on the predictions made by the trained model.

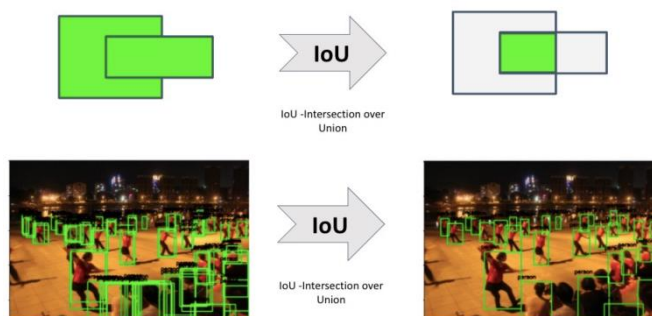


Figure 6 Non-Max suppression - Intersection over union

The objects (example person, car) in the frame can be of different shapes and sizes and to capture each of these accurately, the object detection algorithms or model create multiple bounding boxes similar to left image. But for each object in the frame, we must have a single correct bounding box. Something like the image on the right side. To select the best suitable bounding box, from the multiple bounding boxes predicted by yolo v3 model, we use non-max suppression object detection algorithms. This non-max suppression technique is used to “suppress” the less likely bounding boxes and keep only the best one from the detected frame.

The non-max suppression takes two things into account

1. The objectiveness score is given by the model yolov3.
2. The overlap or IOU (intersection over union) of the bounding boxes.

Process of selecting the best bounding box using NMS

Step 1: Select the box with highest objectiveness score given by the model yolov3

Step 2: Then, compare the overlap (IOU) of this box with other boxes

Step 3: Remove the bounding boxes with overlap (IOU) > threshold

Step 4: Then, move to the next highest objectiveness score and continue the process Step 5: Finally, repeat steps 2-4 until we get best bounding box for each object

Distance Calculation and Alert

To estimate the person’s location in frame, we can take the bottom centre point of the bounding box as a person’s location in frame. Then we estimate (x, y) location within the bird eye view (perspective view) by applying transformation to rock bottom centre point of every person’s bounding box, leading to their position within the bird’s eye view. Last step is to compute the bird’s eye view distance between every pair of people and scale the distances by the scaling in horizontal and vertical direction estimated from calibration.

$$d(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2}$$

Figure 7 Euclidean Distance formula

Lastly, we can draw Bird Eye View for ROI and draw bounding boxes according to risk factor for person in a image and draw lines between box according to risk factor between two person. Red, Yellow, Green points represent risk to human in Bird's eye view. Red indicate High Risk, Yellow indicate Low Risk and Green indicate No Risk. Red, Yellow lines between two humans in output tell they are violating social distancing rules.

Colour bounding box (Distance) =!

RED colour if distance < thresould

YELLOW colour if distance \leq thresould

GREEN colour if distance > thresould

This system can send the alert mail to the authority who is in charge to monitor social distancing in the ROI. If percentage of people not following social distancing greater than threshold percentage given by the user, mail alert will sent to him/her.

6. Experimental Results & Analysis

6.1 Experimental setup

As our local computer doesn't have GPU (Graphic Processing Unit), we trained our YOLOv3 on GOOGLE COLAB which is free, user-friendly and easy-to-use of Machine Learning Research Tool.

The hardware specification provided in GOOGLE COLAB environment are:

- GPU: 1xTesla K80 , compute 3.7, having 2496 CUDA cores , 12GB GDDR5 VRAM
- CPU: 1xsingle core hyper threaded Xeon Processors @2.3Ghz (1 core, 2 threads)
- RAM: ~12.6 GB Available
- Disk: ~33 GB Available

YOLOv3 was create on Darknet, an open source neural network framework to train detector.

6.2 DATASET

The following datasets were used in the development of the proposed framework:

MS COCO: The Microsoft Common Objects in Context (MS COCO) dataset is a well-known dataset that has configure file which has five parameter (class id, x coordinate, y coordinate, height, width) and bounding boxes used to evaluate how well object detection and image segmentation models perform. The dataset has been utilized to perform training on the YOLOv3 framework on the 'person' class.

Custom Dataset: As a human appearance, scale, visibility, shape, size and pose vary considerably, the transfer learning method is adopted to boost the custom-trained model's performance. The model is trained on a custom data set. The newly trained layer is appended with the existing model. The detection model gives bounding box information, containing centroid coordinates information, height and width.

6.3 Performance evaluation

YOLO v3 model predicts multiple bounding boxes per grid cell. To compute the loss for the true positive, we only want one of them to be the best bounding box for the object. For this purpose, we select the one with the highest IoU with the ground truth.

YOLO uses sum-squared error between the predictions and the ground truth to calculate loss. The loss function composes of:

- Classification loss.
- Localization loss (errors between the predicted boundary box and the ground truth).
- Confidence loss (the object score of the box).

SAMPLE TEST RESULT

Table 1 person deduction sample result

Frame No	TP	FP	TN	FN	Precision	Recall
1	8	1	0	0	0.89	1.00
2	15	2	2	0	0.88	1.00

3	9	1	2	0	0.90	1.00
4	13	3	1	1	0.81	0.93
5	12	1	8	1	0.92	0.92

The custom trained yolov3 model has

- Precision: 82.26 %
- Recall: 86.21 %
- Accuracy: 87.21 %



Figure 8 Loss graph of yolov3 model



Figure 9 sample result of frame contains deducted person with accuracy

6.4 RESULT ANALYSIS

To evaluate the performance of our social distance monitoring system, we perform few tests on our proposed solution with custom dataset. Whereas, table shows the few lines of quantitative results in terms of the distance between objects in pixels and cm, actual known distance in cm. We can see that model exhibited overall good performance.

Table 2 sample result of predicted distance with original distance

Frame No	Original Distance	Calculated distance
1	1681	1690
2	1687	1694
3	1689	1653
4	1694	1656
5	1551	1511

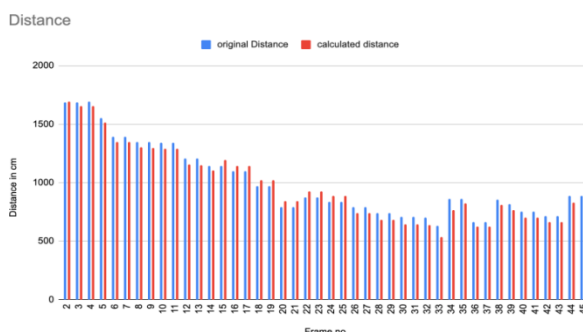


Figure 10 graph representation for original distance VS predicted distance

6.5 Distance based classification Analysis:

Table 3 Number of people in each category, total no of people detected and no of people in frame

Frame No	No Risk	Low Risk	High Risk	No people detected	No people in frame
1	8	2	5	15	14
2	5	4	3	12	12
3	9	6	8	23	22
4	3	3	2	8	10
5	8	7	9	24	22

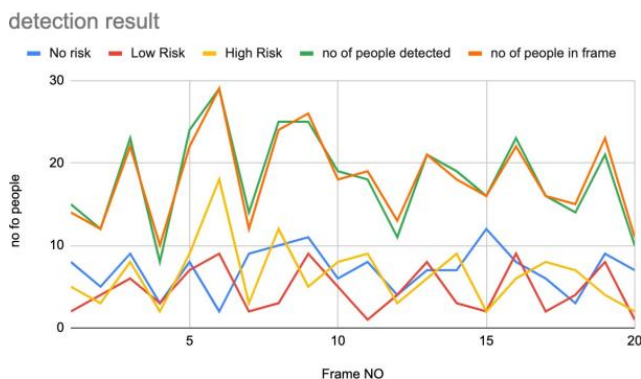


Figure 11 graph representation of no of people in each category

6.6 Simple input UI



Figure 12 Input window

6.7 Perspective Transformation



Figure 13 providing inputs (ROI) for perspective transformation

6.8 People deduction and classification



Figure 14 people deducted and classified based on threshold distance

6.9 Bird eye view

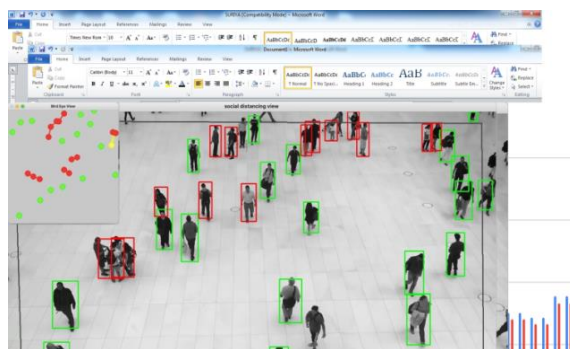


Figure 15 bird eye view representation deduced people in the frame

6.11 Email Alert



Figure 16 template of email message send to the authority if there are more no violations

CONCLUSION

In this work, a social distance monitoring system which uses machine learning techniques such as deep learning is presented. A customer trained YOLO V3 framework is used for person detection in the Region of Interest (ROI). This work is the first attempt that makes use of transfer learning for a deep learning-based detection paradigm, used for overhead perspective social distance monitoring. The work may be improved in the future for different indoor and outdoor environments. Various tracking and detection algorithms might be used to help track the person who are breaches or violating the social distancing norms.

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Music Genre Classification System Using Machine Learning Algorithms

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ABSTRACT

Music is like a mirror, and it tells people a lot about who you are and what you care about, whether you like it or not. Music can be classified into taxonomies based on genre, performer, composer or geographic or cultural point of origin. Music genres can be seen as categorical descriptions used to segregate music based on various characteristics such as instrumentation, pitch, rhythmic structure, and harmonic contents. The top 10 genres in the music industry are blues, classical, country, disco, hip-hop, jazz, reggae, rock, metal and pop. Automatic music classification is an area of research that has been receiving a great deal of attention in recent years due to the rapid growth of digital entertainment industry. There are two major challenges with music genre classification: Firstly, musical genres are loosely defined, so that people often argue over the genre of a song. Secondly, extracting differentiating features from audio data that could be fed to the model is a nontrivial task. Although music genre classification has been a challenging task in the field of Music Information Retrieval (MIR), automatic music genre classification is important for music retrieval in large music collections on the web. This project aims to build a machine learning classifier after scrutinizing various machine learning algorithms that classifies music based on its genres. The chosen classifier, Support Vector Machines then learns from the data, explores the performance of various features extracted from the audio signal and classifies the genre of the audio input. This project can be extended to develop various systems like music genre-based disco lights and emotion-mapped music systems.

Keywords: Rhythmic structure, harmonic contents, genres, Automatic music genre classification, Music Information Retrieval, music collections, machine learning classifier, machine learning algorithms, Support Vector Machines, music genre-based disco lights, emotion-mapped music systems.

INTRODUCTION

The rapid development of various affordable technologies for multimedia content capturing, data storage, high bandwidth in speed transmission and the multimedia compression standards such as JPEG and MPEG, have resulted in a rapid increase of the size of digital multimedia data collections and greatly increased the availability of multimedia contents to the general user. Digital music is one of the most important data types distributed by the Internet and the amount of digital music increases rapidly nowadays. Music classification is an interesting problem with many applications, from Drinkify (a program that generates cocktails to match the music) to Pandora to dynamically generating images that complement the music

However, music genre classification has been a challenging task in the field of music information retrieval (MIR). Music genres are hard to systematically and consistently describe due to their inherent subjective nature. The main motivation of this system is to reduce the time-spent in order to classify music and reduce the human-made errors while classifying music. The goal of the project is to train a system that can automatically classify the audio file submitted by the user into any one of the categories of genre. Music plays a very important role in people's lives. Music brings like-minded people together and is the glue that holds communities together. Communities can be recognized by the type of songs that they compose, or even listen to. Different communities and groups listen to different kinds of music. One main feature that separates one kind of music from another is the genre of the music. Hence the best algorithm which has the highest accuracy will be chosen and then it will be coded in such a way to classify the audio sample efficiently.

The objectives of the proposed system are as follows:

1. To build a machine learning model that classifies music into genres based on various different features, instead of manually entering the genre.
2. To reach a good accuracy so that the model classifies new music into its genre correctly
3. This model should be better than at least a few pre-existing models

Supervised learning is a powerful tool for data classification. Supervised learning is a learning model that was built to predict the given unforeseen input instance. With supervised learning, the labelled data can be used, which is the data that has been classified to infer a learning algorithm. A supervised learning algorithm takes a known set of input data (the learning set) and known responses to the data (the output) to learn a classification model. A learning algorithm then trains a model to predict a new instance of data. Supervised algorithms use

classification and regression techniques to develop predictive models. There are a number of approaches that have been proposed in the past for music genre classification system. The objective of this survey is to do a comparative study in order to plump for a classification algorithm that suits best for music genre classification. This literature survey contains papers on Music Genre Classification System using several algorithms.

LITERATURE SURVEY

Meimei et.al. [1] attempts to classify the genre of music using a Double Weighted KNN algorithm (DW-KNN). This algorithm makes improvements in two aspects, both in distance calculation and category judgement of traditional KNN algorithm. The first step in music genre classification is dataset collection. The second step is data preprocessing which includes generating characteristic matrix by extracting 59-dimensional characteristic of each songs; so, the result is to obtain a characteristic matrix with 59 columns and 1000 rows, forming the training set and the test set. The dataset is divided into four equal parts where three parts are used as the training set and one part as the test set. Then it performs loop test and data normalization. The data in sample set is normalized uniformly into the range of [-1,1]. The third step is evaluation criteria and validation methods. The cross-validation method divides the sample randomly into k collections. It selects k-1 collections as training set and remaining as testing set. The final step is observing the experimental results and analysis, which involves selecting the value of k. This algorithm has better classification accuracy rate for mass music data classification.

Liang et.al. [2] proposed a transfer learning approach for audio-based classification of 11 western music genres. The dataset used here consists of 100 audio tracks for each genre, having 1100 in all in mp3 format, out of which 75% is used as training data and remaining is used as testing data. Transfer learning can be applied for different classification and regression tasks. The results show that the system does not separate pop from other genres. So, the future work involves fine tuning the system to classify pop genre.

Ghosal et.al. [3] propounded an automatic music genre classification system using a deep learning model. The dataset used here is GTZAN dataset, that contains 10 music genres (blues, classical, country, disco, hip-hop, pop, jazz, reggae, rock, metal), each with 100 audio clips in .au format. The dataset incorporates samples from a variety of sources like CDs, radios, microphone recordings, etc. The training, testing and validating sets are randomly partitioned following the proportion 8:1:1. The model consists of a four-layer convolutional neural network (CNN) of 64 feature map, 3-by-3 convolutional kernels and max pooling layers. The output of CNN is a sequence in which every timestamp relies on the immediate predecessors and long-term structure of the entire song. LSTM Sequence to Sequence Autoencoder is used to capture both transient and overall characteristics and to learn representations of time series data by taking into account their temporal dynamics. Clustering Augmented Learning Method (CALM) classifier is used for classification. CALM is based on the concept of simultaneous heterogeneous clustering and classification to learn deep feature representations of the features obtained from LSTM autoencoder. Computational Experiments using GTZAN dataset resulted in an overall test accuracy of 90% with a precision of 85%. The future involves improvising new distance metric methods to compute the similarity between genres.

Vishnupriya et.al. [4] proposed automatic music genre classification using Convolution Neural Network (CNN). Music genre classification involves feature extraction and classification. Initially features are extracted from the waveform later using these features classifier is built for training. The dataset used contains 10 genres namely blues, classic, country, disco, rap, jazz, heavy metal, popular, reggae and rock. Each genre contains 100 recording, making it 1000 in all. The features are then extracted from the music. The accuracy of the model is calculated using

$$\text{Accuracy} = \frac{\text{No of songs correctly classified} \times 100}{\text{Total number of songs}}$$

Jawaharlalnehru et.al. [5] presents a comprehensive machine learning approach to the problem of automatic musical genre classification of audio signal. The first step is data collection. The music database consists of 400 audio tracks with metadata. For each genre (considering only 4 genres namely classical, pop, rock, and electronic) 100 audio tracks of 60sec long are considered. All the audio files are in .au format with 44.1 KHz sampling frequency, stereo and 16bit PCM. the dataset is partitioned randomly into three parts: 60% for training, 20% for validation, 20% for testing. The next step, feature extraction is the process that converts an audio signal into a sequence of feature vectors. Feature extraction reduces the redundant information from audio signal and provides a compact representation. The most popular technique Mel Frequency Cepstral Coefficients (MFCC) is used. It is based on a linear cosine transform a log power spectrum on a nonlinear mel scale of frequency. Each short-term Fourier transform magnitude coefficient is multiplied by the corresponding filter

gain and the results are accumulated. Then discrete cosine transform is applied to the log of the mel spectral coefficients to obtain MFCC. The final step, classification is the process by which particular label is assigned to a particular music format. The system is developed using a Multi label feed-forward Deep Neural Network (DNN) to recognize the genres. The DNN is fully connected neural network which consists of one input layer, one output layer, and several hidden layers. The number of neurons of input depends on the dimensions of input feature vectors, while the number of neurons of output layers is equal to the number of music genres being considered. The proposed system observed higher classification accuracy of 97.8%. The future work includes increasing databases and using other feature techniques and to find an effective method to combine ensemble method with DNN architecture

Quinto et.al. [6] proposed designing of a classifier for Jazz sub-genre classification using an LSTM. The dataset of three sub-genres of jazz which are swing, bebop and acid jazz are under concern. The accuracy of this system was about 90%. The future works would be training the classifier to classify up to 10 genres from GTZAN dataset, adding custom penalty matrix for misclassification and implementing larger network configurations such as increasing the number of LSTM units and the number of layers and finally trying to replace MLP with CNN.

Weibin et.al. [7] proposed two ways to improve music genre classification with convolutional neural networks. The two ways are: 1) combining max-pooling and average-pooling to provide more statistical information to higher level neural networks; 2) using shortcut connections to skip one or more layers, a method inspired by residual learning method. The dataset used is GTZAN dataset, which was collected by Tzanetakis and Cook. There are 1000 song excerpts that are almost evenly distributed into ten different genres: Blues, Classical, Country, Disco, Hiphop, Jazz, Metal, Pop, Reggae and Rock. Each song excerpt lasts about 30 seconds and is sampled at 22050Hz, 16 bits; as this improved the classification accuracy. The input of the CNN is simply the short time Fourier transforms of the audio signal. The output of the CNN is fed into another deep neural network to do classification. The output of the networks are the probabilities of different genres for each music clip. The probabilities of the clips from the same song are added and the genre with the maximum value is chosen as the label of the song. By comparing two different network topologies, preliminary experimental results on the data set show that the above two methods can effectively improve the classification accuracy, especially the second one. The future enhancement of this project is to fuse new methods such as multi-scale convolution and pooling with residual learning and study end-to-end learning to extract salient musical representations from the raw audio signals directly.

Jeong et.al. [8] describes a framework for temporal feature learning from audio with normalized cepstral modulation spectrum and deep neural network and applies it to classify music genres. The dataset used is the GTZAN dataset, that consists of 1000 (100 from each of 10 genres) 30-second long music clips with the sampling rate of 22050Hz. The results were examined by partitioning the dataset in two ways. 1. Dividing the dataset randomly into three groups (50% for training, 25% for validation and 25% for testing) and performing the experiments four times to present the averaged results. Since this random partitioning cannot be trusted, they moved for the next method. 2. "Fault-filtered" partitioning, where the dataset is divided into 443/197/290 to avoid repetition of artist across training, validation and testing sets. DNN was trained using mini-batch gradient descent with 0.01 step size and 100 batch size for the proposed algorithm. Optimization procedure was done after 200 epochs. Genre classification was performed using random forest (RF) with 500 trees as a classifier. Each music clip of 30s was first divided into a number of 5s-long short segments with 2.5s overlap. Classification was performed on each 5s-long segment, and used majority voting to classify the whole music clip. It is noted that both training and validation data were used to train RF since it does not require additional data for validation. To inspect the performance of different features, using random and fault-filtering partitioning, the features from test data were visualized using a 2-dimensional projection. The overall accuracy of this proposed system is 85%. The classification accuracies are higher with random partitioning because of artist repetition. The future enhancement is to apply the proposed method to various MIR related tasks, mood classification and instrument identification.

Rajanna et.al. [9] involves a two-layer neural network with manifold learning techniques for music genre classification. Preprocessing and extraction of meaningful audio features was difficult and challenging task of music classification. Adding to it, appropriate choice of a learning model is next challenging task. Input is a set of raw audio signals which needs to be processed. This proposed method involves preprocessing of audio signals, feature extraction, dimensionality reduction techniques, classification model such as SVMs or DNNs and genre label prediction of test samples. Future enhancements include the study other network architectures

such as convolutional neural networks and stacked autoencoders for music classification and explore different signal preprocessing and representations to measure the network sensitivity for classification.

Hagblade et.al. [10] investigates various machine learning algorithms including k-nearest neighbor (k-NN), k-means, multi-class SVM and neural networks to classify music genre. The dataset used here is GTZAN Genre collection containing 1000 audio tracks each 30 seconds (100 tracks in each genre). In this paper, the 4 distinct genres: classical, jazz, metal and pop are classified. Thus, the total dataset contains 400 songs, of which 70% is used for training and 30% is used for testing and measuring results. For audio processing, Mel Frequency Cepstral coefficients (MFCC) is used. The fundamental calculation in k-NN training is to figure out the distance between two songs. This is computed using Kullback-Leibler divergence.

$$D_{KL}(p, q) = KL(p//q) + KL(q//p)$$

The first ML technique used to classify genre is k-nearest neighbors (k-NN) which is known for its ease of implementation. For unsupervised k-means clustering to work on the feature set, a custom implementation was written to determine how to represent cluster centroids and how to update centroids in each iteration. SVM classifiers provide a reliable and fast way to differentiate between data with only two classes. In order to generalize SVMs to data falling into multiple classes (i.e. genres), directed acyclic graph (DAG) of two-class SVMs trained on each pair of class is used. The next ML technique is neural network. The data is randomly split by a ratio of 70:15:15- 70% of the data for training the neural network, 15% of the data for verification to ensure that there is no over-fitting, and 15% of the data for testing. After multiple test runs, the feedforward model with 10 layers for neural network model gives the best classification results. The overall accuracy of k-NN and SVM is 80% and 87%. This work doesn't give a completely fair comparison between learning techniques for music genre classification. The future work includes adding a validation step to the DAG SVM would help determine which learning technique is superior in this application. In addition, including additional metadata text features such as album, song title, or lyrics could allow us to extend this to music mood classification.

Yaslan et.al. [11] had 1000 music and each music having maximum of 30 seconds in length and the genres present in the data set are classical, country, disco, hiphop, jazz, rock, blues, reggae, pop, metal. They have experimented with ten different classifiers like KNN, Naïve bayes classifier, etc. They have used forward and backward selection algorithm to select best feature activity and they have used Principal Component Analysis to reduce the dimensionality of feature set. They have combined some classifier for improving the accuracy of classification and concluded that the classification is more accurate when classifiers are combined for classification.

Alessandro et.al. [12] suggested to extract features from various parts rather from single part so that performance of classification is improved. They have designed multilayer perceptron neural network classifier with one hidden layer. They have combined the outputs of the three neural networks to compensate the drawbacks of each neural network. Improved musical genre classification is achieved when the two best single classifiers are combined through the weighted sum or weighted product rule.

Meng et.al. [13] focused on extracted features based on three time scales short-term. They have introduced a feature integration technique called AR model, has been proposed as an alternative to the dominating mean-variance feature integration. They have used two classifiers a single layer neural network and a Gaussian classifier based on the covariance matrix for the purpose of classification.

Li et.al. [14] presented a comparative study between the features included in the MARSYAS framework and a set of features based on Daubechies Wavelet Coefficient Histograms (DWCH), using also other classification methods such as SVM and Linear Discriminant Analysis. For comparing they have employed two datasets. One dataset with features extracted from the beginning of the music signal, and other one being dataset composed by 755 music pieces having five music genres, with features extracted from the interval that goes from second 31 to second 61. Experimental results prove that the SVM classifier has more accuracy than other methods in case of first dataset it improves accuracy to 72% using the original feature set and to 78% using the DWCH feature set, in the second dataset results were 71% for the MARSYAS feature set and 74% to the DWCH feature set.

Tzanetakis et.al. [15] proposed set of features to represent a music piece and those features were obtained from a signal processing perspective which includes pitch related features, beat-related features and timbral texture features and the features were extracted from the first 30- seconds of each music. For classification they have used Gaussian classifiers, Gaussian mixture models and the k Nearest-Neighbors classifier. Their dataset had one thousand samples containing ten music genres. Obtained results indicate an accuracy of about 60%.

Hareesh Bahuleyan [16] gives an approach to classify music automatically by providing tags to the songs present in the user's library. It explores both Neural Network and traditional method of using Machine Learning algorithms and to achieve their goal. The first approach uses Convolutional Neural Network which is trained end to end using the features of Spectrograms (images) of the audio signal. The second approach uses various Machine Learning algorithms like Logistic Regression, Random forest etc, where it uses hand-crafted features from time domain and frequency domain of the audio signal. The manually extracted features like Mel-Frequency Cepstral Coefficients (MFCC), Chroma Features, Spectral Centroid etc are used to classify the music into its genres using ML algorithms like Logistic Regression, Random Forest, Gradient Boosting (XGB), Support Vector Machines (SVM). By comparing the two approaches separately they came to a conclusion that VGG-16 CNN model gave highest accuracy. By constructing ensemble classifier of VGG-16 CNN and XGB the optimised model with 0.894 accuracy was achieved

Tom LH Li et.al. [17] made an effort to understand the main features which actually contribute to build the optimal model for Music Genre Classification. The main purpose of this paper is to propose a novel approach to extract musical pattern features of the audio file using Convolution Neural Network (CNN). Their core objective is to explore the possibilities of application of CNN in Music Information Retrieval (MIR). Their results and experiments show that CNN has the strong capacity to capture informative features from the varying musical pattern. The features extracted from the audio clips such as statistical spectral features, rhythm and pitch are less reliable and produces less accurate models. Hence, the approach made by them to CNN, where the musical data have similar characteristics to image data and mainly it requires very less prior knowledge. The dataset considered was GTZAN. It consists of 10 genres with 100 audio clips each. Each audio clip is 30 seconds, sampling rate 22050 Hz at 16 bits. The musical patterns were evaluated using WEKA tool where multiple classification models were considered. The classifier accuracy was 84 % and eventually got higher. In comparison to the MFCC, chroma, temp features, the features extracted by CNN gave good results and was more reliable. The accuracy can still be increased by parallel computing on different combination of genres

Paradzinets et.al., [18] explored acoustic information, beat-related and timbre characteristics. To obtain acoustic information they used Piecewise Gaussian Modeling (PGM) features enhanced by modeling of human auditory filter. To do so, they obtained the PGM features, then applied critical bands filter, equal loudness and specific loudness sensation. To extract the beat-related characteristics, they used wavelet transforms, getting the 2D-beat histograms. For the timbre characteristics, they collected all detected notes with relative amplitude of their harmonics and then computed their histograms. Among others issues, their results show: (i) an improvement when using perceptually motivated PGM instead of basic PGM, i.e., accuracy of 43% versus 40.6%; (ii) training different NNs for each genre is better than training only one NN with all the genres being considered, which corresponds to an average accuracy of 49.3%.

Jang et.al. [19] proposed a novel music genre classification system based on two novel features and a weighted voting. The proposed features, modulation spectral flatness measure (MSFM) and modulation spectral crest measure (MSCM), represent the time-varying behavior of a music and indicate the beat strength. The weighted voting method determines the music genre by summarizing the classification results of consecutive time segments. Experimental results show that the proposed features give more accurate classification results when combined with traditional features than the octave-based modulation spectral contrast (OMSC) does in spite of short feature vector and that the weighted voting is more effective than statistical method and majority voting

Lu L. et.al. [20] presented their study of segmentation and classification of audio content analysis. Here an audio stream is segmented according to audio type or speaker identity. Their approach is to build a robust model which is capable of classifying and segmenting the given audio signal into speech, music, environment sound and silence. This classification is processed in two major steps, which has made it suitable for various other applications as well. The first step is speech and non- speech discrimination. In here, a novel algorithm which is based on KNN (K- nearest- neighbour) and linear spectral pairs-vector quantization (LSP-VQ) is been developed. The second step is to divide the non-speech class into music, environmental sounds, and silence with a rule- based classification method. Here they have made use of few rare and new features such as noise frame ratio, band periodicity which are not just introduced, but discussed in detail. They have also included and developed a speaker segmentation algorithm. This is unsupervised. It uses a novel scheme based on quasi - GMM and LSP correlation analysis. Without any prior knowledge of anything, the model can support the open-set speaker, online speaker modelling and also the real time segmentation.

This literature survey discusses in detail all advances in the area of music genre classification. The most accurate solution provided in this area directly or indirectly depends upon the quality, pros and accuracy

provided by the method. Various techniques have been described in this paper for the classification of music genres. The comparison table shown below delineates the differences between the algorithms proposed in the existing systems. From the study done so far, it has been analysed that the selection of the algorithm plays a crucial role in order to attain good rate of accuracy. Studies in the paper reveals that there is still scope to enhance the algorithms as well as to intensify the accuracy rate.

This survey was mainly done for choosing an algorithm that suites best in implementing a music genre classification system. The best algorithm is chosen based on the accuracy and the efficient working of the system. The results of this literature survey show that K-nearest neighbors and Support Vector Machine suits well for the problem statement. Various researches have shown that KNN gives best results for this problem. K-Nearest Neighbors is a popular machine learning algorithm for regression and classification. It makes predictions on data points based on their similarity measures i.e., distance between them. Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for both classification and regression. SVM scales relatively well to high dimensional data. Taking these advantages on consideration, the KNN and SVM are chosen as the best algorithm for music genre classification system.

System Design

System Design is the process of defining the architecture for a system to satisfy the specified requirements. System design is the process of designing the elements of the system such as the architecture, modules and the components of the system, the different interfaces of those components and the data that goes through the system.

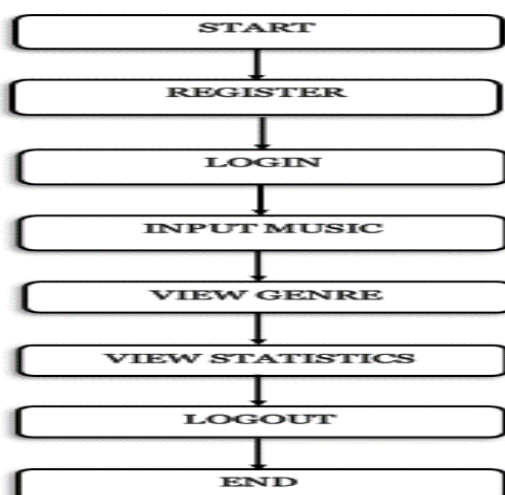


Figure 1 Block Diagram (User)

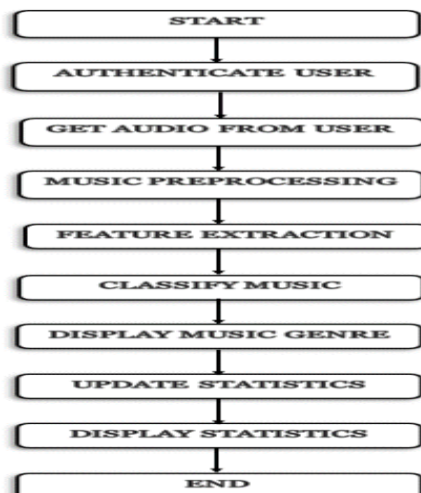


Figure 2 Block Diagram (Music Genre Classification System)

The music genre classification system takes the role of authenticating the users. It stores all the details collected from the users during registration and validates the credentials entered by the user during login. The system then extracts the music file uploaded by the user. It then preprocesses the data and performs feature extraction. The

system then identifies the genre of the music based on the features collected and knowledge from the trained model. The system then computes the accuracy of the classification and displays the genre of music and the statistics.

UML USECASE DIAGRAM



This acts as the master of this website which provides certain services. This maintains the details of all the user who have registered to the website. This system then validates the users based on the details collected during the registration. This system takes the music files provided by the user to perform the classification task. The system performs music preprocessing followed by feature extraction. It then classifies the music by comparing the features extracted with the trained model and produces the result. The system then displays the genre of music and the statistics, the total files, training set and testing set count and the accuracy obtained.

USER INTERFACE DESIGN

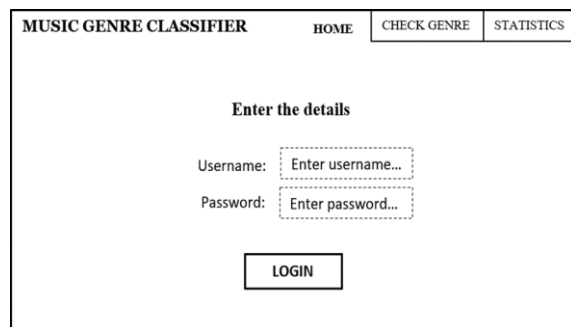


Figure 4 User Interface (Home page)

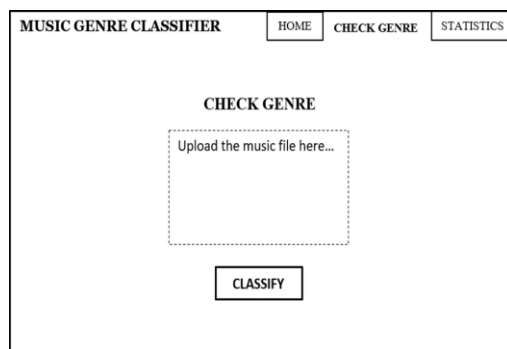


Figure 5 User Interface (Check Genre page)

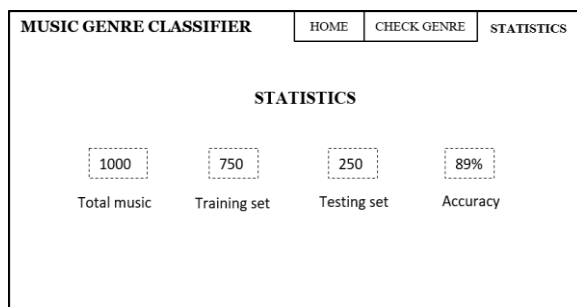


Figure 6 User Interface (Statistics page)

Proposed System

DATASET COLLECTION

The dataset consists of 1000 audio tracks each 30 seconds long. It contains 10 genres, each represented by 100 tracks. The tracks are all 22050Hz Mono 16-bit audio files in .wav format. The genres are: Blues, Classical, Country, Disco, Hiphop, Jazz, Metal, Pop, Reggae, Rock

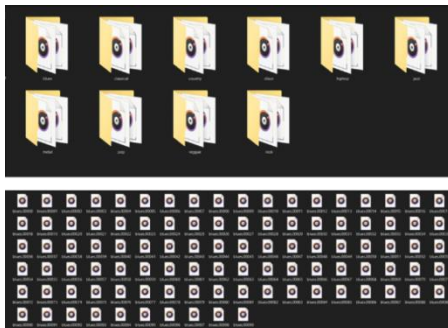


Figure 7 GTZAN Dataset

These audio files must be converted into a form which can be interpreted by humans as well as the system. This involves the conversion of audio files into Mathematical Numbers which results in easier interpretation. This can be done by using the librosa package in python. Librosa is an open-source python package for music and audio analysis. It provides the building blocks necessary to create music information retrieval systems.

DATASET VISUALIZATION

The audio file can be interpreted in the form of an image for better visualization. There are two ways to visualize an audio file. They are:

1. Waveform

The generic term waveform means a graphical representation of the shape and form of a signal moving in a gaseous, liquid, or solid medium. For sound, the term describes a depiction of the pattern of sound pressure variation (or amplitude) in the time domain. In colloquial speech, waveform audio is often used to mean the recorded sound itself (not the graphical representation) in order to distinguish it from structured audio, e.g., MIDI (Musical Instrument Digital Interface) data. The temporal frequencies of sound waves are generally expressed in terms of cycles (or kilocycles) per second. The simplest waveform is the sine wave, since it has only one frequency associated with it. The sound waves associated with, say, music, are constantly varying.

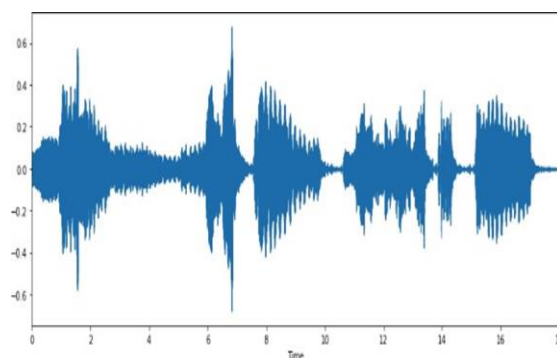


Figure 8 Audio Waveform

2. SPECTROGRAM

A spectrogram is a visual representation of the spectrum of frequencies of sound or other signals as they vary with time. The Mel spectrogram can be thought of as a visual representation of an audio signal. Specifically, it represents how the spectrum of frequencies vary over time. The Fourier transform is a mathematical formula that allows us to convert an audio signal into the frequency domain. It gives the amplitude at each frequency, and we call this the spectrum. Since frequency content typically varies over time, we perform the Fourier transform on overlapping windowed segments of the signal to get a visual of the spectrum of frequencies over time. This is called the spectrogram. Finally, since humans do not perceive frequency on a linear scale, we map the frequencies to the mel scale (a measure of pitch), which makes it so that equal distances in pitch sound equally distant to the human ear. What we get is the mel spectrogram.

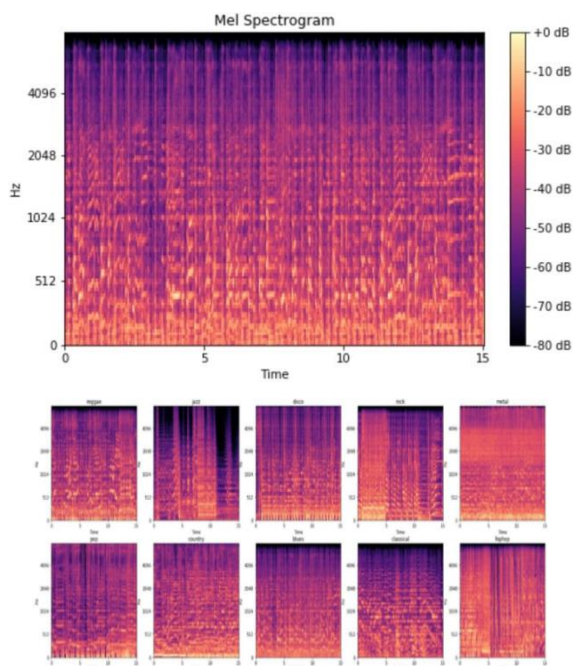


Figure 9 Mel Spectrogram

FEATURE EXTRACTION

Feature extraction is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. Feature extraction is the name for methods that select and /or combine variables into features, effectively reducing the amount of data that must be processed, while still accurately and completely describing the original data set. In the GTZAN dataset, a total of 9 features can be extracted. They are:

1. TEMPO

Tempo refers to the speed of a musical piece. More precisely, tempo refers to the rate of the musical beat and is given by the reciprocal of the beat period. Tempo is often defined in units of beats per minute (BPM). In classical music, common tempo markings include grave, largo, lento, adagio, andante, moderato, allegro, vivace, and presto. Tempo can vary locally within a piece. Therefore, we introduce the tempogram as a feature matrix which indicates the prevalence of certain tempi at each moment in time.

2. Beats

The beat is the basic metric level in music. It corresponds to the rate at which most people would tap their foot on the floor while listening to music. Beat times correspond to the points in time when the foot would hit the floor.

3. Chroma STFT

Chroma features are an interesting and powerful representation for music audio in which the entire spectrum is projected onto 12 bins representing the 12 distinct semitones (or chroma) of the musical octave. Since, in music, notes exactly one octave apart are perceived as particularly similar, knowing the distribution of chroma even without the absolute frequency (i.e. the original octave) can give useful musical information about the audio -- and may even reveal perceived musical similarity that is not apparent in the original spectra.

4. Root Mean Square (RMS) Energy:

The energy of a signal corresponds to the total magnitude of the signal. For audio signals, that roughly corresponds to how loud the signal is. The energy in a signal is defined as

$$\sum_n |x^2(n)|$$

The root-mean-square energy (RMSE) in a signal is defined as

$$\sqrt{\frac{1}{N} \sum_n |x^2(n)|}$$

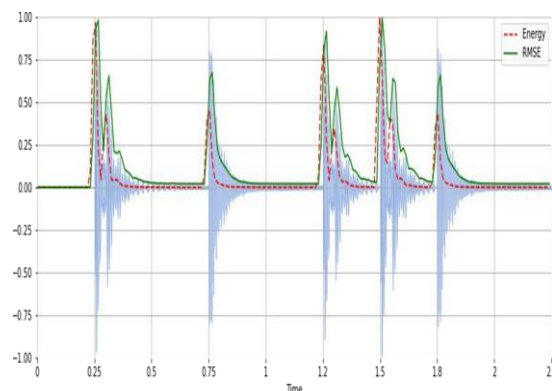


Figure 10 Root Mean Square Energy

5. SPECTRAL CENTROID

It indicates where the "center of mass" for a sound is located and is calculated as the weighted mean of the frequencies present in the sound. Consider two songs, one from a blues genre and the other belonging to metal. Now as compared to the blues genre song which is the same throughout its length, the metal song has more frequencies towards the end. So spectral centroid for blues song will lie somewhere near the middle of its spectrum while that for a metal song would be towards its end. The formula used to calculate centroid is:

$$S_{centroid} = \frac{\sum_{K=0}^{K-1} K A(K)}{\sum_{K=0}^{K-1} A(K)}$$

There is a rise in the spectral centroid towards the beginning.

6. SPECTRAL BANDWIDTH

The spectral bandwidth is defined as the extent of the power transfer function around the center frequency. The formula used to calculate spectral bandwidth is:

$$\left(\sum_k S(k) (f(k) - f_c)^p \right)^{\frac{1}{p}}$$

where $S(k)$ is the spectral magnitude at frequency bin k , $f(k)$ is the frequency at bin k , and f_c is the spectral centroid. When $p=2$, this is like a weighted standard deviation.

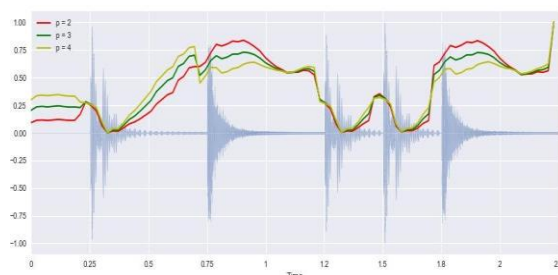


Figure 11 Spectral Bandwidth

7. Spectral Roll - off

Spectral roll - off is the frequency below which a specified percentage of the total spectral energy, e.g. 85%, lies.

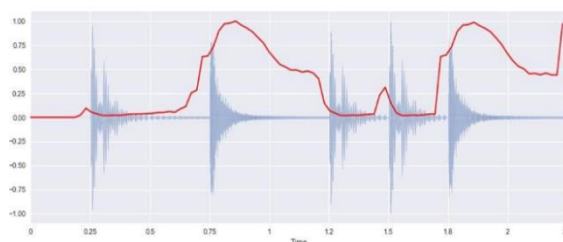


Figure 12 Spectral Roll-off

8. Zero Crossing Rate

The zero-crossing rate is the rate of sign-changes along a signal, i.e., the rate at which the signal changes from positive to negative or back. This feature has been used heavily in both speech recognition and music information retrieval. It usually has higher values for highly percussive sounds like those in metal and rock.

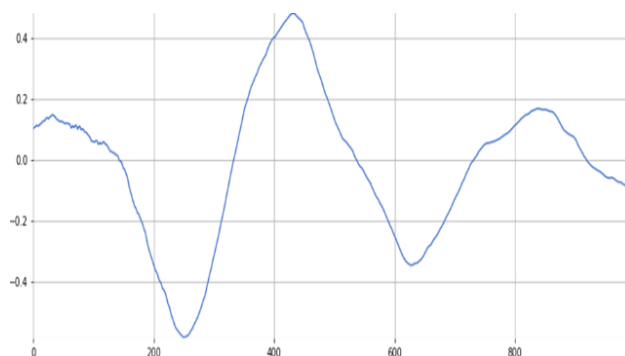


Figure 13 Zero Crossing Rate

This indicates that it has 5 zero crossings.

9. Mel-Frequency Cepstral Coefficients:

The Mel frequency cepstral coefficients (MFCCs) of a signal are a small set of features (usually about 10–20) which concisely describe the overall shape of a spectral envelope. It models the characteristics of the human voice.

$$x(n) \xrightarrow{\text{FFT}} A(k) \xrightarrow{\text{Mel band}} M(k) \xrightarrow{\log} \log M(k) \xrightarrow{\text{DCT}} \text{MFCC}(n)$$

The conversion from linear frequency values f to Mel values m is given by a logarithmic function:

$$m = 2595 \log_{10}(1 + f/700)$$

The spectral values on the linear frequency scale are integrated in triangular windows which are uniformly spaced on the Mel scale (i.e., they are logarithmically spaced on the linear frequency scale):

$$M(k) = \sum_{k=0}^{k/2-1} A(k)w_{k'}(k)$$

where $w_{k'}(k)$ are triangular windows with increasing width for higher k . We computed 20 MFCC s over 97 frames. The final dataset with the extracted features is:

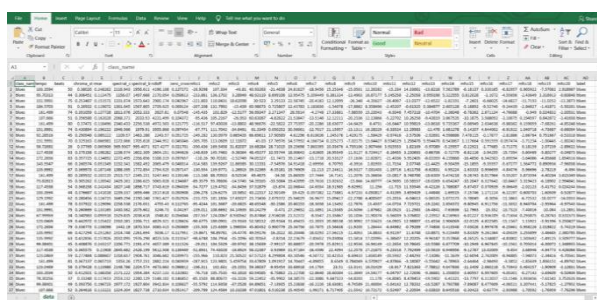


Figure 14 Final Dataset with Extracted Features

EXPERIMENTAL RESULTS

On surveying about 20 papers on Music Genre Classification, we came to a conclusion that Support Vector Machine algorithm performed better on the dataset than other algorithms and was computationally efficient to implement. We also decided to implement a few algorithms like K-Nearest Neighbor, Random Forest Classifier, Decision Tree Classifier, XGBoost Classifier, Gradient Boost Classifier, Naïve Bayes Classifier and Logistic Regression.

1 RANDOM FOREST

Random forests is a learning algorithm that is supervised. It's suitable for both classification and regression. Trees make up a forest. A forest is said to be more durable the more trees it contains. Random forests construct decision trees from randomly chosen data samples, get predictions from each tree, and vote on the best solution. It also serves as a useful indicator of the feature importance.

The parameters that provided the best results are:

Criterion -> entropy

max_depth -> 11

max_features -> auto

n_estimators -> 1000

The accuracy obtained is 65.2 %.

2 K-NEAREST NEIGHBOR

KNN is a non-parametric and lazy learning algorithm. Non-parametric means there is no assumption for underlying data distribution. In other words, the model structure determined from the dataset. This will be very helpful in practice where most of the real-world datasets do not follow mathematical theoretical assumptions. Lazy algorithm means it does not need any training data points for model generation. All training data used in the testing phase. This makes training faster and testing phase slower and costlier. Costly testing phase means time and memory. In the worst case, KNN needs more time to scan all data points and scanning all data points will require more memory for storing training data.

The parameters that provided the best results are:

metric -> manhattan

n_neighbors -> 5

weights -> distance

The accuracy obtained is 62 %.

3 SUPPORT VECTOR MACHINE

Support Vector Machines is considered to be a classification approach, it but can be employed in both types of classification and regression problems. It can easily handle multiple continuous and categorical variables. SVM constructs a hyper plane in multidimensional space to separate different classes. SVM generates optimal hyperplane in an iterative manner, which is used to minimize an error. The core idea of SVM is to find a maximum marginal hyperplane (MMH) that best divides the dataset into classes.

The parameters that provided the best results are:

C -> 100

degree -> 1

gamma -> 1

kernel -> rbf

The accuracy obtained is 66.4 %.

4 DECISION TREE

Decision Tree algorithm belongs to the family of supervised learning algorithms. Unlike other supervised learning algorithms, the decision tree algorithm can be used for solving regression and classification problems too. The goal of using a Decision Tree is to create a training model that can use to predict the class or value of the target variable by learning simple decision rules inferred from prior data(training data). In Decision Trees, for predicting a class label for a record we start from the root of the tree. We compare the values of the root attribute with the record's attribute. On the basis of comparison, we follow the branch corresponding to that value and jump to the next node.

The parameters that provided the best results are:

criterion -> gini

max_depth -> 9

min_samples_leaf -> 4

The accuracy obtained is 49.2 %.

5 XGBOOST

XGBoost is a decision-tree-based ensemble Machine Learning algorithm that uses a gradient boosting framework. Basically, XGBoost is an algorithm. Also, it has recently been dominating applied machine learning. XGBoost is an implementation of gradient boosted decision trees. Although, it was designed for speed and performance. Basically, it is a type of software library. That you can download and install on your machine. Then have to access it from a variety of interfaces.

The parameters that provided the best results are:

booster -> gbtree

eval_metric -> rmse

objective -> multi:softmax

The accuracy obtained is 64.8 %.

6 GRADIENT BOOST

Gradient boosting re-defines boosting as a numerical optimization problem where the objective is to minimize the loss function of the model by adding weak learners using gradient descent. Gradient descent is a first-order iterative optimization algorithm for finding a local minimum of a differentiable function. As gradient boosting is based on minimizing a loss function, different types of loss functions can be used resulting in a flexible technique that can be applied to regression, multi-class classification, etc. Intuitively, gradient boosting is a stage-wise additive model that generates learners during the learning process (i.e., trees are added one at a time, and existing trees in the model are not changed). The contribution of the weak learner to the ensemble is based on the gradient descent optimisation process. The calculated contribution of each tree is based on minimising the overall error of the strong learner.

The parameters that provided the best results are:

N_estimators -> 25

The accuracy obtained is 60 %.

7 NAÏVE BAYES

Naive Bayes is a statistical classification technique based on Bayes Theorem. It is one of the simplest supervised learning algorithms. Naive Bayes classifier is the fast, accurate and reliable algorithm. Naive Bayes classifiers have high accuracy and speed on large datasets. Naive Bayes classifier assumes that the effect of a particular feature in a class is independent of other features. For example, a loan applicant is desirable or not depending on his/her income, previous loan and transaction history, age, and location. Even if these features are interdependent, these features are still considered independently. This assumption simplifies computation, and that's why it is considered as naive. This assumption is called class conditional independence.

$$P(h|D) = \frac{P(D|h)P(h)}{P(D)}$$

P(h): the probability of hypothesis h being true (regardless of the data). This is known as the prior probability of h.

P(D): the probability of the data (regardless of the hypothesis). This is known as the prior probability.

P(h|D): the probability of hypothesis h given the data D. This is known as posterior probability.

P(D|h): the probability of data d given that the hypothesis h was true. This is known as posterior probability

The accuracy obtained is 40.8 %.

8 LOGISTIC REGRESSION

Multinomial logistic regression is an extension of logistic regression that adds native support for multi-class classification problems. Logistic regression, by default, is limited to two-class classification problems. Some extensions like one- vs-rest can allow logistic regression to be used for multi-class classification problems, although they require that the classification problem first be transformed into multiple binary classification problems. Instead, the multinomial logistic regression algorithm is an extension to the logistic regression model that involves changing the loss function to cross-entropy loss and predict probability distribution to a multinomial probability distribution to natively support multi-class classification problems.

The parameters that provided the best results are:

C -> 11.288378916846883

Penalty -> l2

Solver -> lbleast

The accuracy obtained is 60 %.

The Accuracy of the above-mentioned algorithms is shown below:

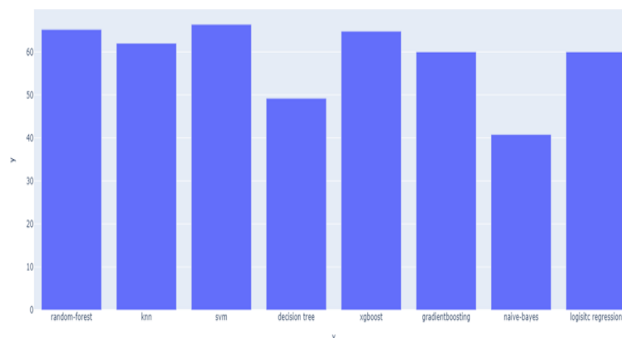


Figure 15 Accuracy Obtained by Machine Learning Algorithms

SUPPORT VECTOR MACHINE

Support Vector Machine (SVM) is a supervised machine learning algorithm which can be used for both classification and regression challenges. However, it is mostly used in classification problems. In the SVM algorithm, we plot each data item as a point in n-dimensional space (where n is number of features you have) with the value of each feature being the value of a particular coordinate. Then, we perform classification by finding the hyper-plane that differentiates the two classes very well. Support Vectors are simply the coordinates of individual observation. The SVM classifier is a frontier which best segregates the two classes (hyper-plane/ line).

WORKING OF SUPPORT VECTOR MACHINE:

The main objective is to segregate the given dataset in the best possible way. The distance between the either nearest points is known as the margin. The objective is to select a hyperplane with the maximum possible margin between support vectors in the given dataset. SVM searches for the maximum marginal hyperplane in the following steps:

1. Generate hyperplanes which segregates the classes in the best way.
2. Select the right hyperplane with the maximum segregation from the either nearest data points.

HYPERPARAMETERS

- i. Kernel: The main function of the kernel is to transform the given dataset input data into the required form. There are various types of functions such as linear, polynomial, and radial basis function (RBF). Polynomial and RBF are useful for non-linear hyperplane. Polynomial and RBF kernels compute the separation line in the higher dimension. In some of the applications, it is suggested to use a more complex kernel to separate the classes that are curved or nonlinear. This transformation can lead to more accurate classifiers.
- ii. Regularization: Regularization parameter in python's Scikit-learn C parameter used to maintain regularization. Here C is the penalty parameter, which represents misclassification or error term. The misclassification or error term tells the SVM optimization how much error is bearable. This is how you can control the trade-off between decision boundary and misclassification term. A smaller value of C creates a small-margin hyperplane and a larger value of C creates a larger-margin hyperplane.
- iii. Gamma: A lower value of Gamma will loosely fit the training dataset, whereas a higher value of gamma will exactly fit the training dataset, which causes over-fitting. In other words, you can say a low value of gamma considers only nearby points in calculating the separation line, while the value of gamma considers all the data points in the calculation of the separation line.

The audio file to be classified is obtained from the user through the check genre web-page build. The user will be able to upload any file into the webpage. It is the role of the webpage to check if it is a valid audio file or not.

- i. If the file is not of the .wav format, an error pops up as a toast message stating that the file is invalid.

ii. If the user uploads, a valid .wav file, the file gets uploaded and commences the classification process.

The audio file to be classified is extracted from the user interface where the user has uploaded the file. The features are extracted from the audio file and the same process for creation of dataset sticks to this as well. The model created is then loaded and the features thus generated are used to classify the audio file to its proper genre.

The final result is the genre of the audio file uploaded by the user. This is displayed in the check genre page of the website as an alert dialog or a toast message. The final result also includes the statistics of the dataset count, testing and training count and the accuracy of the implemented system.

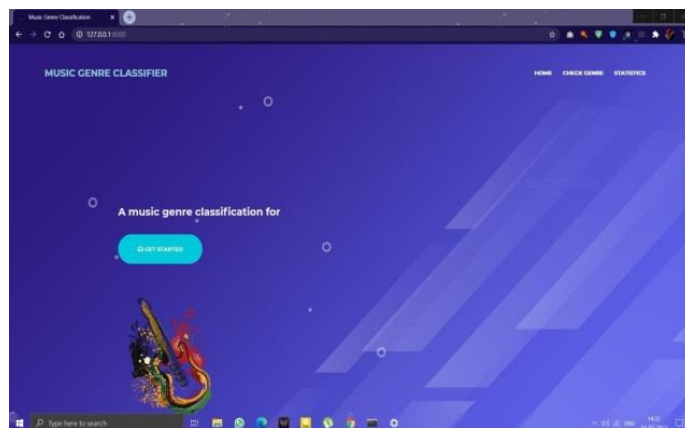


Figure 16 Music Genre Classification (home page)

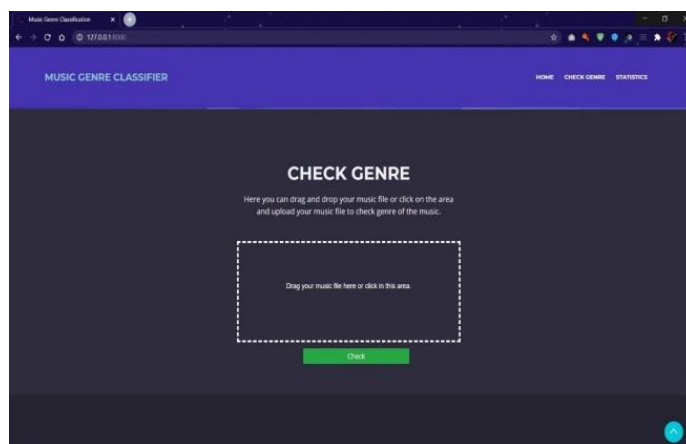


Figure 17 Music Genre Classification (check genre page)

CASE 1: when user uploads an invalid file:

In this case, the system doesn't accept the file and notifies the user with a toast message stating 'only .wav file type is allowed'.

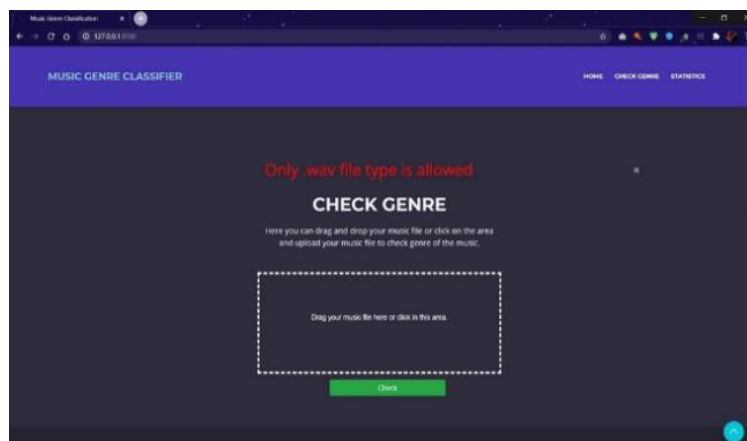


Figure18 Uploading an Invalid File

CASE 2: when user uploads a valid file:

In this case, the system extracts the .wav audio file and proceeds on the classification process.

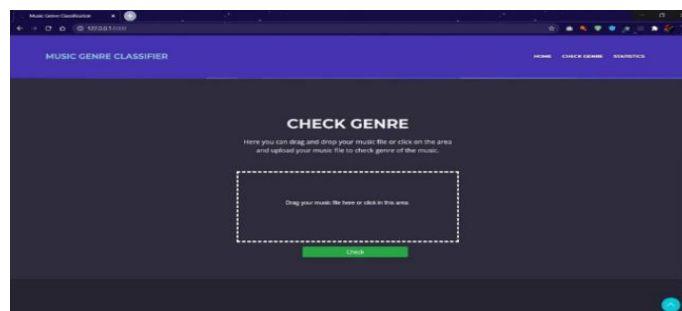


Figure 19 Uploading a Valid Audio File

CLASSIFICATION OF MUSIC GENRE

Once the user uploads a valid file, the system commences the classification process. The features are extracted from the test file and the classification model classifies the audio file into the correct genre.

VIEW RESULTS

Once the music is classified by the system, the music genre of the audio file is displayed to the user as the result.

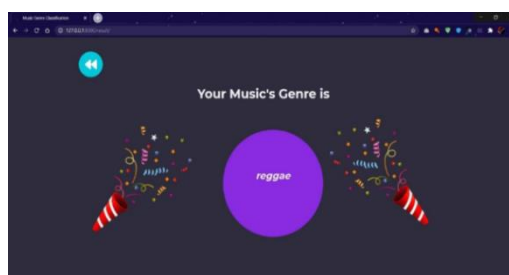


Figure 20 View Results

VIEW STATISTICS

The system also displays the details of the following: total count of files in the dataset, the training and testing split up, the accuracy obtained by the system.

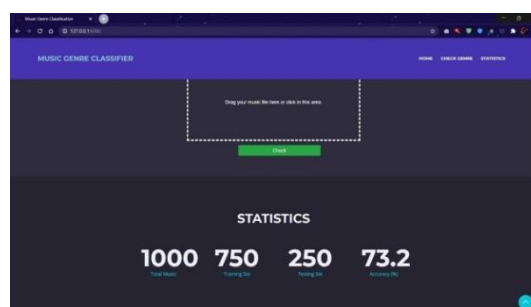


Figure 21 View Statistics

CONCLUSION

The exponential growth in the internet and multimedia systems applications that categorizes music based on genre has led us to develop a system for the above task. Our system can help apps which organize and classify songs, albums, and artists into broader groups which shares similar musical characteristics. Automatic analysis and classification of the music is one of the required components of such Music information retrieval systems. The proposed system to classify music reduces laborious manual work and automates the task of classifying music. Hence, we have proposed system covering the stated functionality with optimal accuracy. Various techniques have been employed in each phase in this system to classify the music. Challenges still prevail in the system like classifying a music genre which is new to the system and input file with more noise. The proposed system has shown enhanced performance in classifying music genre.

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Blockchain Based Digital Asset Management: Stepping Forward in Building a Cyber-Physical World

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ABSTRACT

E-Governance is becoming popular nowadays due to the use of Information and Communication Technology (ICT) at all the level of the Government. This helps the Government to deliver the services to the citizens and exchange information among different agencies of the Government in a fast, well-organized, convenient and transparent manner. Among the various Government services offered the property document management system remains highly centralized and laborious which has high probability of leading to single point of failure. The proposed work aims at developing a Blockchain based Digital Asset Management System that focuses on automation of the existing system, and in making the system more secure and resistant to fraud.

The system scans the asset documents and extracts the key features from it. The extracted features are recorded as immutable transactions over the Blockchain network. Blockchain can be used to mark every asset event as a unique transaction and store them in the distributed ledger. A distributed ledger supports the validation and execution of a transaction in near real time. The model serves to be distributed and the transactions can be fetched whenever required by the concerned authority after appropriate authentication.

Keywords: Agent based system, Blockchain, BCB DAMS, Digital Asset Management System, Distributed ledger.

1. INTRODUCTION

A cyber system involves monitoring of a system using computer-based algorithms. It deals with the integration of computational capabilities with the physical processes in a networked environment. Cyber systems are now bringing a greater magnitude of change to the current understanding of a system and this change is happening much faster than ever before. It is an umbrella that includes tools, technologies, databases (DBs), applications, and methodologies. The major objective is to enable real-time access to data and manipulation of data. By analysing historical and current data valuable insights for decision making can be obtained.

With various technologies emerging around the globe, the government can consider cyber social systems for multiple e-governance issues. The Government can particularly use advanced technologies in land registration process. Currently in India, land registration details are validated and maintained manually in paper-based format across various departments within the local Municipal Corporations, Registrars, Gram Panchayats etc. This leads to high degree of latency and inaccuracy of information. Such latency of information depicts absence of any land records systems at place, creating ownership issues in the country. Further, the system is highly centralized, with greater possibility of leading to single point of failure. These demerits pull down the efficiency of the entire system. The users and auditors of such systems could be concerned about possible mutability of transactions and lack of transparency, hence leading to requirement of a framework with more automation, transparency, security and reliability. [1]

2. MOTIVATION

Nowadays Government databases receive gigabytes of data which creates a need for the analysis and utilization of these data for decision making and strategic purposes. Applying Business Intelligence for handling Government databases will help to improve the administration purpose. BI allows making proper decisions that may result in revenue increase, cost reduction, and profit enhancement. BI reporting tools provide a visual interface for accessing and navigating through multidimensional data sources. As a result of that, decision makers and analysts will have easier and faster access to frequently updated information. [2]

A comparison between the existing and expected asset management system is shown in Figure 1. The current Asset management System involves comprehensive and structured approach to the long term management of assets. Tons of paper records are stored, accessing which has become too laborious and time consuming effort. The negligence and lack of verification have also led to increase in land frauds. Digital Asset Management System aims at complete automation of the government monitored land registration process.

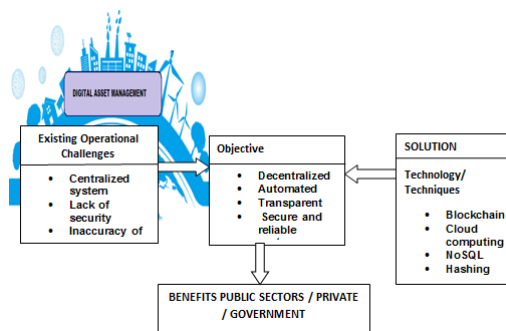


Figure 1: Existing vs Expected Asset management system

3. BLOCKCHAIN BASED DIGITAL ASSET MANAGEMENT SYSTEM-BCB-DAMS

A detailed description of the Digital Asset management system is provided in Figure 2. The highlighted boxes indicate the scope of this work. The Asset management system could be the traditional database system or a web based system. In both cases the major drawback lies in having a centralized system which may lead to single point of failure. Also issues pertaining to security and immutability of data are not addressed here. So a blockchain based asset management system would be preferred to incorporate security features[3][4]. The shaded boxes in the diagram are the features addressed in our proposed system.

Blockchain has the following properties which makes it suitable for using in Digital asset management.

- i. Distributed and Decentralized - The details about the assets(ledger) can be stored at different nodes in a network and the control/ access rights given to each node could vary. The ledger can be shared among a private group of users connected through the local area network. A message is sent on creation of every new block, to ensure that all users have a latest version of the ledger.[5][6]
- ii. Immutable- Data stored in the blockchain is made secure and immutable using cryptography. Every block is referenced by a unique string of characters, generated by a cryptographic hash function. This function can accept any amount of data as inputs and generate a fixed length string as output. This fixed length output is known as a hash. Each block links to the previous block by storing the hash of the parent. Any changes made to the contents of a block will change the hash of the block.
- iii. Traceability- Helps to monitor when a particular transaction was made and the order of transaction can be maintained
- iv. Consensus- Ensures that all the transactions occurring on the network are genuine and all participants agree on a consensus on the status of the ledger.
- iv. Smart contract- Protocol intended to digitally facilitate performance of an agreement. Software to automate tasks, that reduces the time taken for interaction related processes.
- v. Time Stamped: The process of securely keeping track of the creation and modification time of a document, is an indispensable tool in the business world
- vii. Anonymity is the non-identifiability of the source and the target in a transaction; confidentiality ensures transaction and particulars of the nodes are safe
- viii. Secure: Secured through cryptographic techniques and mathematical models

Including all these features in the system would eliminate the drawbacks of the existing system.

The popular platforms for setting up a blockchain framework are as follows. Ethereum is one of the highly active and open source Blockchain which forms the base for development of other applications. The development of Hyperledger Fabric by Linux Foundation is to increase the usage of Blockchain technologies across different industries. IBM Blockchain developed purely for private use, is to create a platform for transparent business operations. Multichain is an open-source Blockchain platform which is used to create permission network. This finds usage in both within and across different enterprises. Hydrachain is a collaborative initiative of Ethereum and brainbot technologies. Since its an extension of Ethereum platform, it is used to create private ledger which is useful for the enterprise. R3 Corda is a permissioned Blockchain and it focusses on interoperability ease of integration with the legacy system. It is mainly used in healthcare, trade finance, supply chain, etc. Open-chain is a popular open source platform useful for companies who are looking for handling digital assets. IOTA is the latest entrant in the world of Blockchain platform.

Inspite of the various framework available the selection of the blockchain framework for any system could be based on the factors like type of network, language used, popularity of framework, activities that can be performed, Pricing policy and the consensus mechanism. Hyperledger framework is used for the implementation of the proposed BCB-DAMS.

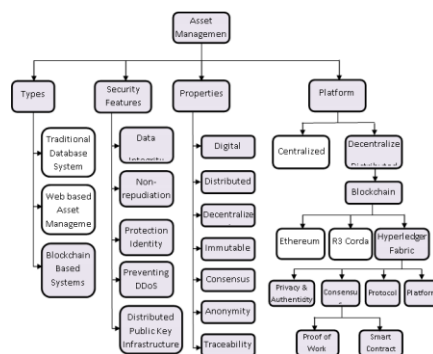


Figure 2: Outline of Digital Asset Management System

3. REALIZATION OF BCB-DAMS

Digital Asset Management system can be viewed as Agent based Software System in which individual software agents interact with each other, in a collaborative manner autonomously following their individual objectives, gaining access to resources and services, and intermittently generating effects for the entities that instigated those software agents as shown in the conceptual Architecture. Efforts have been taken to realize the DAM using various types of agents namely System Agent, User Agent, Client Agent, Conversational Agent, Intelligent Agent, Mobile Agent, Multi-Agent System.

Interface Agent is realized as a client-side user interface for a sophisticated DAM distributed application to provide assistance to a user with computer-based tasks. Communication Agent is an ultimate software agent that receive/redirect input from user and communicates the same to

relevant agents. Registration Agent is a loosely coupled open multi-agent system whose task is to authenticate the users of the system and validate the land details. Pre-processing agent is a daemon System Agent that continuously runs in the background that has a focussed, pre-processing purpose like Extracting the features from the land documents and converting them into transactions to be stored in blockchain. Storage Agent is a set of programs that probes selected portions of the system for information of interest. This need not be visualized as an agent since it is not performing on behalf of a user, but it is accumulating data that can be used for system as a whole. Search Agent is an autonomous piece of software realized as a Mobile Agent that migrates between host systems which does not need to be strictly intelligent, but have sufficient elasticity to deal with DAM in which things can change at any time like receiving query from user and retrieving land details from the blocks.

Table 1: BCB-DAMS-An agent based system

Interface Agent	Registration Agent	Communication Agent	Pre-processing Agent	Search Agent	Storage Agent
Role of Agents in Realizing Blockchain based Digital Asset Management System					
Interface Agent					
Purpose: To provide assistance to a user with computer-based tasks					
Technology : HTML, XML, CSS, JavaScript					
Input: Mobile Application / Web application					
Output: Access to Digital asset management system					
Communicates with: Registration agent, Search Agent, Communication Agent, Pre-processing Agent, Storage Agent					
Property Compliance : Distribution and decentralization					

Registration Agent

Purpose: To authenticate the users of the system (add participants , add registrar) and to validate the land details (add property)

Technology : HTML, XML, CSS, JavaScript

Input: User details and land details

Output: Successful updation of user's and land information

Communicates with: Interface agent, Communication agent, pre-processing agent

Property Compliance : Distribution and decentralization

Communication Agent

Purpose: Receiving input from user and transferring it to storage agent , Receiving query request from user and transferring it to search agent and Return of results to users

Technology : JavaScript APIs

Input: Land details and Query regarding land

Output: Results from blocks

Communicates with: Registration agent, Pre processing agent, Storage agent and Search agent

Property Compliance : Achieving Consensus

Pre-processing Agent

Purpose: Extracting the features from the land documents and converting them into transactions to be stored in blockchain

Technology : Hyperledger Composer language for describing the structure of transaction

Input: Land documents in pdf format

Output: Extracted features from documents

Communicates with: Communication agent , Storage agent

Property Compliance : -

Storage Agent

Purpose: Storing the transactions in the blockchain

Technology : Hyperledger Composer APIs - Hyperledger Composer resources are stored on the Blockchain.

Input: Transactions of extracted features

Output: A block that represents a transaction is created and is validated by all nodes in the network

Communicates with: Pre processing agent, Communication agent, Search agent

Property Compliance : Immutable, Enhanced security, Traceability, Distributed ledgers, Smart contracts.

Search Agent

Purpose: Receiving query from user and retrieving land details from the blocks

Technology : JavaScript APIs to query, create, update and delete resources and submit transactions from client applications. JavaScript transaction processor functions runs on Hyperledger Fabric when transactions are submitted for processing.

Input: Search query

Output: Immutable transactions from blockchain

Communicates with: Communication agent, Storage agent

Property Compliance : Immutable, Enhanced security, Traceability

Table 1 provides an agent based realization of BCB-DAMS. It shows the various agents involved in the implementation, the role of each agent and its relation with other agents.

The agents communicate with each other in a collective manner to realize the system.

4. SYNERGY BETWEEN QUEUING THEORY AND BLOCKCHAIN

Based on the literature, Queuing theory is a study of queuing customers or items. A basic queuing system consists of an arrival process, the queue itself, the service process and finally departing from the system. Using Kendall's notation it is written in the form A/S/c/B/N/D, where

A - when customers arrive at the queue

S - how long it takes for a customer to be serviced after it leaves the queue

c - number of servers in the queuing system

B - number of items that can be in the system

N - number of potential customers ;

D- service discipline of the queuing system, such as FIFO or LIFO

A Markov chain is a queuing model; queue length is Markov if the items arriving in the queue and leaving are independent of each other. A Markov process is a random process in which the future is independent of the past. In other words future states depend only on the current state, not on the events that occurred before it. In probability theory, randomly changing systems are modeled using a Markov model which is a stochastic model and they form one of the most important classes of random processes. The property of characteristic of a Markov chain is that no matter how the process arrived at its present state, the possible future states are fixed; In fact the probability of transitioning to any particular state is dependent solely on the current state and time elapsed.

Let us consider our BCB-DAMS as an ordered pair [O,M]; where

'O' represents the Origin that is Genesis block and

'M' represents the main Sequential chain of blocks: B1, B2, . . . Bn.

A Blockchain is a linked list of transactions which contains data and a hash pointer to the previous block in the Blockchain. A given blockchain functions based on the verification of a hash and digital signatures. Hashing is the process that the blockchain uses to confirm its state. For any new block addition, the requirement is the substantiation of its association with the previous block. To speed transactions, a set of rules – called a smart contract – is stored on the blockchain and executed automatically.

BCB-DAMS can be viewed as a perfect queuing model in which transactions arrive at the Blockchain system; it is expected that each transaction (asset's digital information), first enters and queue where the waiting space is of infinite size; each transaction first queues up in the shared space; it waits for being successfully mined as a block, this is regarded as the first stage of service, called block generation; a block can consist of several transactions newly generated block is confirmed by solving a difficult mathematical problem by means of a cryptographic hash algorithm. This confirmation process is called mining. Number of nodes who compete for finding the answer is called miners.

5. IMPLEMENTATION OF BCB-DAMS

The process of Blockchain can be viewed as a 7 step process as shown in figure 3.

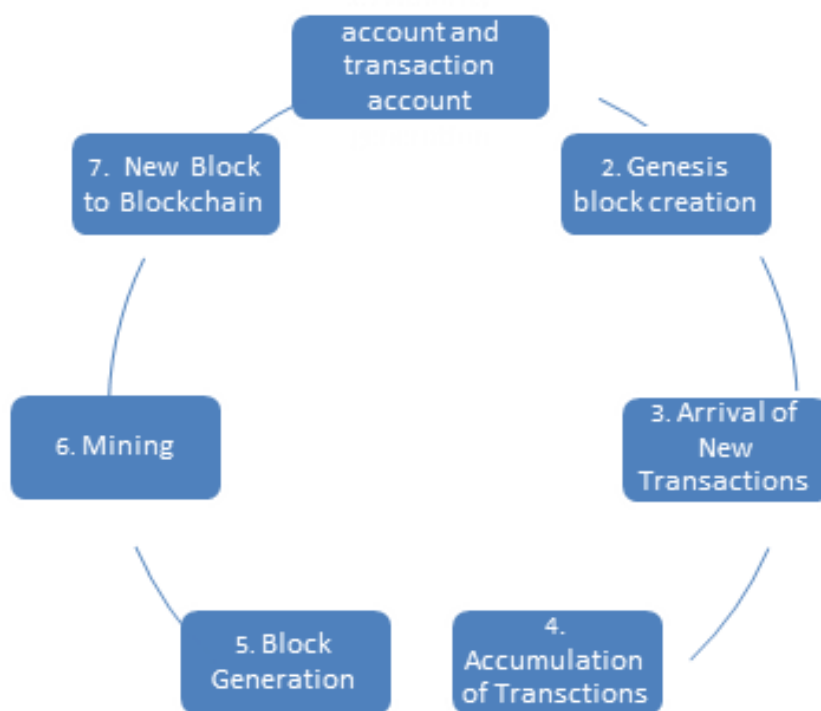


Figure 3: The Blockchain process

The Blockchain based Digital Asset Management System (BCB-DAMS) focuses on automation of the existing asset management system, in making the system more secure and resistant to fraud. A distributed ledger supports the validation and execution of a transaction in near real time. Blockchain network can be used to mark every asset event as a unique transaction and storing them in the distributed ledger. The transition from the existing management system to the Blockchain based Digital Asset management would involve the following. Table 2 shows the various modules involved transforming the system to a blockchain based asset management system.

The participant's details should be added to the blockchain network so that he/she can participate in asset buying and selling transactions. Each participant is identified by their Aadhaar Number. Details like Email ID, Phone Number, and Address are available for each person. Only the users who are a part of the user chain can perform buy/sell actions of the registered properties.

Only registrars added to the network can perform the various administrative functions. Security card is created for each registrar with that he/she needs to use for authentication before being able to create the transaction and store it in the blockchain. Card will give them write access to the blockchain. Each card will be created and distributed by peer admin.

Table 2: Modules involved in BCB-DAMS

Add Participants	Check whether data come valid peer admin: for each registrar entry: check if registrar data already present in blockchain: true : return
Add Registrar	Check whether data come valid peer admin: for each registrar entry: check if registrar data already present in blockchain: true : return
Add Property	Check whether data come valid client sdk:

	for each property entry: check if property already present in blockchain: true : return false: add the data to blockchain
Register Property	Check whether transaction come valid client sdk: for each transaction: check if property present in blockchain: true: check whether owner in transaction is the owner of the property: true : check whether buyer is valid person: true : commit the transaction to blockchain false:Invalid transaction false: Invalid transaction false: Invalid transaction
Search Module	Check whether request come valid client sdk: check if details requested present in blockchain: true : return data false: return details not found

The property details like its location, last transaction price etc. should also be stored in the blockchain. Only those properties added to the network are valid assets and can be bought or sold and are treated as valid transactions. Each property is identified by their Property ID which acts as the key. Details like Total square feet, Plot Number, Price, Previous Owners are also available for each property.

This activity is invoked when there is buying or selling of property occurs. Registrar will create the transaction with Property Owner ID, Buyer ID, Property ID and send it to all the endorser peers. If the transaction has valid Property Owner ID, Buyer ID and Property ID, it will be send to all the other peers and included in the blockchain. If any one of the detail is invalid transaction will be roll backed and terminated.

Searching data/records is an important part of any system. User would like to search the property and ownership details from the blockchain. External user will request for fetching the required details of a particular land document to the registrar. Registrar may/may not grant access based on authentication. On validation that it is a proper user request, the respective data from the blockchain is fetched by the concerned registrar and mailed to the person's registered email.

Digital Asset Management System scans the asset documents and the important features are extracted from the document (Feature Extraction). The extracted features can now be recorded as an immutable transaction over the Blockchain model. The model serves to be distributed and the transactions can be fetched whenever required by the concerned authority after appropriate authentication. Hence this model ensures consistency and non-repudiation.

The model makes use of the e- land documents that are produced after land registration. Figure 4 shows the sample document that is taken from the official Tamilnadu government website- Public Utility Forms[11].

The model makes use of two major concepts namely, Feature Extraction from the document and storing the transaction in a distributed ledger system using blockchain. The e-document can be uploaded to the server from where the feature extraction will take place. The required features from the uploaded document like name of the Buyer, name of the Seller, details of the asset involved, price of the transaction, registrar details related to this transaction are extracted from the document as shown in Figure 5. The extracted features are merged together to create a new a transaction that will be stored in the blockchain network. The structure of the transaction is given below.

Transaction
(Tid,Doc_No,Date,Buyer_Name,Add_Buyer,
Contact_buyer, Seller_Name, Add_Seller,
Contact_Seller, SquareFeet, Price,SubRegistrar)

BY:

1. Mr. Somasundaran, son of Mr. Kovindh, aged about 51 years residing at
.1-dharapuram Main road, Dharapuram , (AADHAAR NO: 8045 2145 6654
) (Mobile no 98424497500)

hereinafter called the 'VENDOR'.

(which term shall, wherever the context so permits, mean and include
his heirs, legal representatives, executors, administrators and assigns)

TO AND IN FAVOUR OF

Mr. Aravindh Sami, son of Mr.Bhajan lal, aged about 25 years, residing at
VGN Apartment, Velacherry , Chennai

(AADHAAR NO: 8121 4445 6872) (Mobile no 8036503793
)hereinafter called the 'PURCHASER'

(which term shall, wherever the context so permits, mean and include
his heirs, legal representatives, executors, administrators and assigns)

witnesseth:

Whereas the property, viz., vacant house site measuring an extent
of 2500 sq.ft., bearing Plot no : 22 Survey no :5426, was originally
purchased by Kovindh, son of Bhanath the Vendor herein, from , under
a Sale Deed dated 16.09.2013, registered as document No 16547845 in
the office of the Sub-Registrar, Mr.Muruganandham, Dharapuram
Registration Office , Dharapuram.

Figure 4: Sample Land Document

Once the transaction is created, it is broadcasted and the validity of the transaction is verified by the Certificate Authorities in the network. The transaction is committed only if it is authenticated as a valid transaction by all these nodes. Once the transaction is committed, any node cannot, in future, say it did not perform the transaction. Thus the system clearly supports non-repudiation. The user can request to view details of any transaction via the e-portal. He/she submits the request which includes his/her Aadhar number and the concerned land document number. The request is validated by the registrar and then the details are fetched from the blockchain network are sent to the user.

***** FILE PARSED SUCCESSFULLY *****

```
{date : 22-04,  
name : Ramesh,  
father name : Suresh,  
age : 22,  
address : 23/11,Krishnankovilstreet,  
id no : 23453535,  
mobile no : 9478548723478,  
name : Karthi,  
father name : Naveen,  
age : 45,  
address : 23,northstreet,  
id no : 324342,  
mobile no : 93443243243,  
sqr feet : 3443,  
bearing : fdfsfdfds,  
purchaser : bajanlal,  
father name : mukesh,  
city : Coimbatore,  
wife : ram,  
Doc no : 3,  
total : 4,  
sub register : karthikeyan}
```

Figure 5: Sample Feature Extraction

Figure 6 shows the structure of blockchain used for BCB DAMS. The constituents of a block includes Block header, Transaction counter, Block size and Transaction data. The block header for each block six main components namely Block version, previous block hash, Merkle root, timestamp, nonce and difficulty target. Block version takes 4 bytes to keep a track of software or protocol updates; previous block hash takes 32 bytes to store Hash of the preceding block; Merkle root takes 32 bytes to store the hash value of the root of the Merkle tree of the current block's transactions. This hash of the root is known as Merkle root; Timestamp takes 4 bytes to store the time of the creation of the block; Nonce takes 4 bytes to store number needed for Proof-of-Work process; Difficulty target uses 4 bytes to store the difficulty target set for Proof-of-Work algorithm.

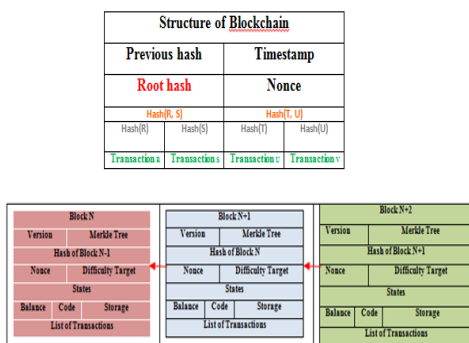


Figure 6: Preceding and succeeding blocks Structure

The Hyperledger Composer language could be used for describing the structure of resources (assets, participants and transactions) that participate in a blockchain backed business network. JavaScript APIs could be used to query, create, update and delete resources and submit transactions from client applications. The JavaScript transaction processor functions runs on Hyperledger Fabric when transactions are submitted for processing. These functions may update the state of resources stored on the Blockchain via server-side Hyperledger Composer APIs. The Runtime API is the available to all transaction functions. Using protocol buffers can help to define data model once and then easily write and read structured data to and from a variety of data sources.

6. CONCLUSION & FUTURE ENHANCEMENTS

Though several sectors have started to adopt blockchain, the following are highly-influenced use cases for innovation. In Real Estate industry middleman can be avoided between the parties actually involved. In Automobile Industry blockchain can be used to track vehicles to ease maintenance, Fitness and ownerships. In Entertainment industry ownership of direction, music, producers can be maintained easily without dispute in a blockchain. E-governance applications such as voting, traffic maintenance, supply chain and Logistics, Public distribution system, healthcare record management can be automated with blockchain to maintain records without disputes handle wrong practices with ease.

This paper has proposed a Blockchain based Digital Asset Management System that focuses on automation of the existing system, and in making the system more secure and resistant to fraud.

This model can be extended in future to the class of prediction. The system will have the details of land assets that have been bought and their corresponding rates at which they were bought in the recent transaction. Cluster analysis can be performed on this data where clustering can be done based on locality to predict the land rates in that particular locality. This can also be used to predict urbanization based on the details of the parties involved in the transactions. The system can also be extended to private sector firms for management of their assets on a large scale.

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17. <https://intellipaat.com/blog/tutorial/blockchain-tutorial/how-does-blockchain-work/>
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Reinforcement Learning Infused IOPE Based Semantic Web Service Composition

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ABSTRACT

The number of web services are growing at a rapid rate in today's world. Composition of these web services is required by the users to gain personalized experience. The public and the commercial service providers compete to satisfy this because the Search Space is exponentially large and the services offered must satisfy the QoS parameters. As the number of web services grow exponentially, the manual composition of web services is difficult which lays emphasis on automatic composition of web services. This article aims in dynamically composing the web services based on IOPE parameters. Various Reinforcement Learning Algorithms are considered for study and the most effective algorithm is utilized in the smart composition framework. It is found that, the smart composition framework infused with Expected SARSA yields a high accuracy and a balanced precision and recall which makes it suitable for real time dynamic composition.

Keywords:Semantic Web Service, Service Composition, Reinforcement Learning, Learning Automata, Machine Learning.

INTRODUCTION

A web service is any piece of software that is available to the user through Internet [1,2]. The role of web services in today's world is inevitable as most of the real world processing are accomplished through the usage of web services. Every web service is linked with a Web Service Description Language (wsdl) file [1,2] which is used by the clients to invoke a web service. The wsdl file contains the general binding information. In order to extract the semantic information related to a web service OWL-S (Semantic Web Ontology Language) files are used. The OWL files (Web Ontology Language) contain the most important Input Output Precondition and Effect (IOPE) parameters related to a web service. Input refers to the various input parameters that have to be given to a web service for processing. Output indicates the result that the web service gives to its client after processing. Precondition lays emphasis on pre-requisite of a web service and the Effect illustrates the result that a web service produces on completion.

A web service predominantly has three major roles namely the Web Service Consumer, Web Service Provider and the Registry[3]. Registry is a place where the services are registered for public use. A web service provider is the one who creates the web service for public use. A web service consumer is the client. The client utilizes the web service for his personal use. When the client requires a web service, he issues a user query to the registry and the registry responds back to this query with a list of executable services. The client then chooses the most appropriate web service and executes them to solve his request.

The registry solves the user query in various phases namely discovery, selection and composition. The client provides his/her request in the form of query to the registry. The registry initially decomposes the query and analyses the underlying semantics. Based on the semantics analyzed, every service which matches the functional description of the user query is retrieved. This process of extracting the web services which functionally match the user query is known as discovery. These web services then undergo a phase known as web service selection. Here, the best web service is chosen based on the non-functional aspects. Quality of Service (QoS) values formulates the non-functional aspect of every service. These values represent the real time behavior of a web service which predominantly determines the user satisfaction level. Hence, the web services discovered are ranked based on the QoS values and the web services with QoS value greater than a threshold value are utilized in the composition phase.

The user query in general are complex cannot be solved using a single web service. So, multiple web services have to be combined in a specific order, to satisfy the user request. This process of chaining the web services to satisfy the user request is termed as service composition phase. In general, the services are chained based on Input Output (IO) parameters. The authors of [4] have utilized IO parameters to perform service composition using reinforcement learning techniques. In reality, every web service has four parameters addressed as IOPE parameters. This article aims in applying the most suitable Reinforcement learning algorithm as suggested by [4] to solve the web service composition problem using IOPE parameters.

MOTIVATING SCENARIO

Industry 4.0 being the buzz word today aims in automating everything around a person. Web Service serves as the key for automation in today's world as everything is based on Internet. A user query to be solved is generally complex in nature. Solving the user query with a single web service is not possible as the web services are granular. So it becomes necessary to use multiple web services in a predefined order to solve the given user query.

Table I. Sample Web Services For Composition

Web Service	Parameters			
	I	O	P	E
S1 (Search_for_Items)	Search Query	List of Items	-	List of items displayed
S2 (Place_Order)	List of Items	Order_id	List of items displayed	Order placed
S3 (Pay)	Order_id	Payment_id	Order placed	Payment Successful
S4 (Track_order)	Payment_id	Order_details	Payment Successful	Order details displayed
S5 (Fetch_order_details)	Order_id	Order_details	Order placed	Order details displayed

Table I depicts five sample services used for the purpose of E-Commerce. When the user wishes to purchase online, the user query will generally be stated in a generic fashion to purchase a product. For instance, let the registry discover the services mentioned in Table I for the given user query. From Table I, it can be seen that, all the five services are utilized for the purpose of online purchase. The user in an online purchase, initially selects the products required which can be accomplished by service S1. Once, the products are selected, the user will place an order. This functionality is accomplished using service S2. On placing an order, the user will be redirected towards payment process which can be realized using user S3. After payment, if the user wishes to track the order, it can be achieved using service S4 and if the user wants to get an order summary, it can be achieved using service S5. Hence, it is very clear that, to satisfy a user query multiple services has to be executed in a predefined order. To satisfy the user query of purchasing a product, the services S1-S2-S3-S4 can be utilized. This process of composing web services to solve a complex user query is highly challenging and is of utmost importance. Hence, this article aims in providing solution to this problem by utilizing Reinforcement Learning strategies.

RELATED WORKS

A number of research works have been carried out in the area of applying Reinforcement learning to solve the semantic web service composition problem. The most significant research contributions are emphasized here.

In [5], the authors have performed an intensive survey on various techniques and methodologies utilized for composition. The author's emphasis the fact those, utilization of optimization and learning methodologies are more effective in composing the web services when compared with the traditional methods.

In [6] Cetina et al have suggested a novel model for service composition using RL algorithms like policy iteration and value iteration. The authors have utilized the Input and the Output parameters to evaluate the composability of two services. According to the model proposed in [6], the authors imply that if n services are discovered, then all the n services has to be chained to satisfy the user query. Lei Yu et al of [7] has utilized the QoS values along with the semantic information to chain the services. The authors have used Q-Learning and Monte Carlo techniques to solve the semantic web service composition issue.

Wang Hongbing, et al. [8] has utilized Precondition and Effect along with the QoS values to compose the services. The authors have applied the Q-Learning technique to solve the dynamic composition problem.

In [9] Ren et al have utilized the Input, Output and the QoS values to provide solution to the user query. The authors have again applied Q-Learning to solve the issue of service composition.

Wang Hongbing, et al. of [10] have used Deep Reinforcement Learning to dynamically compose the services. Although this technique yields better results it is found to increase the complexity of the problem exponentially.

In [11], the authors have utilized hierarchical Reinforcement learning approaches to solve the composition issue. Automatic task decomposition technique is adopted by the authors to speed up the process of composition.

In [12], Wang Hongbing, et al. have utilized deep reinforcement learning to chain the services in a definite order. In spite of its advantages, this method suffers from serious dimensionality issues.

Yu Xuezhi, et al. of [13] has brought a variation in Q- Learning algorithm for service composition. A hybrid approach of combining Deep Neural Networks and Q-Learning was utilized to solve the service composition problem.

[14] provides a detailed analysis of graph based service composition. A composition framework which performs both semantic discovery and composition using graph based approach is proposed. Even though graph based approach is found to be effective in terms of time efficiency, it lacks scalability.

The authors of [15] have proposed a cultured genetic algorithmic approach to chain the web services. It is a two phased approach in which, initially the services are filtered and the later stage enables the composition of services. Similarly, the authors of [16] have used particle swarm optimization strategy to perform service composition.

The authors of [17] have applied Harmony Search Algorithm to compose the services. In [18], the authors have utilized Elite guided multi objective Artificial Bee Colony Optimization (EMOABC) to compose the given set of services. Here, QoS values are aimed to be maximized there by reducing the cost factor associated with it.

Authors of [4] have performed a deep analysis of the most suitable Reinforcement Learning strategy for service composition. The service composition in [4] was carried out using IO parameters. This article aims in performing service composition using IOPE parameters.

From the above discussed literature it is observed that the researchers have applied the RL technique without investigating the fitness of the technique to the given problem. Also, the researchers have not considered the usage of IOPE parameters as such to solve the composition crisis. This article aims in investigating the best RL technique as indicated by [4] and the optimal technique is applied to the smart composition framework to solve the dynamic web service composition issue.

PROPOSED SYSTEM

This article proposes a smart framework that utilizes Reinforcement Learning technique to compose semantic web services based on IOPE parameters. The proposed smart framework lays emphasis on the reward model which is utilized by the agent to gain positive and negative reinforcement based on the decision taken. The proposed reward model is then applied to various reinforcement learning Algorithms like SARSA, Expected SARSA, Lambda SARSA, Q-Learning and Lambda Q-Learning to evaluate the efficiency of each algorithm. The most effective algorithm is chosen based on regressive experimentation and is utilized in the smart framework to compose web services based on user needs.

REINFORCEMENT LEARNING

Reinforcement Learning (RL) [19] is a reward based learning technique which focuses on learning the environment through positive or negative reinforcements. Every RL problem has an environment of States, Action and Reward. A State is representation of a problem. It represents the features of a problem that has to be addressed in order to obtain a proper solution. Action denotes the steps that are taken to solve the given problem. Reward symbolizes the reinforcement that is given to the agent. With this reinforcement the agent learns to solve a problem. Generally every problem has an initial state and a goal. The solution to the problem is to reach the Goal State from the initial state.

Various RL algorithms are available among which algorithms like SARSA, Expected SARSA, Lambda SARSA, Q-Learning and Lambda Q-Learning are taken for experimentation [19]. All the above mentioned algorithms work well with discrete state and action space. As the composition is formulated as a problem with discrete space and action the above said algorithms are found to be of better suit. And hence the other algorithms in RL are neglected for experimentation.

LEARNING AUTOMATA FOR SEMANTIC WEB SERVICE COMPOSITION

Semantic Web Service Composition must use a specific learning automaton to suit its composition needs. The Learning automaton proposed in a combination of environment representation and the reward model. The learning environment for the service composition problem is designed as follows,

- State: The number of web services discovered for the given user query (n) with additional states such as Initial State (I) and the Goal State (G). In general, the total state that the composition environment possesses is $n+2$.
- Action: The process of linking the suitable state (S) with the other state (S') is termed as action. As there are n services discovered, there are n possible actions.

- Reward: Positive, Negative and Neutral reinforcement rewarding scheme is followed to train the agent in composing the given web services. A detailed description of the reward model is explained in Section IV.C

REWARD MODEL

Reward Model plays a significant role in any Reinforcement Learning strategies. The entire framework revolves around the type of reinforcement given to the agent for an action taken, which is a major process in agent training. To train the agent, generally three types of reinforcement strategies such as positive reinforcement, neutral reinforcement and negative reinforcement are used. The reward model suggested here utilizes all the three types of reinforcement techniques to train the agent.

Composing a service to itself has no meaning. So, when a state (S) tries to link to itself a negative reward is given to the agent. Similarly, after reaching the Goal state (G) extending the composition process is of no technical importance. So, when the agent tries to link any state (S) after Goal state (G) a negative reward is imposed on the agent. When the transition takes place from the initial state (I) to any state (S), based on the IOPE satisfaction either a positive or negative or neutral reward is given. The main rewarding revolves around composing of any state (S) with other state (S'). Under these linking circumstances, the IOPE satisfaction is observed. When the IOPE parameters are fully satisfied a positive reward is given to the agent. In all the other cases a negative reward is imposed.

Semantic Web Service Composition Framework

From the experimentation results shown in section V.A, it is evident that Expected SARSA has a balanced efficiency and it can be applied for the real world problem. So, the smart framework incorporates the strength of Expected SARSA to perform Semantic Web Service Composition. Fig 1 illustrates the working of the smart framework.

The Smart Composition Framework for Semantic Web Service as shown in Fig. 1 gets the user query from the Web Service Consumer. Based on the user Query, the most appropriate web services are discovered. For the purpose of discovery Match making Algorithms are employed. From the set of discovered web services, based on the QoS value, the best web services are selected. This process of Selection is done using TOPSIS technique. The filtered web services are then given to the Expected SARSA based composition Engine.

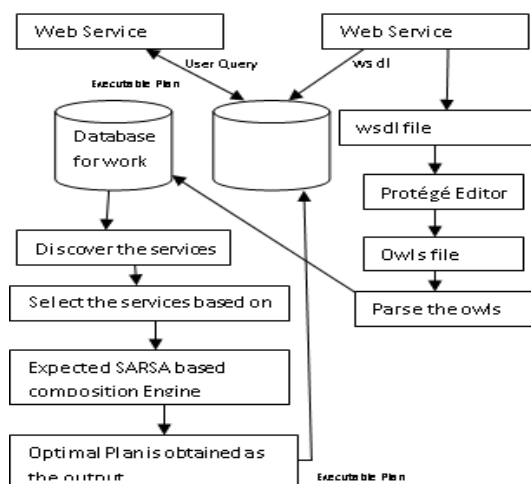


Fig. 1. Smart Composition Framework for Semantic Web Services

This composition engine composes the selected web services based on Reinforcement Learning. The engine initializes the $Q(S,A)$ with arbitrary values. The training episode generally starts with the initial state. From the initial state (I) an Action (A) is chosen using the Epsilon Greedy Strategy. The Selected Action is executed and the values of the $Q(S,A)$ are updated based on the updation rule $Q(S,A) = Q(S,A) + \alpha(r + \gamma(\sum \pi(A'|S')Q(S',A')) - Q(S,A))$ where α indicates the learning rate and γ depicts the discount factor. This process is repeated until convergence point is reached.

Once the training of the agent is converged the learning process is stopped and the composed set of services is extracted from $Q(S,A)$.

Experimentation and Results

The experimentation is conducted in Intel i5 core processor. The RL Algorithms like SARSA, Expected SARAS, Lambda SARSA, Q Learning and Lambda Q Learning are implemented using Anaconda Python

Environment. OWLS-TC dataset [20] with 6042 web services, OWL-S dataset [21] with 164 web services are used for experimentation purposes. In addition to these 1500 web services were developed exclusively for experimentation. A total of 7706 web services were used. The wsdl files were converted to OWL-S files using the Assam wsdl annotator. The experimentation is done by varying the count of the selected web services within a range of 25 to 100. The results depicted in Section V.A are averaged out from a range of 25 to 100 web services and the results depicted in Section V.B are sampled over 20 queries across various domains.

Comparison of RL Algorithms

Various algorithms like SARSA, Expected SARSA, Lambda SARSA, Q Learning and Lambda Q Learning are tested for efficiency against the composition problem. The values for various parameters like α (Learning rate), γ (Discount Factor), ϵ (Greedy Rate) and λ (Usage of Eligibility Trace) were fixed as shown in Table I after extensive experimentation. Fig. 2 illustrates the learning rate value for Expected SARSA. From the graph shown in Fig. 2 it can be seen that, the change in the episodes is minimum at the transition from 0.6 to 0.7. So, the Learning rate value is fixed as an average of 0.6 and 0.7 which is 0.65. The results obtained are found to be analogous with the results shown in [12]. And so, the parameters values as indicated in [12] are utilized for experimentation purposes which are tabulated in Table II.

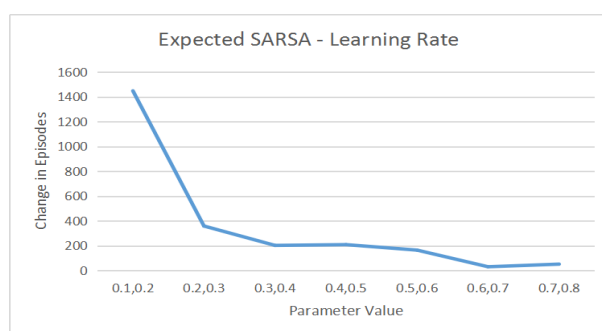


Fig. 2. Learning Rate for Expected SARSA

TABLE II. VALUES OF VARIOUS PARAMETERS USED IN RL ALGORITHMS AS DEPICTED IN [12]

Algorithm	Parameters			
	λ	α	ϵ	γ
SARSA	nil	0.45	0.55	0.3
SARSA Lambda	0.9	0.65	0.45	0.25
Expected Sarsa	nil	0.65	0.45	0.3
Q Learning	nil	0.75	0.55	0.2
Q Learning Lambda	0.8	0.65	0.65	0.15

The RL algorithms are compared on various parameters like Convergence point, Time duration, Maximum reward achieved and Total number of Iterations. Fig. 3 represents the time taken by the RL algorithms to reach the Goal state. From the Fig. 3 it is evident that, Lambda SARSA takes the maximum time to reach the convergence point whereas the other algorithms almost take the same amount of time to converge.

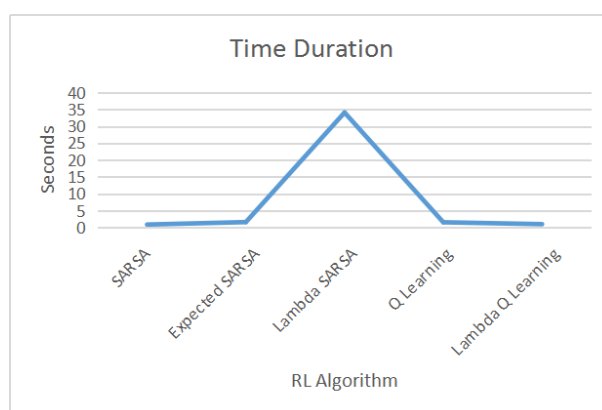


Fig. 3. Time taken by the RL Algorithms

Fig. 4 represents number of episodes taken by the RL algorithms to converge. From the Fig. 4 it is evident that, Lambda SARSA takes the maximum episodes to reach the convergence point whereas Lambda Q Learning

takes the minimum amount of episodes to converge. Fig. 5 represents the total rewards earned by each RL Algorithm taken under study. From the Fig. 5 it is evident that, Lambda SARSA earns the maximum rewards whereas Lambda Q Learning earns the minimum rewards. Fig. 6 represents the total iterations taken by each algorithm to reach the point of convergence. From the Fig. 6 it is evident that, Lambda SARSA takes the maximum number of iterations to converge whereas SARSA takes the least number of iterations to converge. It can be clearly seen that, comparison of the RL algorithm based on various parameters as such is a tedious task.

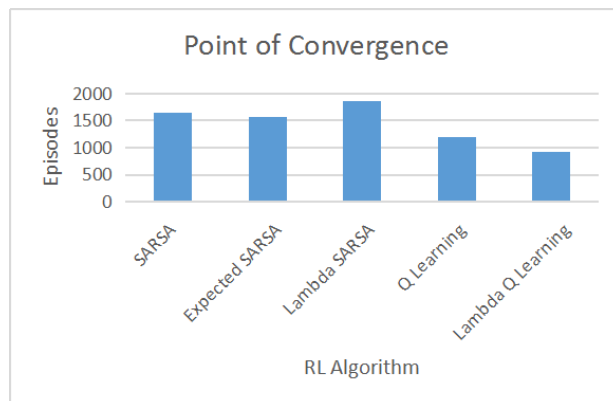


Fig. 4. Point of Convergences of the RL Algorithms

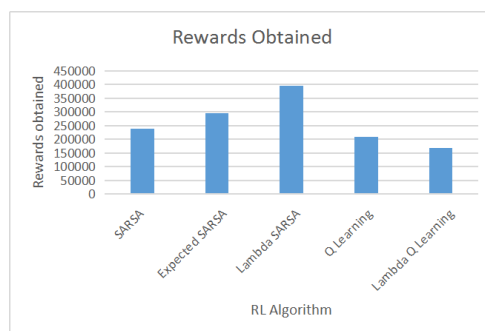


Fig. 5. Rewards earned by the RL Algorithms

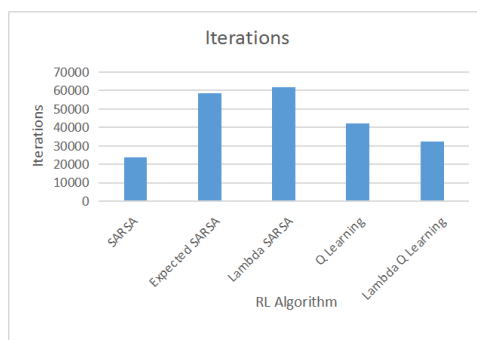


Fig. 6. Total Iterations taken by the RL Algorithms to converge

In order to compare the RL algorithms over various parameters TOPSIS technique is employed. As, accumulation of reward is the most important goal of Reinforcement Learning, the parameter reward is given a weightage of 0.4 and the other parameters are given an equal weightage of 0.2. Table III indicates the performance score of each algorithm. Based on the performance score obtained, the algorithms are ranked. From Table III it is seen that the performance of Expected SARSA is the best and hence, Expected SARSA is utilized in the smart composition framework as shown in Fig. 1.

Table III. Ranking Of RL Algorithms Based On Topsis

Algorithm	Performance Score	Rank
SARSA	0.564069751	4
Expected SARSA	0.802933163	1
Lambda SARSA	0.406404776	5
Q Learning	0.734683912	2
Lambda Q Learning	0.654827503	3

Efficiency of the Proposed Framework

The proposed smart framework as depicted in Fig. 1 is evaluated using various parameters like Accuracy, Precision, Recall and F1-Measure. From Fig. 7 it is noted that, the proposed framework has an accuracy of 92.5%, Precision of 92 %, Recall of 96% and F1-Measure of 93.9%.

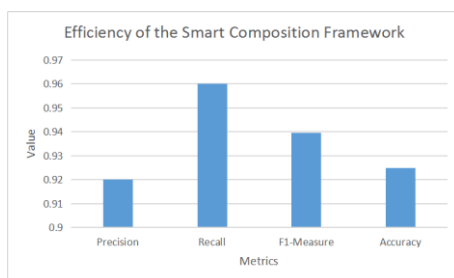


Fig. 7. Efficiency of the Smart Composition Framework

It is evident from the results that, the proposed smart composition framework has a high accuracy and a balanced precision and recall values which makes it best suited for real time dynamic composition.

CONCLUSION

A Smart composition framework has been proposed in this article which aims in reducing the complexity of the semantic web service composition problem. From the results discussed in Section V, it is evident that, among the various RL algorithms available Expected SARSA suits best for the composition needs. And so, Expected SARSA is utilized in the smart composition framework and it is found that, the efficiency of the framework is well balanced by making it more suitable for real world issues.

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Automated Screening of Tuberculosis from Microscopic Images

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ABSTRACT

Tuberculosis (TB) is a widespread, infectious, fatal disease in developing countries. Mycobacterium tuberculosis, the causative pathogen, is communicated via infected sputum. Early diagnosis and treatment becomes vital to refrain from fatal consequences. Conventionally, diagnosis of tuberculosis is done by the manual microscopic examination of sputum smears using Ziehl-Neelsen stain (ZN stain) method which requires human expertise and time and thus becoming tedious. These limitations prompt the need for automation of examination and detection of TB bacteria. In this work, a computer aided system for TB diagnosis based on segmentation through color deconvolution is developed for identification of the bacilli in microscopic sputum smear images. The Mycobacterium are discriminated using aspect ratio. This automated method aims to cut down the examination costs, processing time and human error thereby improving overall efficiency.

Keywords: Computerized diagnosis, Microscopic sputum images, Segmentation, TB detection automation.

1. INTRODUCTION

Tuberculosis (TB) is a potentially harmful disease caused by Mycobacterium tuberculosis. The disease may be classified as pulmonary TB or extra pulmonary TB depending on whether it affects the lungs or other parts of the body like liver, kidneys, bone, brain or central nervous system. According to WHO report, a massive 9.4 billion new cases are identified and 1.68 million deaths are reported worldwide annually [1,2]. Prevention relies on screening programs and vaccination with Bacillus Calmette Guerin vaccine.

1.1 CHARACTERISTICS

Tuberculosis is a widespread disease caused by different types of Mycobacterium, usually Mycobacterium tuberculosis. It typically targets the pulmonary system may also create problems to other organs. The disease is transmitted mainly through air through via cough, sneeze or sputum of an affected individual. Mycobacterium tuberculosis is a small, aerobic, non-motile bacillus. The distinctive clinical character of the species is the high lipid content. It is a slow growing bacteria which divides every 16 to 20 hours [3]. The bacterium is surrounded by a lipid bilayer membrane. Naturally, the bacteria can grow mostly inside the human body but it is possible to develop in the laboratory using invitro culture method also. Mycobacterium tuberculosis (MTB) can be identified from microscopic examination of histological stains or sputum samples. Even after cleansing with acid, MTB has an amount of stain in it, so it is called as acid-fast bacillus (AFB). The commonly used AFB staining technique is Ziehl Neelsen (ZN) stain, which stains the pathogen pink in contrast with blue background (Figure 1.1.1). Auramine- rhodamine stain can also be used followed by fluorescence microscopy. Four other TB-causing mycobacterium are inclusive in the M. Tuberculosis complex: M. bovis, M. africanum, M. canetti and M. microti. The former species has ceased to be a major causative agent after the advent of pasteurized milk in developed countries. M. africanum and M. canetti have grounds confined predominantly to African races. M. microti is rare and encountered in immune deficient people. M. leprae, M. avium and M. kansasii are other significant pathogenic Mycobacterium. The latter two are called Non-Tuberculosis Mycobacterium (NTM) as they cause neither leprosy nor TB but a pulmonary disease akin to TB.



Figure 1.1.1 Mycobacterium Tuberculosis

1.2 Signs and symptoms

Tuberculosis infection is not always contagious as our immune system can safeguard us initially revealing no noticeable symptoms. This TB category, referred to as latent TB, causes infection but the pathogen remains in the body in a dormant state. It can be contagious and communicable if timely treatment is not administered. An

estimated 2 billion people are reported to have latent TB. On the other hand, the contagious version, or the active TB causes illness and variety of symptoms which may manifest within few weeks of infection or some years. Common symptoms of active TB are Persistent cough lasting beyond 2 weeks, Chest pain, Loss of weight, Loss of appetite, Fever and chills, Fatigue, Night sweats. Symptoms may vary in Extra pulmonary TB. For instance, back pain is observed in spinal infection whereas infection in kidneys may cause loss of blood through urine.

1.3 TRANSMISSION

As said earlier, transmission of TB is through infected droplets released by patients while talking, coughing or sneezing. Mostly people get infected due to prolonged or frequent contact with infected individuals. The disease is communicated only when it dwells in an active form, otherwise latent TB is not infectious. Transmission can be controlled by administration of drugs to people with active infections. A person with an incidence of TB takes minimum 3 to 4 weeks before being capable of spreading the infection.

1.4 Microscopy staining techniques

Direct microscopy is useful in identification of pathogen after staining the sputum sample. The three common staining procedures are:

1.4.1.1 Ziehl-Neelsen Method

This classical Acid-fast staining technique can stain the bacterium bright red by the retention of carbol-fuchsin dye against blue background developed by methylene blue counter stain, which are otherwise resistant to Gram stain due to high lipid content in cell wall in the form of mycolic acids (Figure (1.4.1.1)). The species are heat fixed on the slide and viewed on microscope under oil immersion. AFB cultures accompany AFB stain for improved predictive value negative.

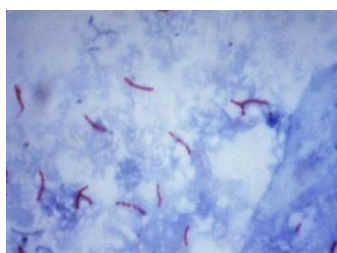


Figure 1.4.1.1 Ziehl Neelsen stain

1.4.1.2 Kinyoun Method

This is a cold staining technique unlike the Ziehl-Neelsen technique. It uses more concentrated carbol-fuchsin dye to stain the bacteria bright red on the slide. After decolorizing other species with acid alcohol, the slide is flooded with methylene blue to counter stain and dried (Figure (1.4.1.2)). The slides can be examined under high magnification (400x) or oil immersion for stronger evidence.

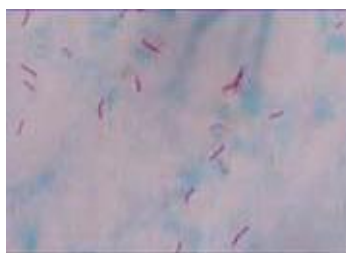


Figure 1.4.1.2 Kinyoun stain

1.4.1.3 Auramine-Rhodamine Method

This histological technique uses a mixture of Auramine O and Rhodamine B dyes, Auramine binds to mycolic acid in cell wall. Permanganate is used as counter stain post decolorizing. The detection requires a fluorescence microscope equipped with BG-12 exciter filter and an OG1- barrier filter. Acid-fast bacteria appear as brightly fluorescent against dark field (Figure (1.4.1.3)). It is more quick, affordable and more sensitive, therefore it is often used screening tool.

Manual examinations of microscopic sputum smear images consume time and are prone to error. Thus, automation of examination is proposed in this work by computer aided diagnosis system using image processing technique aiming to minimize the effort, time and cost thereby enhancing early diagnosis.



Figure 1.4.1.3 Auramine Rhodamine stain

2. LITERATURE REVIEW

Forero and Cristóbal, 2003; Forero et al, 2004; Forero et al, 2006, proposed segmentation of microscopic sputum smear images by Adaptive thresholding and K-means clustering in their but the results were not absolutely accurate. Sadaphal et al, (2008) proposed tuberculosis identification by multi stage colour based Bayesian segmentation followed by artifact removal by shape comparison. Superimposed AFB clusters, extreme stain variation and low depth of the field were the challenges. The results of research by Ibnu et al, (2010) published in "Development of Algorithm for Tuberculosis Bacteria Identification Using Colour Segmentation and Neural Networks" are based on Neural Networks. The testing result by using 15 hidden layers showed an accuracy of about 88% [8]. Castaneda et al, (2010) in their work, "Automated Tuberculosis screening using image processing tools" employed edge detection and mathematical morphology to extract the bacilli. This method showed specificity over 90% but it is applicable only on samples stained with Auramine and not ZN stain images. Khutlang et al, (2010) in their work "Classification of Mycobacterium tuberculosis in Images of ZN-Stained Sputum Smears" proposed segmentation using a combination of two-class pixel classifiers. This method could not be implemented for automatic segmentation. In this work, computerized automation of TB diagnosis is realized by identification of Mycobacterium from microscopic sputum smear images using segmentation techniques [10].

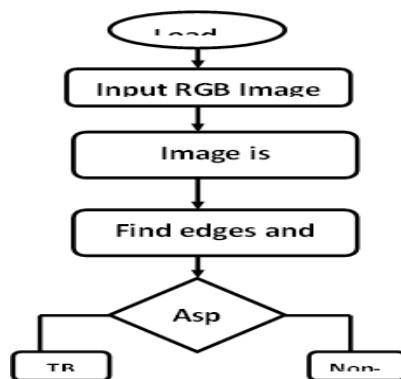


Fig. 2. Flow chart for the proposed system

3. METHODOLOGY

In this work, an algorithm based on segmentation which is a common method in image processing is developed for identification of mycobacterium tuberculosis bacilli in microscopic sputum smear images. Segmentation is used to extract region of interest. Feature extraction also helps us to identify the exact object in image.

3.1 Colour Segmentation Based On K-Means Clustering

Our objective is to distribute the pixels in the original image into groups based on coherence in properties like colour and texture and extract information from the image. K-means clustering is an unsupervised clustering algorithm that intends to distribute n observations into k clusters in which each observation belongs to the cluster with the nearest mean. This method produces exactly k different clusters of greatest possible distinction. Given a set of features (x_1, x_2, \dots, x_n) , where each feature is a d -dimensional real vector, k -means clustering algorithm tries to partition the n features into k ($k \leq n$) sets $S = \{S_1, S_2, \dots, S_k\}$, in order to reduce the total intra-cluster variance,

$$V = \sum_{i=1}^k \sum_{x \in S_i} (x - \mu_i)^2 \quad (3.1)$$

The algorithm here is supplied with a two dimensional image as an input and then the algorithm is applied in the following sequence:

- The initial assignment of points to clusters can be done randomly.

- The mean of each group is calculated.
- The distance of every point from each group is estimated by its distance from the corresponding group mean. Each point is assigned to the cluster it is nearest to.
- The above two steps are repeated till the sum of squares within group errors cannot be lowered any more.

In k-means clustering, the actual requirement is only one cluster to be segmented. But the acquired output has two clusters that are overlapping (Figure 3.1.1). Since the output is not accurate other methods are tried.



Figure 3.1.1 Image segmented using k means clustering

3.2 Colour Segmentation Based On Siox

SIOX stands for Simple Interactive Object Extraction and is a solution for extracting foreground from still images with very little user interaction. It has hands free selection tool that is used to specify the region of interest which contains foreground objects to be extracted. The algorithm initially creates colour signatures i.e. set of representative colours for background and foreground. Next, all image points are assigned to nearest neighbour in the colour signature and the output mask is generated. The output can be refined by morphological operations like erode, dilate, and blur which helps to remove the unwanted details present in the image. As with any segmentation algorithm, this algorithm doesn't guaranty exact segmentation. The disadvantage of SIOX is that it dependence on the colour characteristics. Though colour characteristics is considered to be one of well distinguished feature with respect to images, the method fails to handle the camouflage. If there is common shades shared with both the the foreground and background f similar colours, the method might produce an outputt with parts missing or incorrectly classified as foreground (Figure 3.2.1).



Figure 3.2.1Image segmented using SIOX

3.3 COLOUR THRESHODING

Thresholding is a simple segmentation technique which simply converts a gray scale image into a bi-level image. In 8 bit gray scale images and colour images there are 256 intensity graduations which can be assigned to a pixel. Thresholding works by separating the pixels which fall in a desired range of intensity values from those that do not. Thresholding is an effective method for extracting distinct features in an image. An effective thresholding algorithm preserves logical and semantic content. The two types of thresholding are:

- Global thresholding algorithm: Global thresholding can be applied when all the pixels of background and foreground are fairly consistent by using a single threshold for all image pixels.
- Local or adaptive thresholding: As the name implies, this technique uses different threshold values for different local areas in an image.

The output acquired by thresholding is quite accurate but the drawback of this technique is that the threshold range varies for each of the images and thus is dependent on manual adjustment of threshold values for different images(Figure 3.3.1). Not fulfilling the cited aim of automation of TB detection, next approach was made by colour deconvolution.



Figure 3.3.1Threshold image

3.4 COLOUR DECONVOLUTION

Colour deconvolution is a sophisticated algorithm for image segmentation [11]. In this technique, the original RGB image is transformed depending on information from the user about the three colours into images representing the stain densities. The diagnostic information provided by the contrast of individual stains in mixtures of multiple stains with different spectral absorption characteristics is restored.

The intensity of transmitted light from the specimen with stain concentration is described by Bouguer-Lambert-Beer law as,

$$I(\lambda) = I_0(\lambda) \cdot e^{-\delta(\lambda) \cdot c} \quad (3.4.1)$$

where $I_0(\lambda)$ is the incident intensity, $\delta(\lambda)$ is the optical density for a unified layer of thickness; c is the concentration of the stain.

For a mixture of absorbing stains, spectral absorbance $A(\lambda)$ can be expressed as $A(\lambda) = -\ln\left(\frac{I(\lambda)}{I_0(\lambda)}\right) = \sum_i(\delta_i(\lambda) \cdot c_i)$ (3.4.2)

Each pure stain has three characteristic absorbance for each of the three RGB channels and hence three

characteristic optical densities. $\vec{d}_i = \begin{bmatrix} d_{red,i} \\ d_{green,i} \\ d_{blue,i} \end{bmatrix}$ (3.4.3)

Assume there are three stains in the sample, each contributes linearly to light absorption. Then for given sample with three stains, the resultant optical density,

$$\vec{d} = \begin{bmatrix} d_{red} \\ d_{green} \\ d_{blue} \end{bmatrix} = \begin{bmatrix} a_{r1} & a_{r2} & a_{r3} \\ a_{g1} & a_{g2} & a_{g3} \\ a_{b1} & a_{b2} & a_{b3} \end{bmatrix} \begin{bmatrix} c_1 \\ c_2 \\ c_3 \end{bmatrix} = M\vec{c} \quad (3.4.4)$$

where M is the convolution matrix, and \vec{c} is the concentration of the three stains.

To ease calculation, optical density vector \vec{d} and concentration vector \vec{c} are normalized by dividing respective unit vectors

$$\hat{D} = \hat{M}\hat{C} \quad (3.4.5)$$

Stain concentration thus can be found as

$$c = M^{-1}D \quad (3.4.6)$$

The matrix M^{-1} is the deconvolution matrix which can be found if the optical densities of each individual stain is known and hence find the individual concentration of the stains. This method was superior in ZN stained image segmentation over other methods. This method has best accuracy since it is based on stain used to colour the slides (Figure 3.4.1). However, it also segments other small particles besides TB bacteria. This calls for further clarification to exactly extract the rod shaped TB bacilli only.

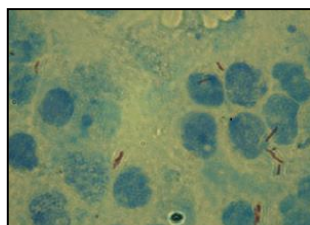


Figure 3.4.1 Original Image

The microscopic images are given as input for colour deconvolution process. In ZN stained sputum images the background is stained blue colour in contrast to red stained AFB Mycobacterium Tuberculosis. From the built in vectors, Brilliant blue vector is selected as it is best related to the concept. The image is split by deconvolution into three channels one of which consists of only red coloured TB cells (Figure 3.4.2). But slide staining is a manual procedure and hence shades of stain colour may vary in different slides giving rise to possibility of detection of other cells or particles in pink regions. So the shape describing property is used to discriminate TB

from Non TB cells. After deconvolution, the image is converted into binary image to find the edges (Figure 3.4.3 & 3.4.4). The edges are then detected for cells and particles in the binary image.



Figure 3.4.2 Deconvolved Image

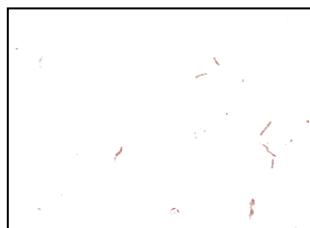


Figure 3.4.3 Binary Image



Figure 3.4.4 Image after edge detection

The particles present in the image are analyzed using the option analyze particles where the circumference is set in order to extract only the rod shaped bacteria (Figure 3.4.5). Still other particles may not be removed. Next, region of interest from the image is selected and the properties are studied. From the featured properties, the aspect ratio seems to be varied for TB and Non TB cells. Aspect ratio is the ratio of major axis to minor axis. If the aspect ratio is greater than 3.5 the cell is distinguished as TB cell otherwise it is a Non TB cell.



Figure 3.4.5 Image after particle analysis is done

4 RESULTS AND DISCUSSION

This work highlights the various segmentation methods for image processing for the automation of TB detection from microscopic sputum smear images. The images are initially captured from a camera attached to microscope magnifying the ZN stained sputum slides. A set of 50 images each were captured from both TB positive and TB negative slides and subjected to segmentation. Colour deconvolution has proved to be the most efficient technique when compared to other segmentation methods. One of the three resulting images from colour deconvolution contain the segmented bacilli. As this method relies on colour for segmentation, various undesirable particles maybe included in the segmented images. Further distinction of TB bacteria from Non TB cells is done by one of the shape describing factors namely aspect ratio which varies for TB and other cells.

5 CONCLUSION

Thus a computer aided system for detection of TB bacteria from microscopic sputum smear images is discussed. Colour deconvolution and feature extraction help to discriminate the TB bacteria from the slides. This technique is simple, inexpensive and wide reaching in emerging economies. This technique can be further extended for similar detection and diagnosis in various diseases. This technique reduces fatigue by automation and elimination of visual inspection of images. This computer aided system has a high degree of accuracy,

specificity and faster detection capability. Thus this automated detection minimizes time, cost, human error and eliminated the need for skilled professional.

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Automated Sedimentary Particle Recognition from Urine Microscopic Images

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ABSTRACT

For diagnosing kidney and urinary tract problems, urinalysis is the test of urine to identify and examine sediments. The results of urine sediment analysis may be used to aid in diagnosis and treatment. Manual urine sediment examination is subjective and labor-intensive. It uses a standard volume of urine as well as several chambers to count the urinary elements. It is crucial to classify and quickly identify the various types of sedimentary particles, including erythrocytes, leukocytes, epithelial cells, crystals, mycete and epithelial nodes. The proposed methodology use Detectron2's Faster R- CNN implementation using one of their base models or configurations to automate the recognition and classification of urine sedimentary particles. The methodology proposed consider urine particle detection as object detection, and use state-of the-art CNN-based object detection techniques. This results in F1 scores for each class of sediment and mAP values. The work also compared the time complexity of different models used to detect Urine sedimentary particles with Detectron2. Computer vision tasks are a subset in Artificial intelligence and can be used to analyze an image using deep learning.

Indexterms: Urinalysis, Detectron2, Object detection, Faster R-CNN, Sedimentary Particle Detection

I. INTRODUCTION

Healthy individuals should have clear, sterile urine. Some sedimentary particles found in urine samples can indicate the presence of corresponding diseases. Microscopic urinalysis can detect particles in urine that may help to diagnose dysfunction, infection, inflammation, or other diseases of the urinary tract. It is possible to determine if the patient has urinary tract inflammation by looking at the number of leukocytes present in their urine. If the patient also has Erythrocytes, it could be that they have urinary tract calculi.

The Manual microscopic analysis using the human eye is one of the most important parts of the test. It is time-consuming, labor-intensive and intuitive. This requires the use of Artificial Intelligence and computer vision to analyze the results. Automatic detection and classification of urine particles is achieved by identifying the regions that contain target objects, and then extracting them. Deep learning is also gaining popularity due to its recent advances and state-of-the-art results in various tasks related to computer vision [1]. Diverse research has used deep learning to classify and detect different types of Urinary sedimentary particle.

Deep learning projects for Urinary Sedimentary particles detection and classification involve tasks such as collecting images, creating labels and then building deep learning models using the data. To provide labels and bounding boxes for different types of sedimentary particles, the labeling process takes time and requires a lot of human labor. This work describes state-of the-art object detection techniques to identify sedimentary particles.

The proposed methodology involves the labeled data currently available and suggests a strategy for generating more labeled information. Our contributions include:

- The current state-of-the-art object detection techniques and their application to Urinary Sedimentary particle classification and detection tasks are explored.
- Experimenting with the dataset [2] to create a single model using Detectron2
- Visualizing and qualitatively evaluating predictions made.

II. RELATED WORK

A. Object detection using Deep Learning

Deep learning is an advanced method for object detection. There are numerous works in the literature on this topic. Region-Based Convolutional Neuro Networks (Rot-Based CNNs) are the most widely used technique. There are also various versions of You Only Have One (YOLO) which are popular.

R-CNNs take a lot of time to train, as there are many stages involved in the training process. The predicting stage can also take a while. In terms of training and prediction rate, the standard R-CNN is slow. To solve these issues, Girshick suggests Fast R-CNN [3]. R CNN is not the same as fast R-CNN. Instead, it is taught as a single model. Fast R-CNN's architecture examines images and provides candidate locations. To extract the features from the candidates, the images are then put through a pre-trained image classification model (e.g.

ResNet [4] VGG-16[5]). After the features have been extracted, a pooling layer is applied. The final step is to create two fully connected layers. For label classification and bounding box regression, two more completely linked heads are added.

Although Fast R-CNN reduces prediction and training time frames, it still necessitates the creation of region suggestions for each image using any image processing technique. To solve this difficulty, Ren et al. [6] offer a quicker model as Faster R-CNN. It has the main advantage of incorporating region proposals into the final model by using Region Proposal Networks (RPN). This is possible through the use of two smaller networks. Region Proposal Network (RPN) and Fast R-CNN are the two sub-networks in concern. Region proposals, bounding box classification, and regression can all be used to train these two sub-networks at the same time. These strategies increase object detection speed and accuracy, while reducing training time.

YOLOv2 [7], YOLOv3[8], YOLOv4[9] - are some of the most popular object detection algorithms. There are many YOLO versions. Each version has a different architecture and uses different techniques. All YOLO variants use the same core strategy: a single neural network. Images, ground-truth boxes/segments, and labels are used as inputs. The bounding box labels and the matching labels for the objects discovered on the image are the outputs. The image is divided into grids of cells. Bounding boxes are used to anticipate objects using the features from each cell. This technique has the benefit of being easier to train and predict, but it does have several drawbacks.

To summarise, YOLO has many advantages in terms of fastness, and a faster R-CNN is more accurate in terms of accuracy. Single Shot Detection [10] on the other hand, provides a better blend of speed and precision. SSD computes a feature map from input images and uses anchor boxes of different sizes and aspects. It is similar to Faster R-CNN. Because the inputs have different receptive fields, SSD predicts the bounding boxes sizes. It is possible to observe that larger bounding boxes are predicted more easily if the features of the convolutional layers are deeper than vice versa.

B. Deep learning-based urine sedimentary particle detection

David M. Roxel[11] proposed manual microscopic inspection of urine. This involves centrifugation followed by high-power (x100) and low-power(x400) observation. The results identify refractile fats bodies and crystals. False negative results were obtained, which is why it is expected that the number of cases will vary between 3 and 37%. Corey Cavanaugh[12] and Mark A. Perazella[10] also conducted a comparison of manual and automated urinalysis. He compared and analyzed different automated urine analyzers such as Cobas-6500 (IQ-200), Cobas u 601, etc. He highlighted the benefits of automated urine analysers over manual methods, such as lower labor costs, better correlation results, higher specificity, and greater sensitivity. Rui Kang, et.al.[2] used CNN to eliminate the manual examination of microscopic urine images. They found that they had a lower labor cost, good correlation results, and a higher specificity and sensitivity.

Abdul Aziz[13] and colleagues[7] proposed an unsupervised method of extracting objects from urine images using U-net. For the extraction of objects methods such as Otsu's, Niblack's, and Sauvola are used. U-net can be trained to extract these objects. The proposed method yielded an artifact-to-object ratio of 0.71. This is lower than the average.

Xiaohong Zhang et.al.[14] also proposed a multi-view urine-cell recognition method based upon multi-view deep residual learning. This was to overcome multi-view grey change in cells and information loss in natural states. There are nearly 17 convolutional layers. Squeeze-and-Excitation block is introduced to screen useful features to improve the sensitivity of the network to information features, thereby effectively extracting deep features in the urine images. The proposed method has state-of-the-art classification accuracy and reduces network computing time. It is concluded from the works that the recognition accuracy of the deep learning algorithms is larger than traditional artificial feature extraction methods.

The automated urine analysis is more accurate than manual methods and gives you precise results. Manual methods are subjected to errors, labour-intensive. Automated urinalysis is cost-effective and also with reduced time of evaluation. One stage automated urinalysis models are slower than Two-stage approaches due to the external region proposal network. Modern models can produce accurate results, and they can also recognize confusing categories of urine sediments.

III. METHODOLOGY

The methodology involves exploring the dataset to understand the data and then proceed by splitting the overall dataset further into the training, testing, and evaluation sets. The training data is split randomly while making sure to capture all the classes that have to be recognized. The validation set enables us to evaluate the

hyper-parameters for our architectures quantitatively and finally. The proposed methodology use the test set to determine the accuracy and other parameters. Regarding deep learning model architectures, the process start with the commonly used model architectures for Urinary sedimentary particle detection and classification tasks. The proposed methodology then proceed with techniques to improve the base model by changing hyper-parameters. In order to obtain higher accuracy, the proposed methodology perform data augmentations to increase our dataset. A brief idea about the various steps involved are depicted in Figure 1. For this challenge, the evaluation criteria is based on the F1 score defined to balance the precision and recall. Also mAP values and test time per image of all models are compared with our proposed model, namely Detectron2

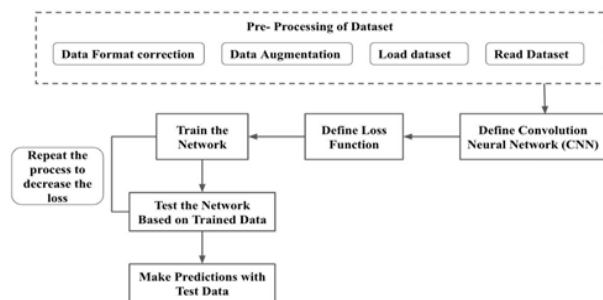


Fig. 1 Work Flow Block Diagram

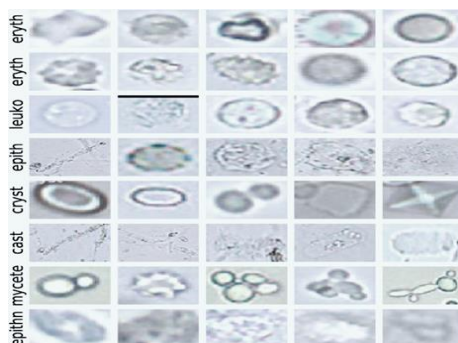


Fig.2. Samples of Urinary Sedimentary particles.

A. DATASET PREPARATION

The proposed methodology involves microscopic urine image database, which is annotated with ground truth boxes by medical professionals, to conduct this research. There are 5,376 annotated photos in our database. Each image's annotations are stored in.xml files. All of the images are coloured and 800×600 pixels in size, which are multiples of 32, obviating the necessity for zero padding prior to CNN training.

Erythrocyte (eryth), Crystal (cryst), cast, leukocyte (leuko), epithelial cell (epith), mycete, and epithelial nuclei are among the seven types of urine sediment particles included in the image dataset (epithn). Eryth, leuko, crystal, mycete, and epithn are only annotated in high-power fields, while epith and cast are only annotated in low-power fields. Figure 2 shows the seven types of urinary sedimentary particles found in the database, as well as their subdivisions in varied shapes.

The complete dataset is divided into three sets: Training, Validation, and Testing. The proposed methodology use 70 percent of data for training, 20 percent for validation, and the remaining 10% for testing from each of the seven classes. Table 1 shows the total number of images with annotations utilised across the entire dataset.

TABLE I: No of annotations in images used for training, validation and testing from each class

Classification Type	# Training	# Validation	#Testing
Eryth	15,270	4,363	2,182
leuko	4,318	1,233	618
Epith	4,322	1,235	618
Cryst	1,150	328	166
Cast	2,564	732	367
Mycete	1,458	416	209
Epithn	480	137	70

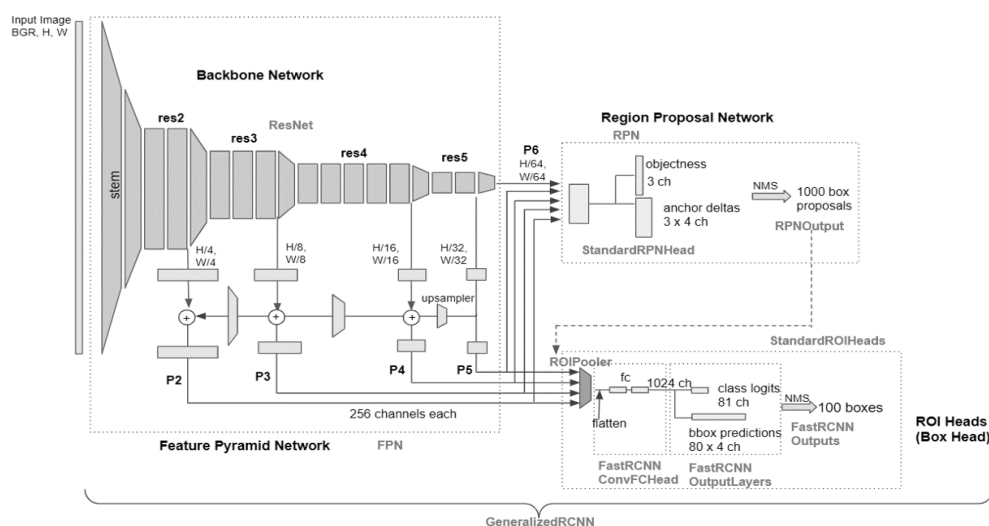
B. DATA AUGMENTATION

Data augmentation is a term used in artificial intelligence to describe techniques that add slightly modified copies of current data or newly created synthetic data from existing data to increase the quantity of data accessible. It acts as a regularizer and helps avoid overfitting when training a machine learning model. Artificial intelligence's oversampling is intimately linked to it.

In our project, the proposed method have performed 7 rotations for each image, and each rotation is incremented by 45° . The rotation angles are 45° , 90° , 135° , 180° , 225° , 270° , 315° . The reason for performing rotations as our augmentation technique is because the orientation of the particles can be at any angle.

CLoDSA, an open-source package, was used to implement the rotation approach (that stands for Classification, Localization, Detection, Segmentation Augmentor). CLoDSA is written in Python and uses OpenCV and SciPy as libraries. CLoDSA allows us to conduct various augmentation techniques such as flipping, scaling, adding noise, and so on. The CLoDSA library works on any operating system and is not dependent on any specific machine learning framework.

C. Architecture



Point Rend works on detectron2 and Mask RCNN as base components. The network utilizes the feature pyramid network concept as backbone. The FPN network helps in detecting small or large objects with high accuracy

Backbone Network: This network is in charge of obtaining feature maps from the images in the training dataset. The base network generates images of various scales. P2 (1/4 scale), P3 (1/8 scale), and P4 (1/16 scale) are the output features. Convolutional neural networks were used to process photos P5 (1/32 scale) and P6 (1/64 scale). As inputs, the FPN network uses batch size, image height, and width. As output parameters, channel size and stride are employed. Different scales will be applied to a single image that is processed into the input sensor (4,8,16,32,64 for p2,p3,p4,p5,p6..Outputs)

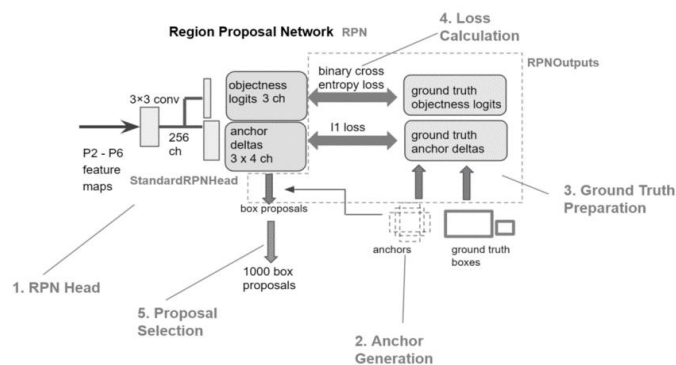
Read image function to load and transform images. An image named 'filename' is loaded. The loaded image is transformed using predefined transformers (such left-right flip), and then the image tensor, whose shape is (channel height, width, width, etc.) is registered.

Transform annotations: If the image is flipped or rotated, the box coordinates will be changed to the new location. The 'annotations' of the dataset are transformed by the transformations performed on the images.

Convert annotations into instances: This function is used to convert annotations into instances. Annotations labelled 'bbox' are registered to the Boxes object that can store a list bounding boxes. Annotations containing 'category_id' are converted to torch tensors.

The Region Proposal network: Detects object regions using multi-scale features. 1000 box proposals are generated by default, with confidence scores.

Help in detection region of interest from multi scale feature maps and creates 1000 box regions with confidence scores. The Regions with high confidence scores will be considered for further processing



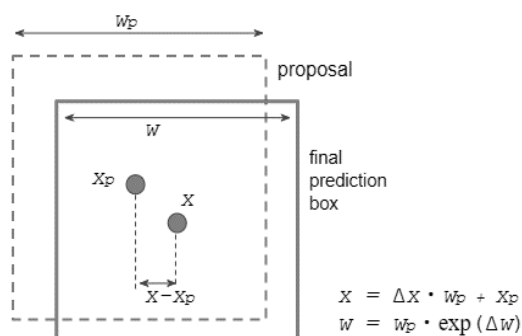
RPN is a cascade convolutional neural network. It has 3 convolutional neural networks and five levels of filters. These feature maps generated from filters are fed into convolutional neural network one by one. Anchor generation helps in connecting between Objectness map and ground truth boxes. Different anchor sizes are used to identify the optimal region of interest on the image. The anchors are placed on the grid cells that are having equitant size to the feature maps.

The proposed method calculates Intersection of Union between the predicted bounding box locations and ground truth labelled data. IOU thresholds Box head: IOU thresholds Box Head. A non-maximum suppression is applied to feature sets created using RPN network. This allows for fine-tuned box locations that allow classification of objects. The Box Head will use the proposed boxes to extract ROIs from feature maps. To speed up the training process, ground-truth boxes can be added to the expected propositions. After ROI Pooling, the feature maps are cropped to create rectangle regions. These are used to identify the proposal boxes. The features that have been cut are then given to the head networks. Mask R-CNN4 has two types of heads: mask heads and box heads. The Fast RCNN Convolutional FCHead Box Head in Base R-CNN NFP is the only one that can classify the item within the ROI. It also fine-tunes both the shape and position of the box.

Two loss functions, localization loss and classification loss applied to fine tune the model based on the validation datasets

Localization Loss: Predictions from foreground are picked and compared with ground truth targets. The tensor values used are relative sizes of the ground truth boxes compared to the proposal boxes

Classification Loss: As the proposed method deals with multiple classes, soft max is the ideal choice of the neural network. Foreground, background and prediction scores are calculated by comparing against the ground truth label dataset.



IV. RESULTS AND EVALUATION

Proposed convolutional neural network models are validated based on 3 parameters:

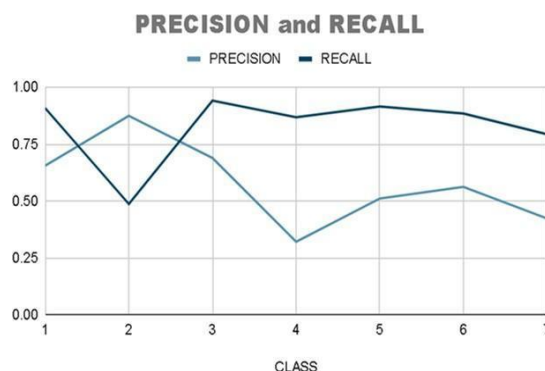
Time Complexity: A convolution is the sum of the row-wise dot products of a filter $W \in \mathbb{R}^{k \times d}$ with a region matrix $A \in \mathbb{R}^{k \times d}$, where k is the length of the filter and d is the depth dimension (e.g, dimensionality of word embedding space).

- $O(d)$ for one dot product (d multiplications + $d-1$ additions)
- The method perform in total kk dot products (there are kk rows in W and A), which amounts to $O(k \cdot d)$

- And finally, at the layer level, the proposed methodology apply the filter over the input $n-k+1$ $n-k+1$ times (where nn is the length of the input), let' say nn times since $n \gg k \gg k$. This gives us a final complexity of $O(n \cdot k \cdot d)O(n \cdot k \cdot d)$.

Accuracy: To validate model accuracy, the proposed idea used precision, recall, and f1 score. The proposed model uses better key performance indicators than state-of-the art research models.

classes	cast	Cryst	Epith	epithn	eruyth	leuko	Mycete
Precision	0.656	0.975	0.69	0.322	0,512	0.563	0.424
Recall	0.909	0.488	0.942	0.869	0.916	0.885	0.794
F1 Score	0.762	0.626	0.769	0.469	0.656	0.688	0.552



Mean Average Precision: Computer vision uses mAP as an evaluation metric for object detection. Localization and classification are two different things. Localization is the determination of where an instance is located (e.g. Bounding box coordinates and classification are used to identify what the instance is.

$$\text{MAP} = \frac{\sum_{q=1}^Q \text{AveP}(q)}{Q}$$

The mean average precision (mAP). where Q is the number of queries in the set and $\text{AveP}(q)$ is the average precision (AP) for a given query, q .

To qualitatively evaluate the findings, the methodology involved also depict the predicted bounding boxes with corresponding labels and their scores, as shown in Figure 3. Predictions and ground truth values agree fairly well. The proposed method proved that the result is extremely sat for automatic urine sediment analysis. Also compared and contrasted the most up-to-date historical models in Table 2. Our suggested model, Detectron2, demonstrated to have a higher mAP value in terms of image segmentation of large and medium-sized objects. The main benefits of utilising Detectron2 include obtaining a superior and similar mAP when compared to other models described by Rui Kang [13] with only 4 hours of training time. In under 4 hours, 10,000 iterations on a huge augmented dataset were learned. Thus for 0.5 IOU, It is possible to get mAP values close to 90% with our proposed model.

TABLE II Comparisons between our detection results and those of other networks

Net	Anchor scales	mAP	Eryt h	Leuko	epith	cryst	cast	Mycete	Epith et	test time (sec/img)
ZF	{1282, 2562, 5122}	0.723	0.607	0.749	0.845	0.86	0.658	0.781	0.566	0.44
	{642, 1282, 2562, 5122}	0.796	0.853	0.809	0.855	0.86	0.671	0.861	0.665	0.045
	{322, 642, 1282, 2562, 5122}	0.779	0.859	0.805	0.854	0.85	0.657	0.863	0.57	0.046
	{642, 1282, 2562}	0.757	0.748	0.823	0.846	0.85	0.642	0.82	0.568	0.044
VGG-16	{1282, 2562, 5122}	0.757	0.599	0.772	0.874	0.79	0.708	0.874	0.679	0.102
	{642, 1282, 2562, 5122}	0.802	0.842	0.818	0.868	0.87	0.716	0.877	0.621	0.104
	{322, 642, 1282, 2562, 5122}	0.795	0.854	0.825	0.857	0.85	0.724	0.876	0.576	0.104
	{642, 1282, 2562}	0.762	0.743	0.822	0.863	0.76	0.712	0.88	0.558	0.104
ResNet-50	{1282, 2562, 5122}	0.77	0.613	0.831	0.853	0.85	0.757	0.873	0.615	0.219
	{642, 1282, 2562, 5122}	0.784	0.761	0.824	0.86	0.82	0.768	0.859	0.595	0.219
	{322, 642, 1282, 2562, 5122}	0.804	0.876	0.812	0.86	0.85	0.747	0.874	0.605	0.22
ResNet-	{1282, 2562, 5122}	0.761	0.606	0.83	0.864	0.8	0.769	0.875	0.578	0.268
	{642, 1282, 2562, 5122}	0.773	0.841	0.814	0.848	0.85	0.749	0.863	0.446	0.267

101	{322, 642, 1282, 2562, 5122}	0.801	0.872	0.809	0.839	0.85	0.772	0.883	0.581	0.268
PVA Net	{482, 962, 1442, 2562, 5122}	0.841	0.884	0.843	0.871	0.88	0.765	0.89	0.76	0.072
Proposed Model: Detec tron2	{64,128,1282 , 2562 , 5122,642 , 1282 , 2562 , }	0.8429	0.886 2	0.845 9	0.8785	0.88 6	0.766 3	0.8913	0.762 5	0.014



Fig.6.PredictedImageoutputs

I. CONCLUSION

The methodology proposeuse Detec tron2 to treat urine particle recognition as object detection and use the well-known CNN-based technique Faster R-CNN as the basis detection framework. They don't require segmentation and can learn task-specific features from start to finish. One of the most pressing issues in the healthcare industry is the detection of urine particles and thus needs precise, accurate and innovative methods to detect them.

The methodology involved is an FPN-based convolutional neural network model to recognise distinct types of urine particles in this publication. In comparison to existing deep learning neural networks, the proposed models achieved better state-of-the-art performance. It is possible to present several types of instance segmentation models in future studies to investigate the size of each particle under urine particle classification.

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Tamil Question Answering System Inagriculture Domain

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ABSTRACT

The remarkable advancement in information retrieval has resulted in more effective knowledge discovery methodologies. Question Answering (QA) system helps to retrieve the exact answer to the natural language queries. Tamil is one of the morphologically rich languages; hence, it is challenging to develop the QA system in Tamil. This system is used to retrieve answers for questions in Tamil in the agriculture domain. We have developed our Tamil stop words list, which consists of hundred and twenty Tamil words. We preprocessed the Tamil language questions using a machine learning technique called the Viterbi algorithm for part of speech tagging. The preprocessed question is given to a search engine to retrieve documents from the Internet. And locality-sensitive hashing technique is used to get the top five relevant documents for the input Tamil question. And Sentence ranking is done to extract the correct answer from the retrieved documents using Jaccard similarity. A corpus size of thousand sentences in the agriculture domain is used to train and test our system.

Keywords--Tamil Question Answering System, Tamil POS Tagging, Locality Sensitive Hashing.

INTRODUCTION

The number of available information repositories has increased dramatically in recent years. The Internet provides enormous information, but English is the dominant language to get most of the information. The information that the users get from search engines may or may not be valuable and relevant. The users spend more time searching for the answer. So, the main objective of the Question Answering system is to extract and represents the exact answer to the user question. There are many question-answer systems in English like IBM Watson. Tamil is a morphologically and grammatically rich language. Our System process Tamil questions and provide Tamil answers to the user in the agriculture domain. The challenge of locating and validating the proper response makes the question answering system more complex than typical search engine information retrieval tasks. There are two main types of QA systems one is web-based and ontology-based. Web-based Q.A. systems utilize the web resource to answer user queries. In contrast, ontology-based make use of closed domain ontology like DBpedia ontology to answer user questions. The questions are classified as factoid questions, List type questions, and affirmative questions. Factoid questions are what, when, how(quantity). Affirmative questions are yes/no questions. This system can answer factoid types of questions. Question Classification plays a significant role in the QAS system. Table 1 shows different types of questions and examples in Tamil.

The main contribution of this work can be summarized as follows: We have developed an agriculture domain-based question answering system in the Tamil language. In this system, the user asks a question related to the agriculture domain in the Tamil language, and the system can answer in Tamil using several processes such as preprocessing, LSH, and answer extraction. We have collected stop words in Tamil and Parts Of Speech (POS) tagged the Tamil words. Locality Sensitive Hashing is used to retrieve relevant documents. And finally, answer ranking is done using Jaccard similarity.

RELATED WORK

The primary goal of the question answering system is to extract compact responses to user queries. The information retrieval system and the QA system are vastly different. The information retrieval system does not give the exact answer. Instead, it gives a set of documents. Recently there has been a high demand for tools to extract answers in Indian languages. Fig. 1 shows the classification of the Question Answering system.

Lakshmana Pandian et al. [14] proposed a system for Part of speech tagging of Tamil words and achieved an F-measure of 96%. They have compared various methods such as rule-based tagging, HMM (Hidden Markov model) tagging, and transformation-based learning tagger. Dhanabalan et al. [15] have proposed a "Tamil Spell Checker". This system helps to identify the spelling errors in Tamil. They have developed a morphological analyzer for analyzing Tamil words. In this system, each word is compared against the dictionary word. If the spelling of the word is incorrect they give suggestions and spelling corrections. Saraswathi et al. [16] have proposed a Tamil speech recognition system that is implemented using acoustic characteristics of the speech signal. The performance of the Tamil speech recognition system was improved by using the language models at different phases of speech recognition. A recognition rate of 74.11% was obtained by applying language models at the segmentation phase, which was further improved to 84.11% at the phoneme recognition phase and finally

to 87.1% at syllable level and word level recognition phase. Thus, the use of language models has drastically reduced the error rates at various levels and improved the recognition rate of the Tamil speech recognition system.

Thenmozhi et al. [8] proposed a cross-lingual information retrieval system in the agricultural domain. The system translates Tamil queries to English and then retrieves documents in an English corpus. This approach does not answer in Tamil. The system translates Tamil queries to English using the ontology-based method in the agriculture domain. Ontology is defined as the relationship between various concepts. They have also analyzed the word sense disambiguation for Tamil words. The same word having a different sense is defined as Word sense disambiguation. After translating to English, the query is searched on the Internet to retrieve the matching documents. S. Lakshmana Pandian et al. [1] developed a system to classify Tamil questions based on the conditional random field (CRF) model and identified the expected answer type. The different types of tagged question corpus in Tamil using morpheme features are used for training the CRF model. Dhanalakshmi et al. [9] presented a POS tagger and chunker for the Tamil language. They have proposed a customized tag set with 32 tags. Due to a large number of tags, the complexity of the system increased. They have used a support vector machine for POS tagging and chunking Tamil words. The Tamil corpus of size two hundred and twenty-five thousand words is used for training and testing the model.

Asad Abdi et al. [2] proposed a QA system in the physics domain using ontology. In this paper, they have developed an ontology in the physics domain and Inferring schema mapping method which makes use of both syntactic and semantic methods to transform user questions into ontological knowledge base queries. In which they have used the n-gram model for passage retrieval. And they have created a semantic graph with the subject-predicate-object triplets. S. Pandian et al. [8] have proposed a Named entity recognizer to identify entity names (place names, personal names, organization names). In this system, they have identified entity names for Tamil words using the Expectation-Maximization (EM) algorithm.

S. Jayalakshmi et al. [3] proposed a Web and Semantic Knowledge-Driven automatic question answering system (WAD). Here the semantic similarity plays a significant role in the question answering system which improves the accuracy of the system. They have proposed a rational probability-based approach for answering questions in the English language. Open Domain Question Answering system answers users' questions in any domain. Hovy et al. [7] proposed a system WebClopedia, an open domain QA that answers factoid type of questions. Users ask domain-specific questions like medical domain QA system. Abaca et al. [6] proposed a system using the semantic web in the medical domain.

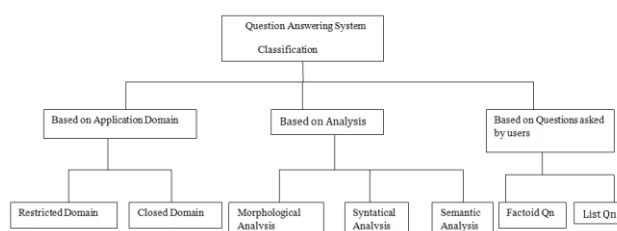


Fig 1. Classification of QAS System

TABLE 1 Types of Questions

S.No	Question Type	Description	Example (In Tamil)
1	Factoid Question	Description and Definition Questions	வறண்ட நிலத்திற்கு எவ்வாறான பழப்பயிர்களை தேர்ந்தெடுக்க வேண்டும்?
2	Listing Question	Types and Listing Questions	நெல் பயிரைத் தாக்கும் நோய்கள்?
3	Affirmative Question	Yes or No Questions	கிழங்கு சாகுபடிக்கு 20 செ.மீ இடைவெளி இருப்பது சரியானதா?

PROPOSED METHODOLOGY

Question Answering system design is composed of four different modules. User input Question in Tamil is given to the system. First, preprocessing on Tamil question are done such as splitting into tokens, stop word removal and POS tagging. The main root word from the question is searched in Google to get documents. On

top of Google search, the LSH technique is implemented to reduce the search space. To extract the answer Jaccard similarity measure is used. And answer validation is done using Tamil QA Corpus which consists of 150 questions and answers in Tamil. Fig. 2 shows the general workflow of the proposed system. This system consists of three main components

- Preprocessing Tamil words
- LSH based document retrieval
- Answer ranking

A. PREPROCESSING

The first step in preprocessing is tokenizing where the input question is split into tokens. After Tokenizing, removal of the stop word is done. No standard stop word list is available for Tamil. So we have created a stop word list of around one hundred and fifty Tamil words. A few of the words are shown in Fig. 3 and Fig.4

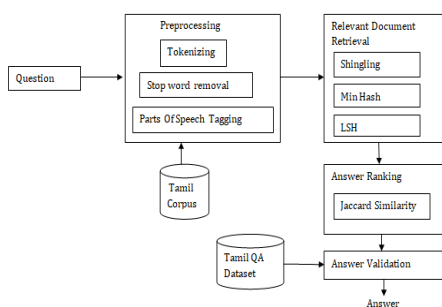


Fig 2. System design for the proposed method

ஒரு,என்று,மற்றும்,இந்த,இது,என்ற,கொண்டு,என்பது,
பல,ஆகும்,அல்லது,அவர்,நான்,உள்ள,அந்த,இவர்,என,
இருந்து,சில,என்,போன்ற,வேண்டும்,வந்து,இதன்,அது,
அவன்,தான்,பலரும்,என்னும்,மேலும்,பின்னர்,கொண்ட,
எல்லாம்,மட்டுமே,இங்கே,அங்கே,அதில்,நாம்,எனவே,பிற,
சிறு,மற்ற,எந்த,எனவும்,எனப்படும்,எனினும்,அடுத்த,இதனை,
இதை,கொள்ள,இந்த,இதற்கு,அதனால்,தவிர,சற்று

Fig3.TamilStopWords

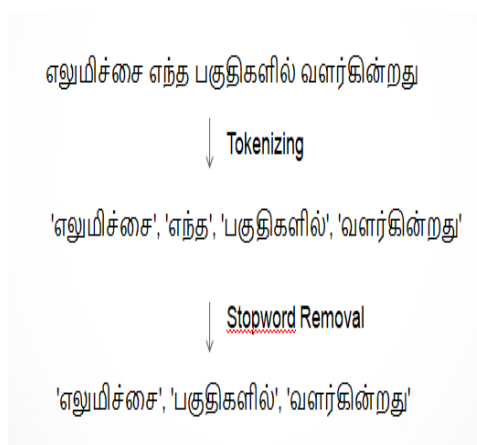


Fig 4. Preprocessing Tamil Words

B. Parts-of-Speech Tagging

Parts of Speech tagging is a process of identifying suitable parts of speech for words. There are two main machine learning approaches for labeling data. The first is the conditional random field (CRF), and the second is the probabilistic model called the Hidden Markov Model (HMM). Viterbi algorithm is an HMM-based model used for labeling sequences of Tamil words. Table 2 and Table 3 shows the few tags for Tamil and English respectively. Fig 5. shows POS tagging Tamil words.

TABLE 2 Tamil Tagset

Tag	English	Tamil
1	Adjective<ADJ>	பெயர் உரிச்சொல்/பெயரடை
2	Adverb<ADV>	வினையுரிச்சொல்/வினையடை
3	Conjunction<CNJ>	இடைச்சொல்
4	Noun<NN>	பெயர்ச்சொல்
5	Proper Noun<NNP>	குனி பெயர்ச்சொல்
7	Verb Finite	வினைச்சொல்

TABLE 3 English Tagset

S.No	POSTag	Description
1	NN	Noun
2	NNC	CompoundNoun
3	NNP	ProperNoun
4	NNPC	CompoundProperNoun
5	ORD	Ordinals
6	CRD	Cardinals
7	PRP	Pronoun
8	PRIN	PronounInterogative
9	PRID	PronounIndefinite
10	ADJ	Adjective
11	ADV	Adverb
12	VNAJ	VerbNonFiniteAdjective
13	VNAV	VerbNonFiniteAdverb
14	VBG	VerbalGerund
15	VF	VerbFinite
16	VAX	VerbAuxiliary
17	VINT	VerbInfintie
18	CNJ	Conjunction
19	CVB	ConditionalVerb
20	QW	QuestionWord
21	COM	Complementizer
22	NNQ	QuantityNoun
23	QTF	Quantifiers
24	PPO	Postpositions
25	DET	Determiners
26	INT	Intensifier
27	ECH	EchoWord
28	EMP	Emphasis
29	COMM	Comma
30	DOT	Dot
31	QM	QuestionMark
32	RDW	ReduplicationWords

C. Locality Sensitive Hashing (LSH)

To retrieve relevant documents, LSH is implemented. In this, the question is compared with the set of documents, and the most relevant document is fetched as a result. There are three main steps in LSH which are illustrated in Fig 6. And Fig 7. To retrieve the sentence from the retrieved document we have proposed an algorithm and it is given below

- Shingling

We use unigram as shingles after removing punctuations and stop words

['எலுமிச்சை', 'எந்த', 'பகுதிகளில்', 'வளர்கின்றது']

- Min Hash

A signature matrix is created by permutating the rows randomly as

1234 → 2413

Figure 5 shows steps in creating a signature matrix.

• LSH

The signature matrix is divided into 2 bands of 2 rows each. And then, each band is hashed separately.

இஞ்சி\NN சாகுபடி\NN நுட்பங்கள்\NN:\RD_PUNC இஞ்சி\NN கடல்மட்டத்திலிருந்து\NN
சுமார்\N 1500\QTC மீட்டர்\NN உயரம்\NN வரையுள்ள\NN வெப்ப\NN மற்றும்\NN
ஈரப்பதமுள்ள\N உஷ்ண\N மண்டலப்பகுதிகளில்\NN நன்கு\N வளரும்\VM.\RD_PUNC
பொதுவாக\RB மானாவாரி\NN பயிராகவே\RB சாகுபடி\NN
செய்யப்படுகிறது\VM.\RD_PUNC

Fig5. POSTaggingUsingViterbiAlgorithm

Tag	English	Tamil
1	Adjective<ADJ>	பெயர் உரிச்சொல்/பெயரடை
2	Adverb<ADV>	வினையுரிச்சொல்/வினையடை
3	Conjunction<CNJ>	இடைச்சொல்
4	Noun<NN>	பெயர்ச்சொல்
5	Proper Noun<NNP>	தனி பெயர்ச்சொல்
7	Verb Finite	வினைச்சொல்

Fig 6. Forming Signature Matrix

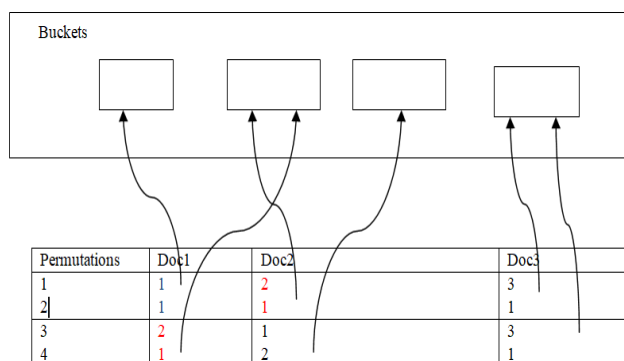


Fig 7. Forming Buckets in LSH

Algorithm Sentence Extraction
Input: Question, Top 5 relevant documents
Begin
Step 1: Split the Sentence in the document.
Step 2: Calculate Sentence Weight
Step2a: Remove all stop words from the sentence
Step2b: Take the first term from the sentence. If it is a positive feature then assign weight of term as 1
Sstep2b: If it is an unfamiliar word then assign weight of term as 0.
Step3: calculate the total weight of sentence
Total = w(t1)+w(t2)+...+W(tn) where t1, t2, tn are words of sentence
Step4: Pick the sentence with highest score
Repeat the procedure for all documents
End

E. ANSWER RANKING

The sentences are split in the relevant documents, and the questions are compared with each sentence using Jaccard similarity as shown in Fig 8. Retrieve the most relevant sentence as an answer as shown in Fig 9.

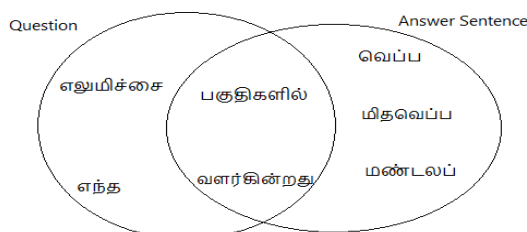


Fig 8. Jaccard similarity between question and answer

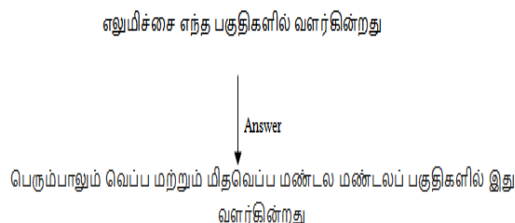


Fig 9. Answer Retrieval

EXPERIMENTS

We have used the Tamil Agriculture Corpus, which consists of 1000 sentences in Tamil and Tamil question and answer datasets for validation. And the corpus is available at Indian Language Technology Proliferation and Development Center. And the sentences are parts of speech tagged. We have used the corpus to train the model in the Viterbi algorithm. We divide the dataset into 80% training and 20% testing. We have created our dataset, which consists of 85 Tamil questions and answers in the agricultural domain. And the Tamil QA dataset is used for answer validation

V. RESULT AND ANALYSIS

We used three metrics, precision, recall, F score, and accuracy, to evaluate the system's performance. Dataset consists of 85 questions; 43 questions are answered correctly by the system. 42 questions are not answered correctly by the system. Table 4 describes the True Positive (T.P.), False Positive (F.P.), True Negative (T.N.), False Negative (F.N.).

$$Accuracy = \frac{\text{No.of correctly answered question}}{\text{Total no.of testing samples}} \quad (1)$$

$$Precision = \frac{\text{No.of correct answers}}{\text{Total no.of related answers}} \quad (2)$$

$$Recall = \frac{\text{No.of related record retrieved}}{\text{Total no.of questions}} \quad (3)$$

$$F - \text{measure} = \frac{\text{Precision} * \text{Recall}}{\text{Precision} + \text{Recall}} \quad (4)$$

TABLE 4 Description of TP, FP, TN, FN

	Correctanswer	Detectedas the correctanswer
TP	Yes	Yes
TN	Yes	No
FP	No	Yes
FN	No	No

TABLE 5 Evaluation Metrics and Score

Evaluation	Formula	Score
Precision(P)	TP/(TP+FP)	0.63
Recall(R)	TP/(TP+FN)	0.65
F score	2*P*R/(P+R)	0.64
Accuracy	(TP+TN)/(TP+TN+FP+FN)	0.50

The accuracy of Tamil QAS is 0.50 because processing Tamil words are one of the challenging tasks as shown in Table 5. Stemming words in Tamil are difficult to identify. Extracting the root word in Tamil by removing prefixes and suffixes needs a lot of data to train the system. Due to the limited availability of Tamil data, this process of removing stemming words is not accurate. So, to improve the performance of this system in the future

we would like to identify the prefix and suffix in Tamil words. By removing the stemming words the accuracy of our system will improve.

VI. CONCLUSION

In this paper, we present the Tamil question answering system in the agricultural domain. LSH based approach is used for extracting the most relevant documents. This system makes use of the Jaccard similarity measure. We analyzed the system using a Tamil corpus and evaluated the performance metrics. Our system uses keyword-based search and cannot provide answers for complex questions like listing type of questions. This disadvantage harms the performance of our proposed system. We want to improve and complete the work by semantically analyzing Tamil words using LSTM.

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Experimental Investigation on Field Balancing of Rotating Machines Using Four Run Method

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ABSTRACT

The design of rotating elements in machines plays a vital role in increasing the performance and efficiency of the plant. The negative effects such as vibration and noise in the rotating machines should be brought to a minimum level. The manufacturing of machines was carried out by precise operations and equipment's but the assembling of all components creates a cumulative effect on balancing. This is mainly due to the uneven distribution of mass existing in the rotating components, which cannot be eliminated, and improper fit between the rotating parts. The failure of wind turbines and performance reduction is mainly due to unbalanced forces acting on them. The introduction of composite materials to the rotating components industry played a vital role in the development of its strength-to-weight ratio, fatigue life, but components made of composite materials have the demerit of uneven mass distribution. In this work, the conventional rotor balancing technique four-run method is adapted to the on-site balancing of large rotating machines and the problems that arise while balancing are discussed.

Keywords: Rotating elements, Vibration, Noise, Failure, Composite materials, Unbalance force, Balancing, Four-run method, problems

INTRODUCTION

Not only with the invention of the wheel, has rotating elements found in wide areas and all motions. Ex. Rotation of earth. Rotating machines are a basic part of the industry and it should be present everywhere. It includes fans, grinder, motors, pumps, automotive engines, governors, aircraft propellers, etc. If it is not in motion, the world will be idle. In such rotary members, failures may occur because of several reasons and create extreme effects on it. According to Fluke's report on the motor, mechanical failures of the motor are because of misalignment, shaft imbalance, shaft looseness, bearing wear, etc. [1] and this will produce jerky movements, vibrations, noise, etc. Mass unbalance is the most common malfunction of rotating machinery (50% or more) [2].

UNBALANCED FORCES

Variation in material density (composite material), tolerance in fabrication, casting, machining, or assembly, unsymmetrical parts, shifting of parts owing to shaft distortion, shrink fit, aerodynamic forces, and thermal effects are some of the physical conditions that can cause unbalance. Static, couple, quasi-static and dynamic unbalance are the types of unbalance conditions [2]. The unmatched weight distribution between the blades results in rotor unbalance. On the main shaft, each blade on a hub provides a moment or torque.

A weight attached to a weightless arm at a distance from the centerline of rotation can represent the moment or torque. (main shaft). The moments of each blade on the rotor should be equal around the center of rotation in an ideal scenario. There is no net imbalance force on the rotor when these moments are equal. The blade's moment is calculated by multiplying the distance between its center of gravity and the center of rotation by the entire blade weight. Dynamic unbalance is mainly by centrifugal force on rotation [3]. The centrifugal force is

$$F = mr \omega^2 \quad (1)$$

Where m - unbalance mass

R - Radius from center of rotation

ω - Angular velocity

EFFECT OF UNBALANCED MASS

When a system rotates with an uneven mass, it produces undesirable vibration, excessive stress in machine elements, and affects the durability of rotating parts, as well as generating high bearing thrust. This could result in the bearing system failing in a short period. The asymmetrical mass has a significant impact on the blades' rotational speed and angular velocity, resulting in jerky movements.

BALANCING

Balance quality

For selecting stiff rotor balancing quality, the international standard ISO 1940-1 is widely accepted[4]. It grades and explains allowable rotor imbalance limits as a function of rotating mass and rotational speed. The lower the grade number, the better the rotor is balanced. A spindle of a precision grinder, for example, would have an ISO balance quality G0.4, whereas the crankshaft of a huge four-stroke, solidly mounted engine would have an ISO G1600. The wind turbine industry has yet to implement a rotor balance quality standard.

Balancing methods

Adding single or multiple balancing mass elements to diminish the intensity of vibration in the rotor blades is the prime objective of this work. Balancing is done to improve the reliability of rotational systems. Literature reveals four methodologies followed in rotor balancing viz. Vector method, Four-run method, Modal balancing and Influence co-efficient method [5]. The above-mentioned methods require the usage of the accelerometer to measure the amplitude of vibration. Four run method needs four runs without Trial-mass and with Trial-mass attached at a known location on each blade respectively. However, attachment and detachment of Trial-masses on megastructures such as windmills is a laborious and time-consuming process. Vector Method needs only two runs without trial-mass and with trial-mass at the known location but requires a phase measurement in addition to amplitude measurement. The phase measurement is achieved by using optical devices. Influence co-efficient Method needs three runs requiring two accelerometers placed at close proximity of bearing support. This method also takes in amplitude and phase measurements. Initially, the unbalances are recorded using the amplitude and phase measurements from the two accelerometers then the trial mass is attached at distinct locations and again readings are made.

Problems in Balancing

Measurement issues such as bad location, probe run-out (mechanical or electrical), erroneous signals due to damaged probes and connecting wires, excessive vibration of rubs that forces amplitude into nonlinear range, non-uniform build-up of debris or erosion of a rotating part, reassembling similar parts in different locations, balancing at lower speeds instead of higher speeds at which vibration occurs (mode shape). When going through the first lateral crucial speed during start-up and shut down, balancing for high speeds can cause complications. The balancing of such huge rotating machines operating at low speeds is challenging. For such challenges, on-site field balancing is recommended.

Four-run method

Four readings were obtained from conducting four runs [2].

1. Without Trial mass (unbalance only)
 2. Trial mass at the first blade
 3. Trial mass at 2nd blade
 4. Trial mass at 3rd blade
- Same radius for trial masses in all the blades
 - By graphical method unbalance mass can be found

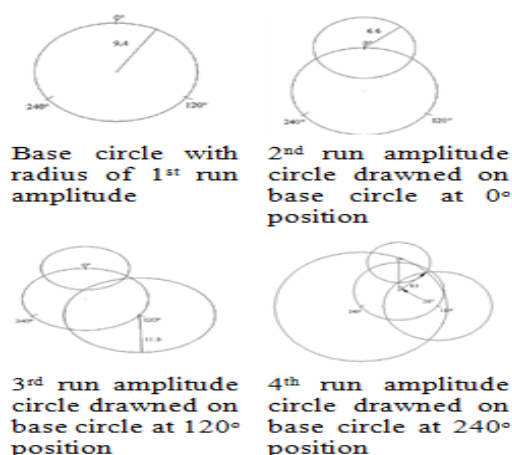


Fig.1 Four run method

LabVIEW program

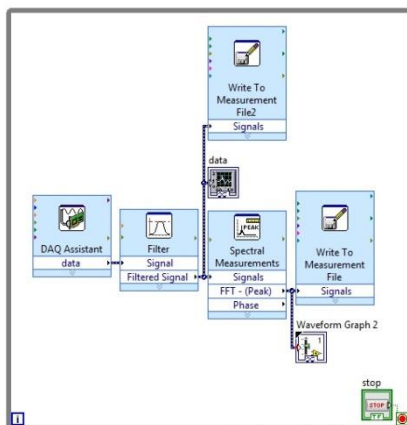


Fig.2 LabVIEW program

Signal produced from the accelerometer is acquired by the data acquisition card. The noises present in the signal were filtered by using a low pass filter. A graph is plotted between the amplitude of vibration and time for the filtered signal, further, the filtered signal is converted by FFT analyser which gives a plot of Amplitude vs frequency, and the values obtained were recorded continuously.

Position of instruments



Fig.3 Position of Vibration pickup

To get measured values more reliable placing of instrument is important and it has to be placed in proper surface.

- Measuring surface should be flat.
- The Accelerometer is placed as close as possible to the support if rotating elements having multiple supports.

Readings recorded

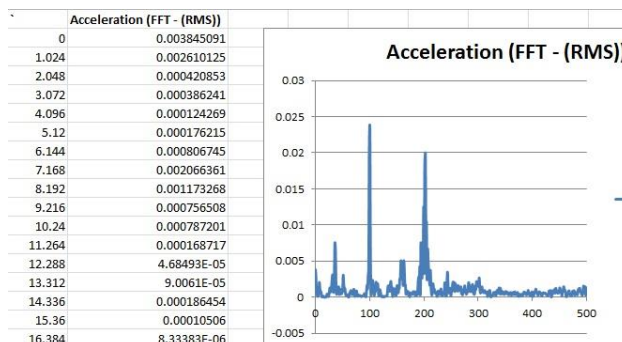


Fig.4 Readings recorded

The readings are recorded in the TDMS format from the FFT analyser and further it is converted into a worksheet.

Repeatability of vibration measuring device

TABLE I. With the mass (20.9822g) placed at the extreme end of the first blade, the fan is to run several times at the same speed and three readings were recorded to check the repeatability of the vibration measuring instrument. From more than 30 graphs (3runX 10 graphs) the values are obtained and listed in the table.1

TABLE II. REPETABILITY OF INSTRUMENT

Amplitude of vibration (g)		
1 st Trial	2 nd Trial	3 rd Trial
0.0020991	0.0020991	0.002067364

From the table I it is noted that the three readings are almost equal, so that, the instrument can able to produce the same readings for the same operating conditions.

LINEARITY OF THE INSTRUMENT

Generally, the assumption is made that the amplitude of vibration is proportional to the corresponding unbalance mass in rotor balancing.

Amp \propto Unbalance Mass

But in on-site balancing, the behavior of vibration is checked with respect to the corresponding unbalance mass by recording the amplitude of vibration for different known masses placed at the same position of any blade and was listed in the table. (10 masses X 10 graphs = 100 graphs)

TABLE III. LINEARITY OF INSTRUMENT

Sl.No	Mass (g)	Amplitude of vibration 10^{-4} ($g=9.81X m/s^2$)
1	20.2988	20.7475
2	31.1735	24.8812
3	45.5822	35.29
4	51.4735	40.994
4	65.881	52.69968
5	76.287	64.86411
6	83.1317	76.74767
7	103.56	95.4239
8	123.8588	113.7674
9	134.7335	172.4386
10	149	286.0665

For the table II values, the graph is plotted by taking mass as X variant and corresponding amplitude as Y variant in terms of 10^{-4} g

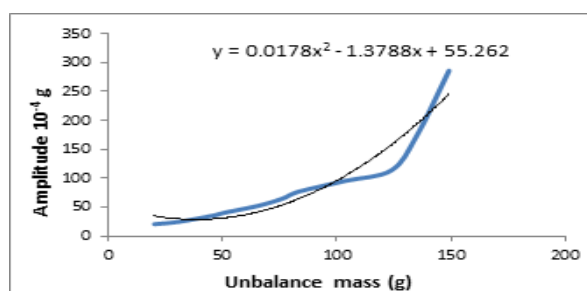


Fig.5 Checking of linearity

In fig.5 the amplitude of vibration is linearly varying up to the mass of 130g and further increasing of mass will increase the amplitude value in the higher rate it was clearly differentiated in fig.5 and fig.6.

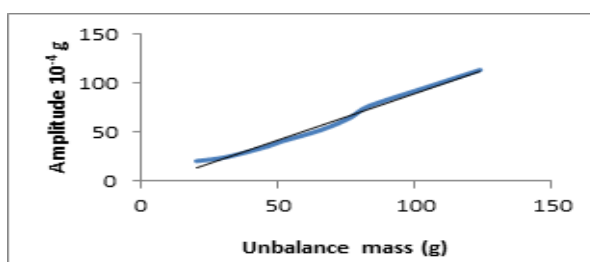


Fig.6. Linearity of instrument

J. Experimental evolution



Fig.7 Unbalance masses and Trial mass

The experiment was conducted for three different masses 20.2988g, 31.1735g, 45.5822g placed at three positions of blade (Extreme end-700mm from center, Middle-450mm from center, and near-235mm from center) individually.

The same thing is repeated for the other two blades and a total of 27 (3massesX 3positionsX 3blades) experiments were conducted. Each experiment required 4 runs and for each run, more than 10 graphs were generated. Finally, from 1080 graphs for 106 runs (27 Exp X 4 Runs), the amplitude of vibration is obtained for the same speed of operation.

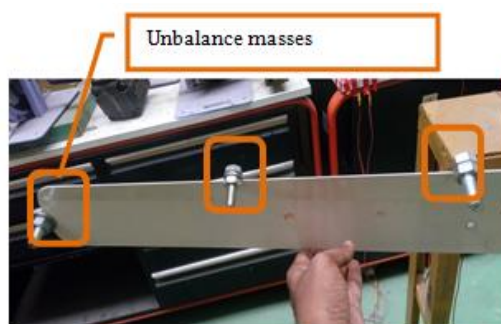


Fig.8 Positions of unbalance masses

TABLE IV. EXPERIMENTAL RESULTS

Location	Unbalanced induced		Amplitude of vibration (10^{-4} g)				Resultant Amplitude (10^{-4} g)	Counter mass found		Actual Counter mass		
	Known unbalance mass (g)	Phase (deg)	1st Run	2nd Run	3rd Run	4th Run		Mass (g)	Phase from 1 st blade (Deg)	Mass (g)	Phase from 1 st blade (Deg)	
Blade 1	Extreme end	20.2988	0	20.043	105.17	54.41	57.55	85.18	24.367	185	20.2988	180
		31.1735	0	23.655	140.3	75.6	68.89	81.04	30.005	171	31.1735	180
		45.5822	0	35.29	186.216	50.318	51.408	81	43.839	195	45.5822	180
	Middle	20.2988	0	19.383	84.727	49.744	60.008	65.91	30.458	195	20.2988	180
		31.1735	0	22.85	101.202	39.906	41	78.33	30.133	181	31.1735	180
		45.5822	0	27.72	122.145	51.7	41.98	54.09	43.499	171	45.5822	180
	Near	20.2988	0	14.104	43.833	31.241	29	37.73	38.713	163	20.2988	180
		31.1735	0	17.45	58.995	35.233	33.554	41.55	43.492	177	31.1735	180
		45.5822	0	22.4	68.953	35.541	31.886	46.61	49.761	175	45.5822	180
Blade 2	Extreme end	20.2988	240	20.302	58.64	112.077	82.71	91.79	22.902	62	20.2988	60
		31.1735	240	25.16	44.32	146.016	74.53	65.67	39.676	54	31.1735	60
		45.5822	240	38.47	55.942	190.983	69.032	72.15	55.224	50	45.5822	60

				5							2	
	Middle	20.2988	240	19.79	49.744	86.34	54.23	66.67	30.74	53	20.2988	60
		31.1735	240	22.45	40.34	103.201	43.65	80.81	28.77	55	31.1735	60
		45.5822	240	28.42	41.591	112.105	40	64.97	45.3	62	45.5822	60
	Near	20.2988	240	15.664	32.614	55.657	34.271	40.024	40.52	58	20.2988	60
		31.1735	240	19.159	42.837	65.962	46.744	51.17	38.774	55	31.1735	60
		45.5822	240	21.125	34.226	71.91	37.225	50.846	43.025	56	45.5822	60
Blade 3	Extreme end	20.2988	120	19.463	51.55	49.868	108.007	88.54	22.759	297	20.2988	300
		31.1735	120	22.786	78.144	64.49	159.2	79.545	29.657	282	31.1735	300
		45.5822	120	36.194	70.288	51.648	236.02	70.4	53.24	386	45.5822	300
	Middle	20.2988	120	19.72	49.5	59.1	63.683	67.651	30.187	271	20.2988	300
		31.1735	120	22	36.08	39.16	87.03	65.47	34.799	317	31.1735	300
		45.5822	120	26.887	43.405	48.187	118.387	72.82	38.51	306	45.5822	300
	Near	20.2988	120	16.103	21.904	28.344	54.773	38.93	42.837	311	20.2988	300
		31.1735	120	18.91	36.457	32.6	52.217	39.85	49.14	296	31.1735	300
		45.5822	120	21.155	32.59	36.81	64.48	43.2	50.71	306	45.5822	300

For the amplitude value of various runs listed in the table, the corresponding resultant amplitude of trial mass and counter mass phase is determined by a four-run graphical method. From the resultant amplitude (trial mass) and unbalance amplitude (1st run) using proportionality formulae of unbalance mass and amplitude of vibration unbalance mass were found. For example, the unbalance mass corresponding to the first set of readings is calculated by,

$$\text{Unbalance mass} = \frac{\text{Trial mass} \times \text{Unbalance amplitude}}{\text{Resultant amplitude}}$$

$$\text{Unbalance mass} = (103.56 \times 20.2988) / 85.18$$

$$= 24.367 \text{ g}$$

CONCLUSION

The introduction of composite materials plays a vital role in machinery. It increases the fatigue strength. But, it is a drawback of using composite materials, because the weight distribution is uneven. Thus, on-site balancing has to be done to run machines smoothly and effectively. Placing of trial mass quantity and position is a critical factor to predict the unbalance more accurately. The results show that at the extreme end of the obtained values and expected values are almost equal and the phase difference is only $\pm 10^\circ$. But at middle and near positions from the center, the obtained values have much difference from the expected values. Trial mass of a very lesser quantity will not produce considerable variation in amplitude of vibration and trial mass of a very large quantity will not produce linearity in a variation of the amplitude of vibration with respect to the unbalance mass. So choosing of optimum value of trial mass is required to predict the unbalance more accurately.

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Numerical Investigation on the Effect Reynolds Number on the Rotational Behavior of Small Wind Turbines

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ABSTRACT

Low-speed wind turbines with efficient designs can successfully access low-grade green energy and so provide a benefit to society. Using a 6 DOF, finite volume solver model, three-dimensional numerical simulations were run to better understand the rotational behavior of the planned wind turbine. The turbine's rotational speed is proportional to the wind speed. The rotational speed of the turbine is found to rise as the incoming wind speed increases. Because the system's inertia is large, material selection becomes an objective function in the design process. In the design of turbine blades, this technology proved to be a powerful virtual prototyping tool.

Keywords: Wind Turbines, Dynamic Meshing, Rotational Behaviour, Wake Dynamics, CFD.

I. INTRODUCTION

Due to cost and performance constraints, small turbines come in a restricted number of configurations. A stall-regulated, variable-speed, horizontal axis, fixed pitch 3-blade, direct drive permanent magnet machine is the most prevalent design. Because it would be difficult to justify blade pitch control on an economic basis, the blades are given a fixed pitch and optimised for power production at the rated speed [1]. This

At lower speeds, which results in poorer performance than a turbine with active pitch control could produce. Consequently, the turbine's rotational speed (N) is a function of own inertia (I), the moment due to loads (bearings) on the shaft (M), and the wind velocity (v in). The purpose for this investigation is because fellow researchers have still not investigated into three-dimensional numerical models of the rotational behavior of low-speed wind turbines in depth. This paper establishes the turbine's dynamic rotational speeds and wake characteristics for the proposed design.

II. Problem Statement

The determination of airfoil properties is at the heart of most of the pioneering work in the field of Wind – CFD [2]. As a result, adding these parts to the geometry of Turbine blades is unnecessary. The planned design will purportedly be modelled using a rectangular portion from now on.

To outline the blade, a wedged profile is created linearly between the chord and tip parts. Normally, the blades are riveted to the hub (i.e., angle of attack is zero). This work presents a numerical evaluation of the dynamic behaviour of wind turbines in response to input flow conditions, thereby filling a research gap.

III. Computational Domain and Meshing

1. Computational Domain

The blade is modelled with $c_1 = 50$ mm chord at the base and $c_2 = 25$ mm chord at the tip. The blade thickness varies linearly from the root ($t_1 = 6$ mm) to the tip ($t_2 = 3$ mm). The blade length is kept constant at $L = 400$ mm. The hub is a circular disc with a diameter of $D_{\text{hub}} = 250$ mm that is used to mount blades. The proportions are parametrically similar to small commercial low-speed wind turbines. Surmounting the turbine is a passive cylindrical domain with a diameter of $D_1 = 1200$ mm. It rotates in perfect sync with the turbine, capturing the wake dynamics.

For a complete comprehension of flow patterns, the domain is generally offset from the blade to its frontal area at approximately D of = 100 mm and to its rear area at about D of = 1000 mm (streamlines). A rectangular outside cushion domain is supplied, which interacts actively with the passive inner domain and ostensibly stops wake effects outside of the inner rotating domain. $X = 100$ mm, $Y = 500$ mm, and $Z = 100$ mm are the dimensions of the enclosure. This limits the potential of wake studies conducted behind turbines. Figure 1 shows the geometry of the fluid domain.

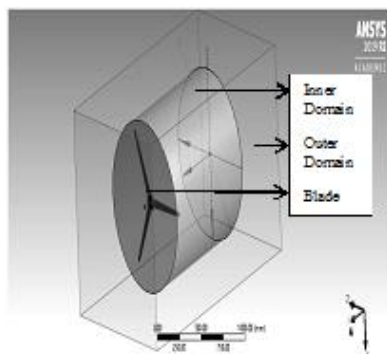


Fig. 1: Geometry for the Computational Domain

2. Meshing and Refinement

For Fluent, the commercial software ANSYS ICEM CFD was utilized to create an unstructured tetrahedral volume mesh. Fine mesh system modifications such as curvature - proximity capture and increased orthogonal quality are carried out. After some practice, the mesh element size is fixed to 0.05 m, which efficiently works with the system. The geometry contains 54840 nodes and 0.279 million elements, respectively..

IV. Conservation Equations and Boundary Conditions

1. Conservation Equations

The model is configured to solve for a pressure-based solver, which is defined as an incompressible flow with density variations of less than 5% (or) Ma 0.3. To account for writing up the motion history as a set of coordinates in different time steps, a transient state simulation is run. Because of its robustness, the k - model can efficiently capture turbulence around turbine blades. For boundary layers with substantial adverse pressure gradients, separation, and re-circulation, a realisable model is preferred. Every nodal point's velocity and pressure are defined by the Continuity Equation and the Three Dimensional Navier Stokes Equations.

The non-dimensionalized form of k-equations linked with the turbulence model is shown here. The default model constants used $C = 0.09$, $k = 1.00$, $\epsilon = 1.30$, $C1 = 1.44$, and $C2 = 1.92$. The 6 DOF Solver is utilised in a simplified form with only 1 degree of freedom rotation around the rigid body's centre of gravity (+Y axis).

2. Boundary Conditions

At the inlet, a uniform velocity profile is evaluated. At the inlet, a flow condition of constant size and normal to the boundary is established (v in). At the outlet, a pressure outlet has been applied (Operating pressure = 101325 Pa). The hard body, according to legend, is the blade rotating around at the Y axis To capture flow dynamics, the inner domain interacts passively (stiff body) with blades. A deforming body is defined as the outer cushion. The non-rotating outer domain's intake and exit are subjected to boundary conditions. The rigid body's mass attributes are defined for 6 degrees of freedom. As inputs, there's a solver. American Oak Wood is used for the turbine's whole construction. M body = 0.3445 kg is the mass of the body. $I_{yy} = 0.017089$ kg.m² is the moment of inertia about the Y-axis. Numerical Procedure in ANSYS Fluent, the Finite volume-based Solver is utilized to solve conservation equations simultaneously. The Semi-Implicit Method for Pressure Linked Equations (SIMPLE) technique is used to establish pressure and velocity coupling. For rotating and swirling flows, QUICK discretization is utilized because it delivers better accuracy than a second order approach. For all computations, the Flow Courant number remains below 1.0. For pressure and momentum convergence, the convergence conditions are set at 10^{-3} . The implicit scheme is used as the solution method, with a time step of 0.1s and a flow period of 90s. This amount of time is adequate for the turbine to reach its steady condition.

V. RESULTS AND DISCUSSION

1. Rotational Behavior of the Turbine

The rotational speed of the turbine is found to increase as the wind speed increases. A set pitch - angle of attack is used in the simulation. Simulated angular displacements in progressive time steps are tabulated as a result of the simulation. The following equations are used to calculate the turbine's RPM:

$$\omega = \frac{\theta_2 - \theta_1}{\Delta t} \times \left(\frac{\pi}{180} \right) \quad (1)$$

$$RPM = \frac{60 \times \omega}{2 \times \pi} \quad (2)$$

It may be deduced from this curve (Fig.2) that successful wind power conversion is not achievable at these lower turbine rotation speeds. Large Eddy Simulation (LES) Model versus the k-ε model for the computational domain for similar wind speeds is used to validate the numerical technique. The percentage inaccuracy decreases from 25.4 percent to 12.57 percent, or 3 and 15 m/s, respectively. The k-model almost perfectly captures adverse swirl behavior and is thus validated to an acceptable degree of accuracy.

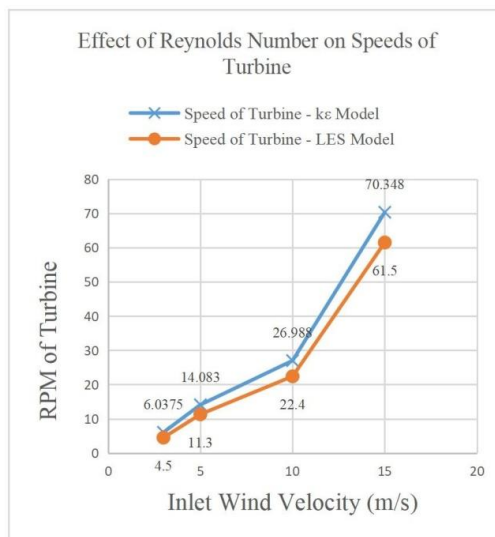


Fig. 2: Variation of Turbine Speed with Wind Velocity

The relevance of proper blade pitching and airfoil design with an eye toward material selection is the future subject of research for this work. This method aids the designer in determining the cut-in speed, or the wind speed at which the system operates normally, and the cut-out speed, or the wind speed at which the system is not operable/extreme condition for a low-speed wind turbine. It specifies the turbine's safe working conditions in terms of strength and dynamic loads.

Condition of the turbine with regard to its strength (dynamic loading).

2. Wake Dynamics

The flow field (streamlines) is subjected to a reaction force as a result of the rotational action of the wind turbine. Behind the hub, a recirculation zone is generated.

Wake effects can be sensed across the inner spinning region. The influence of wake is proportional to the inlet wind speed. Because of the unfavourable pressure gradient created, the expansion of the re-circulation zone is risky.

VI. CONCLUSION

This work effectively investigates the effect of intake wind speeds (i.e. a function of Reynolds number) on the rotational behaviour of a wind turbine. The research is significant because it establishes a framework for numerical analysis in wind turbine blade design. Furthermore, the wake characteristics of turbines can be assessed, as well as previous development in the field of turbine technology.

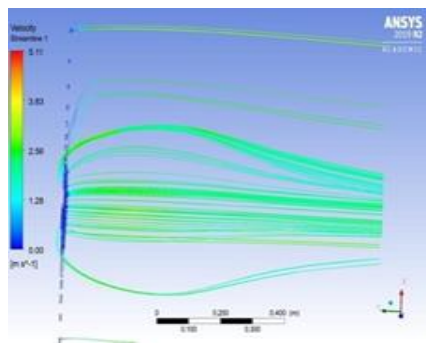


Fig. 3: Formation of Re-circulation Zone for $V_{in} = 3\text{m/s}$

The length of the recirculation zone (RCZ), as shown in Fig.3, is an important factor to consider when placing turbines. The length of RCZ is 0.4m for a wind speed of 3m/s. The strength and length of this swirl are directly proportional to the speed of the inlet wind.

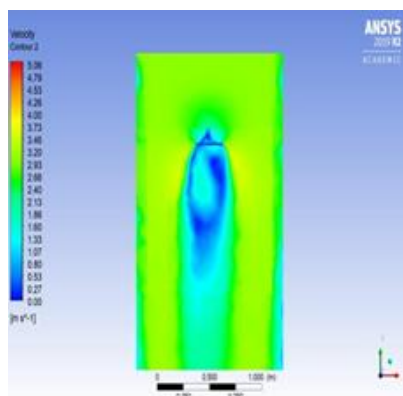


Fig. 4: Contour Plot of Velocity in the Flow Domain for $V_{in} = 3\text{m/s}$

The velocity curve depicts the influence of a flow route obstruction (turbine). Prior to the turbine, a local eddy is formed as the wind stagnates at the hub. The air molecules trapped inside these eddies and in the RCZ cause a reduction in turbine efficiency. With regard to this wake behaviour, it is critical to design the turbine to operate at the optimum position with the best aerodynamic properties

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VLSI Architecture of Feed Backward Filter in DFE for 5G System

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ABSTRACT

The speed of the 5G system will be up to 10Gbps. The Reliability of data transmissions get affected due to the immense effect of Inter Symbol Interference (ISI). Decision feedback equalizer is used to remove the effect of ISI. The speed of DFE is limited due to the feedback loop. With the help of the precomputation of coefficient approach the hardware complexity is reduced without any degradation in DFE's performance. Storage of past decision in a separate LUT will avoid the needs of multiplier in the feed backward filter structure. In this paper we have designed the feed backward filter with different adder configurations (ripple carry adder, carry select adder, carry look ahead adder, carry save adder, carry select adder and carry increment adder) for high speed applications. DFE with different adder configuration has been simulated with Vivado 2017 and implemented in AISC using 180nm technology as well as by targeting Artix-7 FPGA. The obtained results have been compared to select the best configuration for 5G system.

Keywords-Decision feedback equalizer (DFE), Feed backward filter (FBF), Pre computation approach, Carry look ahead adder (CLA), Carry save adder (CSA), Carry increment adder (CIA). Look up table (LUT).

INTRODUCTION

In the receiver of wireless communication the Equalization process plays a vital role in the removal of ISI's effect which was caused by the multipath propagation of signal transmissions. Due to the ISI's effect the prediction of 1's and 0's may go wrong which will results in the uncertainty of wireless communications reliability. Normal equalization detector such as linear equalizer and maximum likelihood detector are only used within the lower effect of ISI. But for the 5G system the effect of ISI will be more as the speed for the 5G system varies from 1Gbps to 10Gbps. Hence conventional equalization process will be ineffective. DFEs are widely used to overcome this problem. Based on the past decision output, the current sample detection will be done which makes the system reliable. The basic DFE structure is shown in fig1. It consist of two filters, they are feed forward filter (FFF) and feed backward filter (FBF). The detected sample output from the detector is fed back to FBF and gets subtracted with FFF's output for current sample detection. Both FFF and FBF are FIR filters which has multipliers and adders as it's elements. The hardware complexity of the conventional DFE is more since more number of multipliers are present which makes the system slow. For ISI removal the order of the filter N should be large. The number of multipliers will grow with the order N. Mainly the speed of the DFE is limited by the feedback loop. The critical path of DFE consists of two adders, one multiplier and one decision detector in the FBF loop. This critical path must be reduced to obtain the high throughput system which is the basic requirement of 5G system. Hence the feed backward filter structure needs to be modified to meet the hardware and speed requirement. The basic FBF architecture is shown in fig 2. Several approaches proposed for different FBF structure. The main idea behind all these approaches is to remove the multiplier from the architecture which reduces the area and increases the speed.

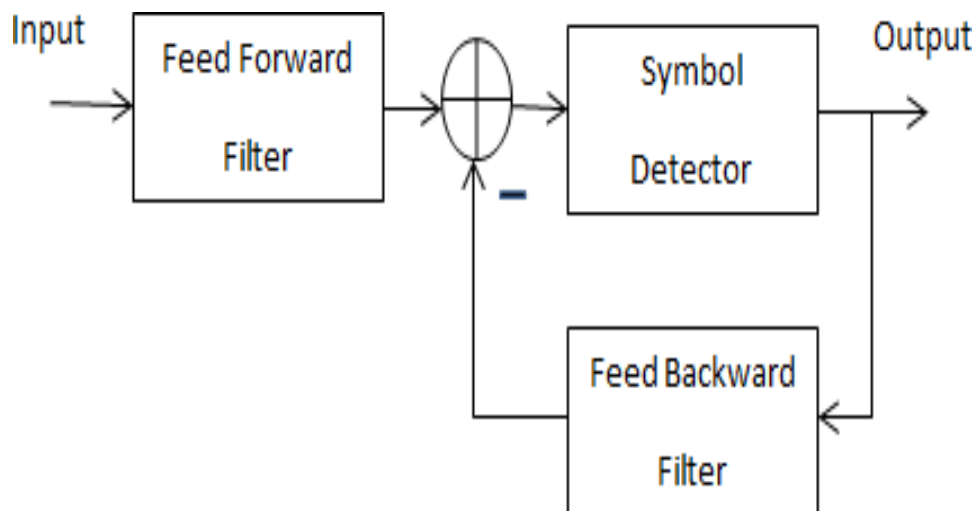


Fig 1. Conventional DFE Architecture

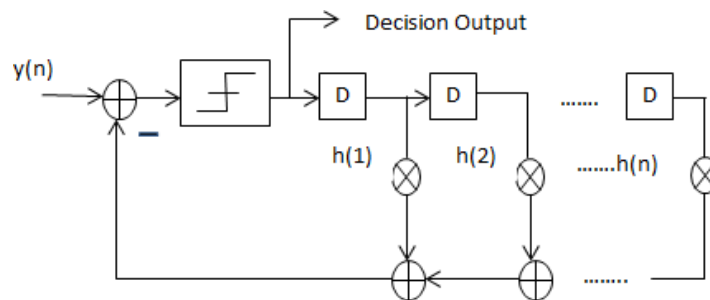


Fig 2. Architecture of FBF

I. DIFFERENT FBF ARCHITECTURES

The main idea was proposed [11] to reformulate the FBF structure into multiplexers, adders and slicers by eliminating the multipliers shown in fig 3. The structure will be further retimed to reduce the critical path. For N tap FBF the hardware complexity is 2N adders and 2 N-1 multiplexers. Unfolding techniques were used to improve the speed. But for N no. of unfolding the hardware also increases by N times. Also complexity of slicers and adders will increase with order N of FBF.

Another method was proposed [2] to reduce the hardware requirement further which involves the precomputation of possible filter coefficient values and storing them in the look-up tables. Based on the passed decision the selection lines will be applied to the multiplexers to detect the current samples. FBF was separated as two parts, in the first section coefficients values were stored in LUTs and the remaining coefficients were implemented by the multipliers itself, it reduced the hardware by half and the method named as partial precomputation approach. Even after optimization more multipliers are present in the FBF which occupies more area. The next approach [1] was targeted to eliminate all the multipliers by precomputing all possible coefficient values.

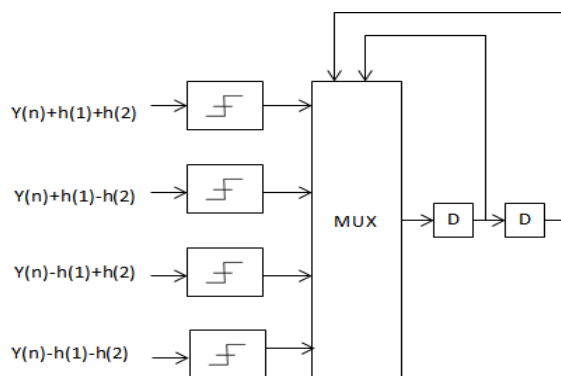


Fig 3. Reformulated FBF structure

The error signal to the multiplexers are applied carefully from the past samples. Since the coefficients values are calculated as two stages, this method is called as two stage precomputation shown in fig 4. The two stage precomputation approach results in better performance than other approaches. The pre computations of filter coefficient have been shown in fig 5 and 6 for filter of the order N=4. Table 1 gives detail comparison of hardware needed for this approach with conventional FBF.

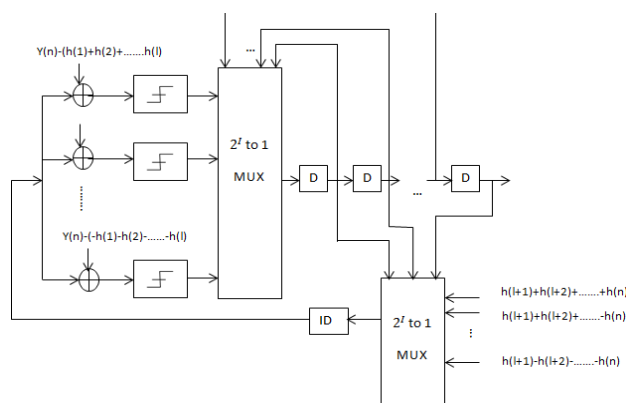


Fig 4. Two stage pre computation FBF structure

MUX SELECT ADDRESS	LUT I CONTENTS
00	$Y(n) + h1 + h2$
01	$Y(n) + h1 - h2$
10	$Y(n) - h1 + h2$
11	$Y(n) - h1 - h2$

Fig 5. Pre computation of first stage coefficients

MUX SELECT ADDRESS	LUT II CONTENTS
00	$h3+h4$
01	$h3-h4$
10	$-h3+h4$
11	$-h3-h4$

Fig 6. Pre computation of second stage coefficients

Table I Comparison Of Hardware Complexities

CELL TYPE	CONVENTIONAL FBF	PRECOMPUTATION FBF
Adders	3	4
Multipliers	4	0
Multiplexers	0	2

From the table I we can observe that there will be no multipliers in precomputation FBF with the penalty of extra adder and multiplexers. FIR filter coefficients are not fixed; it may vary based on the channel noise. Changing LUT contents will change the coefficients value easily. We can change the structure as adaptive one which will change the coefficients value by using Least Mean Square algorithm and updates the LUT contents accordingly.

From the LUT contents we could say that there is symmetry in precomputed values. By using this symmetry of contents we can reduce the LUT size to it's half [2] which will save more area. Fig 7 shows the reduced LUT contents. An additional EXOR gate is required with the multiplexer's select line for the correct detection.

MUX SELECT ADDRESS	LUT II CONTENTS
00,11	$\pm(h3+h4)$
01,10	$\pm(h3-h4)$

Fig 7. Reduced LUT contents.

The symmetry of LUT I contents gets affected by the FFF's output signal. This can be solved by adding the FFF's output externally.

II. FBF WITH DIFFERENT ADDER CONFIGURATIONS

We have designed two stage precomputed FBF with different adders such as ripple carry adder, carry look ahead adder, carry select adder, carry save adder, carry skip adder and carry increment adder which gives a tradeoff among area, power and speed. Feedback loop Speed of FBF was improved by the precomputation approach. By incorporating various adders the speed can be further increased with additional area penalty.

Ripple carry adders can be incorporated when we need small area but the carry propagation from one stage to other stage makes the addition process slow. Carry look ahead logic can be used speed up the addition process. When the order of the filter N is less then we can opt for carry look ahead logic, but for the immense effect of ISI the filter order should be increased. In this case we can use other adders such as carry select adder, carry increment adder and carry save adder. By using the carry select adder, performance of the FBF can be improved. Fig 8 shows the architecture of two bit carry save adder. The next stage sum is calculated in advance by assuming carryin as 1, as well as 0. Based on the result of first stage carry, multiplexers selection will be applied which will speed up the process as basically the multiplexers are faster than adders.

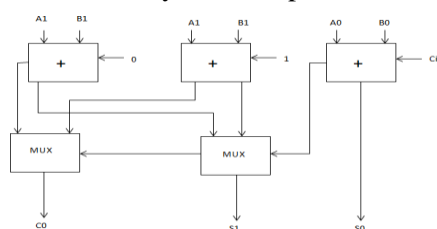


Fig 8. Two bit carry select adder

III. IMPLEMENTATION AND RESULTS

A). FPGA IMPLEMENTATION

FBF with different adder configuration was simulated for FBF order N=8 in Vivado 2017 shown in fig 9. LUT consumption of different structures have been compared shown in table II. Out of which CSEA FBF needs 42 LUTs. Consumption of LUT varies with the FPGA family. We have chosen Artix-7 FPGA with the operating frequency of 100 MHz

TABLE II COMPARISON OF LUT USAGE

STUCTURE	NUMBER OF LUT
RCA - FBF	37
CLA-FBF	34
CIA-FBF	37
CSA-FBF	39
CSEA-FBF	42
CSKA-FBF	41

CIA-FBF and RCA-FBF use less number of LUTs for implementation. If we targeting only on area then we can incorporate these adders in FBF configuration. But for the 5G system we need to consider speed as well.



Fig 9. Simulation results of CSEA FBF

When area of FBF increases which indirectly increases the power needed for the configuration. Hence we need to choose best configuration which gives the trade of between area and speed. As per FPGA implementation CSEA needs more area than other configuration.

B). ASIC IMPLEMENTATION

All FBF structures were synthesized by Cadence RTL compiler in 180nm technology using SCL libraries with the frequency of 100 MHz. CSEA FBF produces less delay among all the adders with the considerable increase in area. Fig 10 shows the delay comparison of all FBF structures.

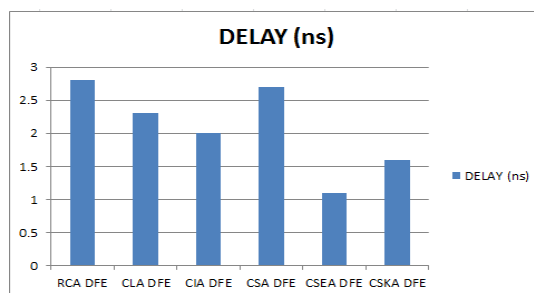


Fig 10. Delay comparisons of different FBF

For 8th order RCA-FBF the maximum critical path delay will be 2.8ns which is more due to the carry propagation stages. But it occupies less area compare to all other configurations. Area required for different implementation is given in fig 11.

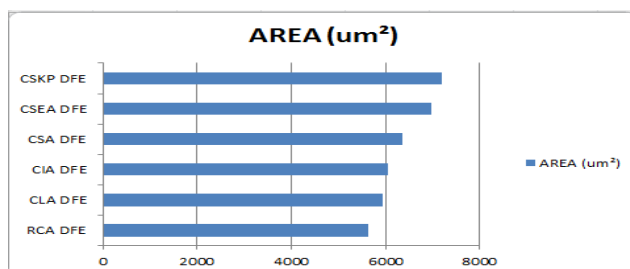


Fig 11. Area comparisons of different FBF

The next important factor in VLSI implantation is power. When area increases the power consumption also more.

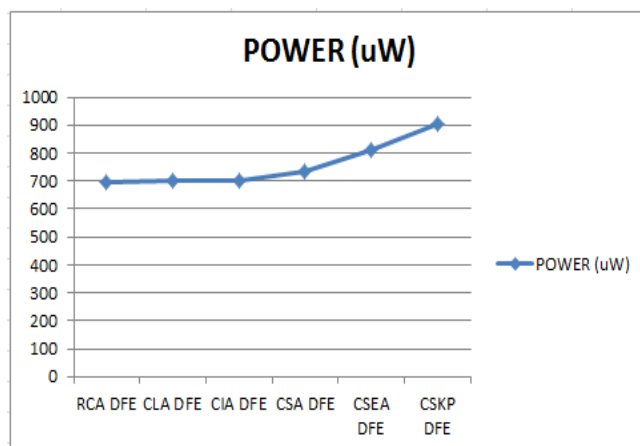


Fig 12. Power consumption of different FBF

Fig 12. gives the power requirements for all configurations. CSA FBF consumes about 800 uW for N=8. Fig 13. gives the tradeoff between area, power and delay.

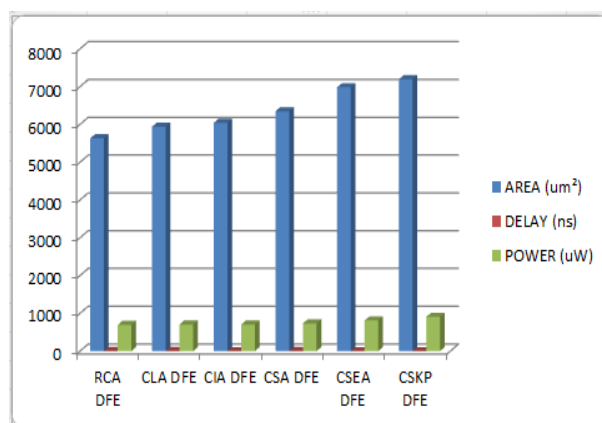


Fig 13. Tradeoff between area, power and delay

We have done the physical design for CSEA FBF which is the fastest configuration among all structures but occupies more area than few other configurations. Fig 14 shows the physical design layout for the implemented CSEA FBF.

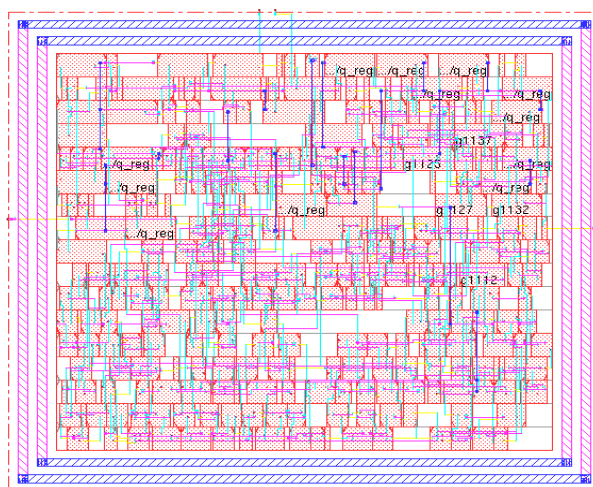


Fig 14. Physical design layout of CSEA FBF.

V. CONCLUSION

FBF with different adder structures were designed with reduced complexity and high speed. Among all structure CSEA FBF produces lesser delay with considerable area penalty. Tradeoff between area, delay and

power has been maintained in CSEA FBF. For 100 MHz frequency CSEA produces 1.1 ns delay in 180 nm technology. For FPGA implementation it requires about 41 LUTs for N=8. We could choose other FBF configuration when we are targeting only on area. DFE performance can be increased by changing the FFF structure by incorporating the same adder configuration. Next to CSEA FBF, CSKA FBF produces the lesser delay. Based on throughput requirement the adder configuration can be chosen. For ISI removal the order of filter N must be increased hence filter operation speed must match with data rate. DFE operation speed can be increased by combining precomputation of coefficient approach which eliminates the multiplier and changing different adder configurations

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Design and Development of Smart Shoes and Accessories for Visually Challenged Personnel

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ABSTRACT

Eyes assume significant job in our everyday lives and are maybe the most important blessing we have. This world is noticeable to us since we are honored with visual perception. Be that as it may, there are a few people who slack this capacity of envisioning these things. Because of this, visually weakened individuals face numerous difficulties while moving in new open places. 285 million individuals are assessed to be outwardly impeded around the world: 39 million are visually impaired and 246 have low vision. Consequently, wearable gadget should structure for such visual debilitated individuals. Brilliant shoes are wearable framework plan to give directional data to outwardly disabled individuals. To give brilliant and reasonable route direction to outwardly disabled individuals, the framework has incredible potential particularly when coordinated with visual preparing units. During the operation, the client should wear the shoes. At the point when sensors will distinguish any snag, client will be educated through Android framework being utilized by the client. The Smart Shoes alongside the application on the Android framework will help the client in moving around freely.

Indexterms: Smart shoe, smart cap, sensors, wearable electronics, visually challenged personnel and self-assistance

INTRODUCTION

The spread of visual impedance is an extremely touchy issue around the world. Outwardly tested individuals are confronting different troubles in their everyday life. Wherever they go they need to run with the assistance of other individual. These incorporate the challenges of moving in entire self-governance and the capacity to look for and perceive objects. Along these lines, we have chosen to comprehend this issue by creating brilliant shoes with sensors for them, which identifies the obstruction present before them and gives criticism by audio output. So by this idea they can go alone without anyone else¹.

Ultra-sonic sensors are used to identify the obstacle present in the environment. Both the shoes are fixed with sensors to identify the obstacle. Each shoe has 3 sensors for detecting obstacles in different directions. The sensors are powered by a compact long lasting battery. The batteries that are used are rechargeable. The output from the sensor is computed by an Arduino board and sent by a wireless transmitter to an audio player which is a receiver. For each and every output from a sensor a corresponding audio is played indicating that the direction in which the obstacle is present².

The sensors present in the shoe detect the objects present at the ground level. So, for detecting objects hanging from above or ceilings, we have used sensors in cap separately to solve this issue. Four sensors are present in the cap for four different directions. The output is in the form of buzzer for cap. This setup is powered separately by a battery. The sensors present in the shoes and cap will guide the visually challenged personnel through the environment by themselves².

I. MATERIALS

1.1 Proximity Sensor

A nearness sensor distinguishes the nearness of items that are almost put with no point of contact. Since there is no contact between the sensors and detected question and absence of mechanical parts, these sensors have long utilitarian life and high dependability. The distinctive sorts of nearness sensors are Inductive Proximity sensors, Capacitive Proximity sensors, Ultrasonic closeness sensors, photoelectric sensors, Hall-impact sensors, and so on³.

1.2 ULTRASONIC SENSOR

Ultrasonic sensor head radiates a ultrasonic wave and gets the wave reflected once again from the objective. An optical sensor utilizes a transmitter and beneficiary, however in ultrasonic sensor utilizes a solitary ultrasonic component for both outflow and gathering. In an intelligent model ultrasonic sensor, it comprises of single oscillator transmits and gets ultrasonic waves on the other hand. This empowers scaling down of the sensor head³.

1.3 INFRARED SENSOR

An infrared sensor measure the IR light that is transmitted in nature to discover questions by an IR LED. This kind of sensor is exceptionally prevalent in route for question shirking, remove estimated or line following applications. This sensor is exceptionally touchy to IR lights and daylight, and this is the principle reason that an IR sensor is utilized with extraordinary exactness in spaces with low light⁴.

1.4 Sonar sensor

The sonar sensor can be utilized fundamentally in route for protest identification, notwithstanding for little questions, and by and large are utilized in undertakings with a major spending plan since this sort of sensor is exceptionally costly. This sensor has superior exhibitions on the ground and in water where it tends to be utilized for submersed mechanical technology ventures⁴.

1.5 Laser sensor

A laser light is extremely helpful for following and recognition an objective situated at a long separation. The separation among sensor and target is estimated by figuring the speed of light and the time since light is transmitted and until the point when it is come back to the beneficiary. A laser sensor is extremely exact in estimation and in a similar time is exceptionally costly⁵.

1.6 Image sensor

Most well-known blend for identification and following a protest or identifying a human face is a webcam and the Open CV vision programming. This blend might be the best in discovery and following applications, yet it is important to have propelled programming abilities and a smaller than expected PC like a Raspberry Pi⁵.

1.7 Lidar Sensor

Lidar utilizes dynamic sensors that supply their very own light source. The vitality source hits objects and the reflected vitality is distinguished and estimated by sensors. Separation to the protest is dictated by account the time among transmitted and backscattered beats and by utilizing the speed of light to compute the separation voyaged.

3-D imaging can be accomplished utilizing both checking and non-examining frameworks. "3-D gated seeing laser radar" is a non-filtering laser running framework that applies a beat laser and a quick gated camera. Research has started for virtual bar controlling utilizing Digital Light Processing (DLP) innovation⁶.

1.8 Buzzer

The piezo ringer produces sound dependent on turnaround of the piezoelectric impact. The age of weight variety or strain by the use of electric potential over a piezoelectric material is the hidden rule. These ringers can be utilized alarm a client of an occasion comparing to an exchanging activity, counter flag or sensor input. They are additionally utilized in alert circuits⁷.

The bell delivers an equivalent loud solid independent of the voltage variety connected to it. It comprises of piezo gems between two conductors. At the point when a potential is connected over these precious stones, they push on one conductor and draw on the other. This, push and force activity, results in a sound wave. Most ringers create sound in the scope of 2 to 4 kHz. The red lead is associated with the Input and the Black lead is associated with Ground. Passive ringers are sound flagging gadgets that deliver sound to show a catch press.

They are of various kinds, for example, piezo ringers that utilization swaying voltage, electromechanical bells that utilization self-motions as in a horn, electro-acoustic ringers that proselyte electrical signs into sound vibrations, and that's only the tip of the iceberg. While picking the perfect bell for your venture, consider the item measure, terminal compose, sound yield, voltage among different components. It signals at sound levels from 80dB to 105dB⁸.

1.9 Arduino Board

Arduino is an open-source stage utilized for structure hardware ventures. Arduino comprises of both a physical programmable circuit board (regularly alluded to as a microcontroller) and a bit of programming, or IDE (Integrated Development Environment) that keeps running on your PC, used to compose and transfer PC code to the physical board.

The Arduino phase has proven to be very popular when people are just starting out with gadgets and given the current circumstances. Unlike most previous programmable circuit boards, the Arduino doesn't need any other equipment (what's called a software engineer) to stack new code on the board that you can simply use via a USB connection. Additionally, the Arduino IDE uses improved C ++ customization that makes programming

easier to understand. Finally, Arduino offers a standard structural factor that splits the smallest controller elements into a progressively open package.

The Arduino board was planned at the Ivrea Interaction Design Institute, which was expected for freshmen without a solid idea of hardware and programming. This board began to adapt to new needs and difficulties, isolating its presence from simple 8-bit scrolling to elements for Internet of Things (IoT) applications, 3D printing, wearables, and installed environments. All sheets are completely open source; Customers can manufacture these on their own and ultimately tailor them to their exact needs. Over the years, Arduino blades have been used to perform a myriad of endeavors, from everyday articles to composite logic instruments. A universal network of authors, artisans, students, software engineers, specialists, and specialists has come together to form this open source organization⁹.

1.10 RF Transceiver

For the most part, a RF module is a little size electronic gadget, that is utilized to transmit or get radio flags between two gadgets. The principle use of RF module is an inserted framework to speak with another gadget remotely. This correspondence might be cultivated through radio recurrence correspondence. For different applications the mechanism of decision is radio recurrence since it needn't bother with line of sight. The utilizations of RF modules primarily include in low volume and medium volume items for purchaser applications like remote alert frameworks, carport entryway openers, keen sensor applications, remote home computerization frameworks and modern remote controls. This article examines about square chart of RF handset module and its applications.

A handset is a mix of a transmitter and a beneficiary in a solitary bundle. The name applies to remote specialized gadgets like cell phones, handheld two-way radios, cordless phone sets, and versatile two-way radios. Now and then the term is utilized in reference to the transmitter or recipient gadgets in optical fiber frameworks or links¹⁰.

1.11 RF receiver

A RF recipient module takes the adjusted RF flag to demodulate it. There are two sorts of RF collector modules, in particular the super-regenerative beneficiaries and super-heterodyne recipients. Typically, super-regenerative modules are low power plans and minimal effort utilizing a progression of speakers to expel adjusted information from a bearer wave. These modules shift, for the most part off base as their task of recurrence fundamentally with power supply voltage and temperature. The fundamental favourable position of Super heterodyne collector modules is an elite over super-regenerative. They offer expanded dependability and exactness over an extensive temperature and voltage extend. This security originates from a steady precious stone structure which thus prompts a moderately increasingly costly item.

RF handset module is utilized in a specific gadget where both the transmitter and beneficiary houses in a solitary module. Such gadgets transmit and get RF flag, so that is named as RF Handset. For the most part the situation of RF Handset module is in the middle of Intensity intensifier/Low Clamor Enhancer and Baseband MODEM in any remote correspondence framework. Baseband Modem houses, chip sets of a few simple or computerized tweak systems and simple to advanced transformation or advanced to simple change chips¹¹.

1.12 DX Mini-player

A minimal effort, barebones MP3 Player module. Plays MP3 music put away in a client provided Micro-SD card. Five arch contact switches gives essential client control: play, skip and come back to a choice, and change the volume control setting. A USB port permits direct mp3 record exchange from a PC¹².

1.13 Speakers

Speakers are one of the most common output devices used with computer systems. Some speakers are designed to work specifically with computers, while others can be hooked up to any type of sound system. Regardless of their design, the purpose of speakers is to produce audio output that can be heard by the listener.

Speakers are transducers that convert electromagnetic waves into sound waves. The speakers get sound contribution from a gadget, for example, a PC or a sound recipient. This info might be either in simple or advanced structure. Simple speakers essentially enhance the simple electromagnetic waves into sound waves. Since sound waves are created in simple structure, advanced speakers should initially change over the computerized contribution to a simple flag; at that point produce the sound waves.

The sound created by speakers is characterized by recurrence and adequacy. The recurrence decides how high or low the pitch of the sound is. For instance, a soprano vocalist's voice creates high recurrence sound waves,

while a bass or kick drum produces sounds in the low recurrence extend. A speaker framework's capacity to precisely duplicate sound frequencies is a decent pointer of how clear the sound will be. Numerous speakers incorporate various speaker cones for various recurrence ranges, which helps produce progressively precise sounds for each range. Two-way speakers regularly have a tweeter and a mid-extend speaker, while three-way speakers have a tweeter, mid-run speaker, and subwoofer¹³.

Amplitude or volume is determined by the change in air pressure created by sound waves from the speakers. So when you turn up the speakers, you are actually increasing the air pressure of the sound waves they create. Since the signal produced by some audio sources is not very loud (such as a computer sound card), it may need to be amplified by the speakers. As a result, most external computer speakers are powered, which means they use electricity to amplify the signal. Speakers that can amplify sound input are often called powered speakers. You can usually tell if a speaker is active by the fact that it has a volume control or that it can be plugged into a power outlet. Speakers without internal amplification are called passive speakers. Since these speakers do not amplify the audio signal, they require a high-level audio input that can be generated by an audio amplifier.

Speakers usually come in pairs, allowing them to produce stereo sound. This means that the left and right speakers transmit audio on two completely separate channels. Using two speakers makes music sound much more natural since our ears are used to hearing sounds from left and right at the same time. Surround sound systems can include four to seven speakers (plus a subwoofer) for an even more realistic experience¹⁴.

1.14 BUZZER

The piezo ringer produces sound dependent on turnaround of the piezoelectric impact. The age of weight variety or strain by the use of electric potential over a piezoelectric material is the hidden rule. These ringers can be utilized alarm a client of an occasion comparing to an exchanging activity, counter flag or sensor input. They are additionally utilized in alert circuits.

Regardless of the voltage variant connected, the hood emits an equivalent strong solid. It is made of piezoelectric gemstones between two conductors. At the point where a potential is placed through these gemstones, they push one ladder and pull the other. This pushing and pulling activity results in a sound wave. Most ringtones produce tones in the 2-4 kHz range..

They are of various kinds, for example, piezo ringers that utilization swaying voltage, electromechanical bells that utilization self-motions as in a horn, electro-acoustic ringers that proselyte electrical signs into sound vibrations, and that's only the tip of the iceberg. While picking the perfect bell for your venture, consider the item measure, terminal compose, sound yield, voltage among different components. It signals at sound levels from 80dB to 105dB¹⁵.

II METHODS

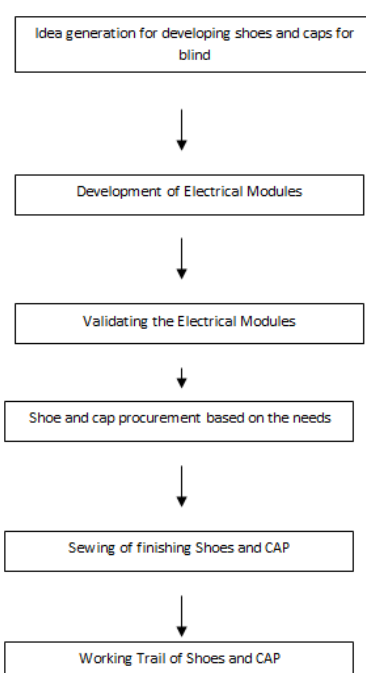


Fig 1 Process Methodology

1.12 Design Development Phase

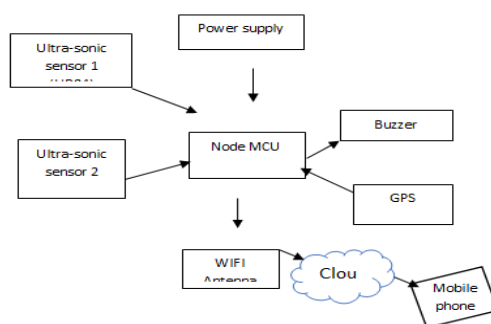


Fig 2 First Phase Block Diagram

2.1 Block Diagram for CAP

The ultra sonic sensor is programmed in such a manner such that when a object comes into that range the it give signal that there is an obstacle. The data is computed in the Node MCU which is powered by a Battery. The output is delivered by buzzer for Cap and the LED light blinks.

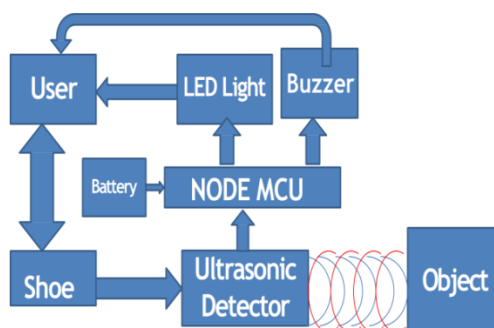


Fig 3 Block diagram for cap

2.2 Block Diagram for Shoe

When the obstacle comes, the sensors give data input to the Arduino-Uno board present in the Shoe and the data is sent to a the Wireless output module carried by the person through wireless transmitter and receiver present in Shoe and Output module respectively where in the output module the data is interpreted by the Arduino Nano board and with the help of DX- Mini Player Corresponding audio is played ("Say left/Right/front if the obstacle is present in Left/Right/Front)by the speaker in the output module.

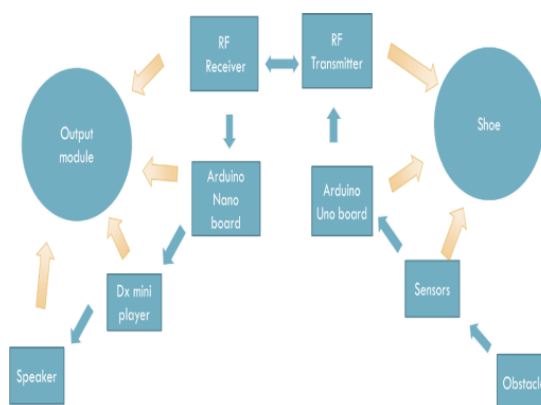


Fig 4 Block diagram for shoe

2.2 Fabric Selection for Shoe

We are utilizing electrical segments it should be secured. We chose single pullover texture for covering the electrical parts. Single pullover texture is simple for covering the shoe because of its stretch-ability yet the cumbersomeness was seen in all respects obviously. So we attempted with rib and result was likewise same as single pullover and finally we tired with Hide Texture. Fur texture conceals the blemishes brought about by the swelling electrical segments superior to some other texture in light of its shagginess. Fur texture builds the stylish appearance of the shoe. It makes the shoe look increasingly elegant and appealing.

Shoes are sourced outside from Hindustan calfskins, Tirupur. Arduino board is put on one side and the power supply board is put in the opposite side. The battery attachment is put in a similar side as power supply board. All the wires are flawlessly held in one spot by join. Sensors are set confronting front left and right bearing.



Fig 5 Fur fabric for shoe



Fig 6 Final Shoe design

2.3 Fabric Selection for Shoe

We chose calfskin texture for covering the electrical segments. The shade of the calfskin texture was picked in order to coordinate with the shade of the cap. It makes the top look increasingly elegant and appealing. We chose to connect the calfskin covering without any difficulty of access. Four sensors are utilized in top.

Four sensors are utilized for 4 distinct headings. All the parts are set over the cap. Sensors are held together by join Battery is likewise kept over the cap. All the wires are disguised by a calfskin texture.



Fig 7 Placement for CAP



Fig 8 Final CAP design

III RESULTS AND DISCUSSION

3.1 Stairs and Holes

We have placed the sensor in front of the shoe for detection of stairs and holes. We have placed the sensor at an inclined angle and programmed a predefined distance. So when the wearer goes to near the hole the distance exceeds the fixed distance and gives an audio output to indicate there is a hole. But the problem here is the ultrasonic waves are reflected when placed at an inclined angle and so the value normally increases than the predefined ones and shows the output as holes. So as to reduce the confusion we have nullified the stairs sensor in both the shoes.

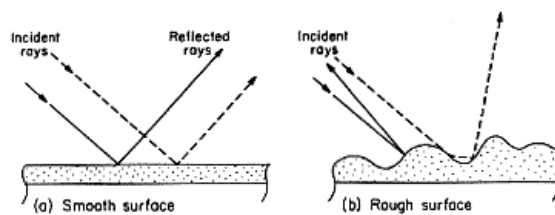


Fig 9 Reflection of Waves

IV CONCLUSION

The project has developed with the smart shoe and finally made it working to help the needy. More sophisticated sensors could be used to make it more accurate and helps them to detect the holes and stairs also. To give brilliant and reasonable route direction to outwardly disabled individuals, the framework has incredible potential particularly when coordinated with visual preparing units. During the operation, the client should wear the shoes. At the point when sensors will distinguish any snag, client will be educated through Android framework being utilized by the client. The Smart Shoes alongside the application on the Android framework will help the client in moving around freely.

V FUTURE SCOPE OF THE PROJECT

Since the cost of those sensors are pretty high and don't have sufficient funding to invest in this project, but if it is available the project could be extended to a successful completely working commercial product with service facilities at lowest cost as much as possible.

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Sustainability in Construction Industry - The Bamboo Potential

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ABSTRACT

The construction industry has long resulted in damage to the environment both during construction and demolition. There is hardly any regulation or policy to regulate the damage caused during and after the construction process. Most construction research focuses on other factors and leaves out sustainability as a distant second in priority. Both steel and cement are the major offenders when it comes to usage of natural resources. The bamboo perfectly fits in here as both a low cost construction material and rural livelihood provider at the same time. Being a hardy plant species, this solution is easy to put into action.

Keywords: Bamboo, construction, concrete, steel, sustainability, carbon dioxide, oxygen, rural economy, pollution, recycling

Damage Caused By Construction

Most research focuses on damage caused to buildings and other infrastructure constructions. Very few study the damage caused by the constructions on the environment and natural resources. Aigbavboa (2017) has listed out the damage caused by the construction industry in South Africa. He mentions wastes generated during the construction process, intensive use of energy, huge usage of water, and general damage to air, water and soil. One of the major causes of rise in construction activity is the increase in population exponentially due to reduced mortality due to better medical facilities, better nutrition and increased health awareness across the globe. Added to this, the major driver of economic growth has always been related to a growth in the construction industry, be it housing, infrastructure, schools, research institutions and anything in general related to buildings. While this is a positive development, it has had a huge backlash in terms of unsustainable growth in construction activity across the world with very little concern of awareness about sustainability norms and designs in construction. The governments too seem more preoccupied with the current economic growth and do not dedicate much time or efforts towards judging the environmental impact of the ventures and the general depleting effect it has on supplies of water, steel and landscape. Sustainable construction is not given a high priority in policy making circles. Mehra et al(2022) have elaborated the damage in more detail. They mention diminishing of resources, increased carbon dioxide emissions, and a predominant focus on steel and cement industries. They go on to propose a link between the construction and related industries with tsunamis, floods, bushfires, general sea level rise, depletion of the ozone layer and also the contamination of soil leading to destruction of soil life. Steel contributes to emission of carbon dioxide in the manufacturing process, transporting process. Same is the case with cement as well. Iron and steel is the biggest energy consumer in the world and a bulk of this industry supplies the construction industry. Abyareh et al (2019) mention the specific damage caused by the steel industry. Their list includes soil contamination, a bulk of which happens to be heavy metals. Conejo et al (2020) have pointed out the role of steel plants in generation of huge amounts of waste water which is rarely recycled for other productive uses. Not to mention the huge mining costs and associated damage to the environment by creating deep holes, damaged soil due to heavy machine usage, and all extraction related losses. Bao et al (2020) mention that recycling construction waste is a huge problem and they are best processed in situ. This is rarely done as government support is not forthcoming and recycling equipment is also not available at hand. This leads to further polluting the environment as this waste has to be sent to a landfill. The value chain of construction therefore is ending in a blind alley without much analysis of the final consequences of demolition waste disposal. Its a linear supply chain that does not replenish the raw materials and nor does it get the finished product disposal back into the economy and as such is an unsustainable process.

Jain et al (2020) suggest that recycling is a better option as regards sustainability when compared to sending the debris to the landfill.

Jain et al (2021) guess that the construction and demolition wastes account for 2-8% of natural resources used in the construction industry and hence need to be recycled. But the whole problem is the lack of a proper recycling technology for construction demolition wastes. And surprisingly the contribution of rural areas to this waste outweighs the urban waste generated due to the sheer size of the area under consideration.

Ramanathan and Ram (2020) note that since construction and demolition wastes are less hazardous when compared to other industries, they have been overlooked, leading to lack of standards for dumping and

management of recycling initiatives. Added to this the estimates of this waste is not accurate enough to take appropriate action. The major method of dealing with these wastes is to reduce the size, recover the aggregates and create recycled products like paver blocks, ready mix concrete and other precast products. Makegaonkar and Dange (2018) proposes that 60% of the construction and demolition wastes can be recycled. But this leaves out 40% of the generated wastes causing a huge stress on the ecosystem. The above discussions lead us to propose that

H1: Current construction materials are not designed for easy recycling or reuse. The materials need additional investment to turn it into a usable form and that too only a fraction of the total wastes.

H2: A drastic rethink is needed on the kind of materials used for construction if the construction and demolition wastes are to be recycled in an eco-friendly manner.

Bamboo the Emerging hero

The construction industry was looking for a structural material that is strong, durable, natural and recyclable. This is where the humble bamboo comes in. There are over 1,500 species of the bamboo that grow in virtually every kind of climate on earth. Out of these a few giant species belonging to the *Dendrocalamus* genus have the right size, strength, hardness and flexibility to be used in the construction industry as a substitute for steel (Goh et al, 2019). This is a renewable grass variety which grows very fast, uses very little natural resources, can grow in degraded soils well and serves to create good, lasting construction, especially in rural areas. Bamboo has been traditionally used for construction in many south and south eastern countries to make houses, some of which are even earthquake resistant. These involve a very lightweight frame that is easy and quick to put together into any construction. Bamboo has a strength on par with steel and density that is one sixth that of steel, giving a very light weight powerhouse for construction. This also results in another popular construction related use, the scaffolding. Considering south and south east asia, India has the largest area under bamboo accounting for 54.9% of the total bamboo cultivated areas when compared to other countries as at 2005. Though a large area does come under bamboo growth, construction specific bamboo is not much studied. And each species of the Bamboo is used to serve a different application. Nine species are mentioned as construction worthy, namely *Bambusa Oldhamii*, *Bambusa Lako*, *Dendrocalamus Asper*, *Dendrocalamus Brandisii*, *Dendrocalamus Yunnanicus*, *Gigantochloa Apus*, *Gigantochloa Atter* and *Gigantochloa Pseudoarundinacea*.

Bamboo cannot be used for construction without proper treatment as it is susceptible to fungal attack and rot. Seytiyowati and Mappaturi (2020) mention both natural and chemical treatment methods to extend the shelf life for bamboo construction structures. Chin (2021) talks of bamboo as a replacement for concrete itself.

Bamboo in construction can be used in foundation, roofing with bamboo tiles, trusses in large buildings, walls, doors, windows, water piping, flooring and ceilings. Due to its lightweight, a 1,00 foot scaffolding can be put together within a day (Goh et al, 2019). They also note that the energy to produce steel is around 234,000 kg/cu m and concrete is 1920 kg/cu m while that of bamboo is just 300 kg/cu m.

Bamboo however, to last long needs to be rid of the sugar and carbohydrates that it has and also the moisture it contains. Traditional methods for achieving this involve soaking, smoking, clump curing, white washing and plastering. Chemical treatment involves use of Boron, borax and boric acid These are safe and eco friendly chemicals that preserve the bamboo poles for a long time. (Goh et al, 2019)

Some hybrid models use bamboo instead of steel to reinforce concrete. The resultant structure is just as durable as the concrete reinforced with steel. (Kumar et al, 2021). This still reduces the energy needed to make steel, which means the freed up energy could be used for other purposes.

Bamboo composites can be used in any kind of building. (Yadav and Mathur, 2021). Developing countries have a greater use for bamboo as a construction material. They mostly combine bamboo with other materials like mud to build their houses. This has given bamboo the nickname - Poor man's timber. (Atamewan, 2020). It is also possible to build a multi level bamboo house that is also long lasting. (Kordea et al, 2018)

Added to this Bamboo also absorbs maximum carbon dioxide and releases more oxygen than comparable size trees. It also improves soil structure and provides both green and dry fodder to animals as well. Hence both during growth and after harvest as well, the humble bamboo is working towards a sustainable environment (Ramakrishnan et al, 2018). This leads us to propose the following

H3: Bamboo is a well worthy replacement for steel in the construction industry. It can also do away with cement if an appropriate binder is used.

Costs and Farming Income

Bamboo construction costs just a fraction of what a conventional steel and cement structure would cost and yet maintains the same durability (Harison et al, 2017). Prefabricated panels for walls and other structures made using bamboo are also equally durable and super light for construction (Puri et al, 2017). In addition to providing low cost building materials for the construction sector, especially the rural ones, bamboo is also a source of livelihood for rural folk, as this plant grows even in degraded and sandy soil conditions. This has a direct impact on the GDP of the nation and also opens up a low cost option to develop wastelands with nation building materials (Manandhar et al, 2019). In earthquake prone areas a traditional bamboo housing called wattle and daub has been used for ages, and these structures have withstood earthquakes for many hundreds of years. This has inspired the modern mind to use the bamboo concept to create earthquake proof housing. (Vengala and Rao, 2020). This leads us to the following hypothesis

H4: Bamboo provides the twin benefits of a good renewable construction material and rural economy booster benefits

CONCLUSION

The construction industry, which is usually the biggest industry in any economy, is also usually the most unsustainable, with hardly any regulation on which resource it impacts, which habitat it pollutes and which landfill it goes to after it is demolished. Added to this it consumes the maximum energy and water resources available and is rarely audited for sustainability. This necessitates the need for an alternate sustainable, renewable and cheap building material. Bamboo fits the billing perfectly and also serves to improve rural prosperity and water conservation initiatives in one stroke.

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Mitigating Problem of Non- Performing Assets in Indian Banking Industry

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ABSTRACT

Non -Performing Assets (NPAs) in Indian banks has persisted since long despite several policy measures taken by GoI and RBI during the past two decades to contain the problem. Even Insolvency and Bankruptcy code enacted in 2016 flunked so much so that present level of NPAs in Indian banks remains much higher compared to developed country standard of 2 percent.

Under the circumstances, strategic approach need to be pursued by individual banks to mitigate present level of NPAs in their loan portfolio on sustained basis. This approach has to be multi-pronged necessitating varied strategies suited to different stages of credit policy of the bank.

Every bank should draw strategic plan to prevent occurrence of NPAs and stoppage of healthy accounts into bad loans. Clear cut policy guidelines regarding credit appraisal, sanction of loan, disbursement and monitoring need to be laid down with focus on in-depth evaluation of health and repaying capacity of the applicant.

To execute the above plan, present structure of the bank must be revamped to make it lean, flat and responsive rife with suitably skilled and experienced employees possessing right kind of aptitudes.

Objective of the present paper is to discern forces responsible for perennial problem of NPAs in Indian banks and analyze the lurking trends thereof in the light of Government of India and RBI policy measures.

Keywords: Bad loan, Debt Recovery Tribunals, Insolvency and Bankruptcy Code, Performing Culture, Prudential Accounting norms, Sticky Loan, Strategic plan.

INTRODUCTION

Non-Performing Advances (NPAs), an integral part of a bank's operations, stem from non-repayment of loan by a borrower. The level of NPAs is recognized as a crucial indicator for assessing a bank's credit risk and asset quality and its efficiency in allocation of resources to productive sectors. This is for the fact that NPAs adversely affect lending activity of a bank as non-recovery of loan instalments and also interest thereon negates effectiveness of credit dispensation process and hurts the bank's profitability. A bank having a high level of NPAs has to carry more owned funds by way of capital and create reserves and provisions to provide cushion for loan losses. It saps vitality of the bank, making it fragile leading to its failure.

Cases of banks' failure around the world mainly owing to accumulation of problem loan over a period of time have been galore during the last few decades, prominent among these being American Savings and loan crisis in 1980s, the Nordic banking crisis at the beginning of 1990s, banking sector problems in Japan and Turkey and in 2008 sub-prime crisis in the USA. As a result, managing bad loans and keeping them at the lowest possible level has become a keyword for the banking industry all over the globe. It may not be out of place to note that world class banks do not have NPAs of over 2 percent of their total loan portfolios.

Problem of NPAs in Indian banking industry has been perennial in as much as it existed before the onset of economic reforms. According to RBI study, the proportion of problem loans (sticky loans) of public sector banks (PSBs) to their gross advances stood at 17.91% as on March 31, 1989. Introduction of Prudential Accounting Norms in 1991 changed an era of taking profits (even unrealized) to providing for expected loss. Days of 'counting the chickens before the eggs hatch' came to an end. This led to surge in NPAs to 23.5% as on March end, 1994.

Why problem of NPAs has been in existence in Indian banking industry since long is of topical issue to be addressed perspicaciously.

Objectives of Study

- To discern forces responsible for the prolonged NPAs crisis.
- To undertake trend analysis of NPAs during two decades in the light of GoI and RBI policy measures.
- To proffer strategic solutions to mitigate problems of NPAs.

Methodology of Study

The study is based on secondary data gathered from publications of RBI, SBI, Economic Times, Business Standard and Business Times and then analysis has been done to draw relevant inferences.

Trend Analysis of NPAs in Scheduled Banks of India

Let us now winnow trend of NPAs of scheduled banks in India and assess the impact of the above policy measures thereon.

Table 1: NPAs of Scheduled Banks in India

Year	Gross NPAs % of gross advances	Net NPAs % of net advances
1997-98	15.7	8.1
2008-09	2.2	1.1
2013-14	3.8	2.1
2019-20	8.2	2.8
2020-21	7.3	2.4

It may be noted from Table 1 that gross NPAs of the banks constituted 15.7 % of total gross advances and net NPAs 8.1 % in 1997-98. It is interesting to observe that proportion of gross NPAs nosedived to 2.2% after over ten years in 2008-09 and that of net NPAs to 1.1%. This sharp decline could be attributed to the above regulatory measures. However, percentage share of both gross and net NPAs surged uninterruptedly to 8.2% and 2.8% respectively mainly due to laxity in implementing the policies.

In 2020-21, gross NPAs as percentage of gross advances declined to 7.3% and net NPAs to 2.4%. The decline in NPAs should not be considered as improvement in financial health of the banks. In fact, the RBI's decision to put off recognizing bad loans and to allow restructuring of loans contributed to this decrease.

Comparative analysis of NPAs of different categories of banks (Table 2) posits that

Table 2: NPAs of different categories of Banks

Year	% of Gross NPAs to Total Advances	% of Net NPAs to Total Advances
PSBs		
1997-98	17.8	9.2
2008-09	2.8	0.9
2013-14	4.4	2.6
2019-20	10.3	3.7
2020-21	9.1	3.9
PVBs		
1997-98	10.7	6.6
2008-09	3.0	1.4
2013-14	1.8	0.7
2019-20	5.5	1.5
2020-21	4.9	1.4
Foreign Banks		
1997-98	4.3	1.9
2008-09	3.8	1.8
2013-14	3.9	1.4
2019-20	2.3	0.5
2020-21	3.6	0.7

NPAs (both gross and net) have been much higher in PSBs compared to PVBs and Foreign Banks throughout the period. Plausible reasons for this could be relatively greater thrust of

PVBs and Foreign Banks on operational efficiency, more flexible structure, higher accountability of employees, better human resource policies and existence of performing culture.

Most intriguing fact is that even IBC flunked in containing the spurt in the NPAs. According to Crisil (domestic rating agency) -IBC's performance against its twin objectives; maximization of recovery and time bound resolution, has been a mixed bag. The Agency expressed concern over low recoveries of about 5 % in recent

high value cases while average resolution time was 419 days compared to the stipulated maximum of 330 days in 2021.

FINDINGS

The existence of problem of NPAs in Indian banking industry can be attributed to internal and external factors. Among the internal factors, the most important one has been project appraisal deficiencies regarding technical feasibility, economic vitality, and project management deficiencies in respect of implementation, production, labor, marketing, financial and administrative matters. Ineffective credit monitoring and follow-up mechanism of banks further contributed to slippage of standard loans into bad loans. Weak collection machinery in most of the banks led to spurt in level of NPAs. Erstwhile culture of Indian banks in respect of permitting excess or irregular drawings to some extent even during the processing stage and ever greening so as to avoid slippage of loans account into NPAs also contributed to poor quality of loans and NPAs. The wide prevalent practice among Indian banks, until the intervention of RBI, of providing working capital facility subject to annual renewal with or without enhancement has also been responsible for persistently high level of NPAs.

Among external factors responsible for the bulging of NPAs, was the 'euphoria' generated following liberalization, a dream of globalization leading to huge investments, which unfortunately could not be utilized due to hesitant liberalization policies. Dominance of traditional industries in credit portfolios, industrial sickness, labor problems and the overall economic slowdown adversely affected the bottom line of borrowable units and their capacity to service the debt leading to slippage of standard assets into NPAs. Other factors, according to RBI study, which fuelled problem of NPAs, included non-availability of raw materials, power-shortage, transport bottlenecks, financial bottlenecks, frequent changes in GOI policy, increase in overhead costs, market saturation, product obsolescence, and fall in demand. Inefficient legal system and regulatory framework further aggravated the problem of NPAs in banks.

Policy Measures by GOI and RBI

Taking cognizance of menacingly high level of NPAs in loan portfolios of Indian banks and inaptitude of the Central management to handle the problem, GoI and RBI undertook the following measures:

- Enactment of the Recovery of Debts, 1993, subsequently amended in 2000 to establish Recovery Tribunals (DRTS) for expeditious adjudicative and recovery of dues and other related issues.
- One time settlement of compromise scheme through Lok Adalat, 1999.
- Establishment of Credit Information Bureau Ltd. (CIBIL), 2001, mandating banks to go for parallel reporting of data on suit filed accounts to RBI and CIBIL.
- Securitisation and Reconstruction of Financial Assets and Enforcement of security in interest (SARFAESI) Act, 2002 to provide for realization of dues without the intervention of courts or tribunals.
- Setting up of a working group in 2004 to improve the functioning of DRTS.
- Insolvency and Bankruptcy Code (IBC) in 2016 to empower creditors to collect dues from debtors.
- National Asset Reconstruction Company Ltd., 2021 to acquire non-performing loans from banks.
- India Debt Reconstruction Company Ltd., 2021 to provide resolutions of these assets.
- Establishment of State-sponsored bad bank, 2022 to dress up banks' balance sheets.

SUGGESTIONS

Since NPAs in Indian banks is much higher than those developed country standard of around 2 %, it would be germane for individual banks to pursue strategic approach so as to mitigate their NPAs problem. This approach need to be multi - pronged necessitating varied strategies suited to different stages of credit policy of the bank. Thus, every bank has to embark upon strategic plan to prevent occurrence of the NPAs and stoppage of healthy accounts into bad loans. This calls for crystal clear policy guidelines with respect to credit appraisal and monitoring on the one hand, and streamlining credit assessment and supervision procedures and strengthening the appraisal and monitoring cell, on the other.

The existing credit evaluation process is not adequate and the staff handling the process is not endowed with required skills and expertise. Hence, it is imperative to bring about radical change in credit evaluation system to ensure an in-depth appraisal focused on risks inherent in the proposal and determine credit rating of the potential borrower. Based on financial statements and their in-depth assessment and physical checking of stocks the bank should develop suitable model to evaluate health and repaying capacity of the applicant.

Serious attention has to be accorded to monitoring of the loans sanctioned by the bank in view of the fact that most bad loans have occurred due to poor credit monitoring. As such, comprehensive mechanism to maintain robust loan portfolio has to be developed which will lay emphasis on early detection of all signals pertaining to the health of the borrower and fast initiation of action upon warning signals to contain damage.

In order to improve quality of the existing portfolio and sustain it, it would be pertinent for the management to have a long-term view of each component in the loan portfolio, taking into account industry scenario and competitive position of the potential borrower.

In order to ensure and personalized appraisal and monitoring speedy recovery of dues, present structure of banks need to be revamped to make it lean, flat and responsive rife with suitably skilled and experienced employees possessing right kind of aptitudes. These employees with clearly defined responsibilities has to be empowered in true sense to discharge their duties objectively. The most important is to fix accountability of those engaged in tasks credit appraisal, sanctioning and disbursement of loans, monitoring of loan accounts and recovery of the dues. These functionaries should be communicated about this well in advance.

CONCLUSION

Managing bad loans and keeping them at the lowest level has become key word for banking industry around the world. NPAs in Indian Commercial banks have been in existence since long mainly due to both external and internal forces. During period of two decades GoI and RBI undertook myriad of policy measures. However, level of NPAs in Indian banks is still much higher compared to these banks in developed countries. As such, strategic approach need to be pursued by individual banks to mitigate level of NPAs in their loan portfolio on sustained basis.

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A Study on the Work Life Conflict and Job Satisfaction of School Teachers in Mumbai

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ABSTRACT

The study intends to know the causes of workplace conflict as well as the job satisfaction of Mumbai school teachers.. The worlds future is carved in the hands of the teachers who are at school. So this study analyses the school teachers job satisfaction level of the aspects of their work and their life. A sample of 100 teachers across Mumbai was taken for the study. A structured questionnaire was given to the respondents to assess and understand their personal and academic related, work life conflicting factors. The questionnaire was filled by the school teachers who were teaching in Primary, Secondary and Higher Secondary Schools in various schools in the city of Mumbai. The Survey was collected by designing the Questionnaire in a google form and circulating in Facebook, Telegram, WhatsApp Group of the teachers in school. The study indicates that there is significant impact of Work Life conflict of the school teachers on their Job Satisfaction. There is no considerable difference among the Satisfaction level for school teachers across their gender. It is higher for the respondents working in aided schools, also it is higher for the respondents teaching in the Secondary section and also for those who hold a permanent job. But the level of satisfaction is similar for both, male and female school teachers.

Keywords: Work Life Conflict, School Teacher, Job Satisfaction

INTRODUCTION

There are over 250 million school going students, more than any other country. In the city of Mumbai, there are 3916 schools. School is the world's largest learning temple, and it plays a critical role in shaping children's minds as nation builders. Understanding their position as nurturers of intellectual minds, school teachers' work-life balance and stress is a major concern. Teachers today are all under a lot of pressure. Approximately 73 percent of teachers have stated that their jobs are stressful. They are physically and emotionally exhausted from their schoolwork, and they are further depleted by the work projects that must be performed at home. Work and family conflicts arise when an individual's demands are incompatible. This imbalance disrupts the harmonious balance of work and life. In the long run, a teacher who is unable to create a balance between job and personal affairs will become burned out. The constant work-life conflict has caused job discontent among the teaching profession.

.Objectives of the study:-

1. To examine the effect of work life conflict of the school teachers
2. To study the level of job satisfaction of school teachers.
3. To offer suggestions and remedies for better management of work life

Hypothesis

1. There is no significant relationship between work life conflict and demographic variables
2. There is no significant relationship between job satisfaction and work life conflict.

REVIEW OF LITERATURE

Ahamed (1997)¹ "Increased social support obtained from husbands tended to lessen work-family conflict in women, according to the study".

Corlson and Perrewe (1999) A total of 403 people from a state government department in the southeast took part in the study, which looked at the impact of social support in work-family conflict. Their findings showed that when there is a work-family dispute, when both the partners are working support of the partner to each other reduces the work life conflict

Aryee et al.(1999) "Family-work conflict was negatively connected to job satisfaction among Chinese employed parents in dual-earner families in the study"

Howard et al. (2004) "Work-family conflict and employee job satisfaction among police officers in a large south-eastern state in the United States are investigated. According to the findings, when an employee has a conflict between work and family, satisfaction with the job in general and the actual work suffers the most".

Karimi et al. (2012) "This study tries to analyse the conflict on Iranian female teachers was carried out. Their primary goal was to investigate the relationship between work/family conflict and satisfaction, which included job satisfaction, family satisfaction, and life satisfaction. The study included 166 Iranian married female teachers from 40 schools in Iran's Kurdistan province. A job satisfaction scale as well as a family satisfaction scale were used. There was negative significant relationship between work family conflict measure the job satisfaction and family satisfaction.

METHODOLOGY

Data Analysis:

Primary information regarding the research on "Study on the Work life Conflict and Job Satisfaction of School teachers in Mumbai" is The data was collected by using a questionnaire. There are total 110 respondents, considered for the primary data. The data information which is collected. The Questionnaire is tabulated below.

The analysis of the Demographic factors.

The primary data relevant to the study consists of demographic factors such as Gender, Type of Institution, present stream of teaching, Marital status and Job Status of the respondents. For further investigation, Demographic information on these 110 respondents is as follows:

Demographics		Frequency	Percent
Gender	Male	18	16.4
	Female	92	83.6
Type of Institution	Aided	51	46.4
	Unaided	59	53.6
Stream of teaching	Primary	23	20.9
	Secondary	71	64.5
	Higher Secondary	16	14.5
Marital Status	Married	93	84.5
	Unmarried	17	15.5
Job Status	Permanent	87	79.1
	Temporary	18	16.4
	Ad hoc/Contract	5	4.5

The above table indicates that out of 110 respondents, 18 are male while 92 are female respondents. Among these, 51 teach in aided schools, while 59 teach in unaided schools. 23 respondents teach to Primary section, 71 teach the Secondary section and 16 respondents teach the Higher Secondary section. 93 respondents are married, while 17 are unmarried. 87 respondents have a permanent job, 18 are temporary and 5 respondents work on Ad hoc/Contract basis.

WORK LIFE CONFLICT

Information related to Work Life Conflict of the respondents is captured from the question 7 of the Questionnaire. Using appropriate rating the mean score for Work Life Conflict is calculated and presented in the following table:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Work Life Conflict	110	36	100	71.78	14.638
Valid N (listwise)	110				

The Table mentioned above shows that the Mean score for Work Life Conflict is 71.78 percent Standard Deviation is 14.63.

JOB SATISFACTION

Information related to Job Satisfaction of the respondents is captured from the question 8 of the Questionnaire. The mean score for Job Satisfaction is calculated and presented in the following table:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Job Satisfaction	110	35	100	75.36	15.734
Valid N (listwise)	110				

The above table indicates that the Mean score for Job Satisfaction of respondents is 75.36 percent. Corresponding Standard Deviation is 15.73, suggesting that there is high differences in the responses.

Cronbach's alpha test

In this study, the Cronbach Alpha test is used to validate the scale for all 110 respondents. Work Life Conflict and Job Satisfaction have Cronbach Alpha values of 0.728 and 0.797, respectively, for both variables under consideration. It exceeds the required value of 0.700. As a result, the test is approved. The conclusion is that the scale is reliable and widely accepted.

HYPOTHESIS TESTING

Objective:

To study the Impact of Work Conflict of the respondents on their Job Satisfaction.

To investigate the aforementioned objective, the following hypothesis is developed and tested for statistical significance..

Null Hypothesis H₀₁: There is no significant impact of Work Life conflict of the school teachers on their Job Satisfaction.

Alternate Hypothesis H₁₁: There is a significant impact of Work Life conflict of the school teachers on their Job Satisfaction.

Null hypothesis is tested by using the Pearson Correlation is calculated and tested for its significance. The results are shown in the below table:

Correlations			
		Work Life Conflict	Job Satisfaction
Work Life Conflict	Pearson Correlation	1	-.318**
	p-value		.001
	N	110	110
Job Satisfaction	Pearson Correlation	-.318**	1
	p-value	.001	
	N	110	110

** . Correlation is significant at the 0.01 level (2-tailed).

INTERPRETATION

The above table shows that the calculated Pearson correlation coefficient between Job Satisfaction of school teachers and their Work Life Conflict is -0.318. The calculated p-value is 0.001. This is less than 0.05. Therefore, the test is rejected. Hence Null hypothesis is rejected and Alternate hypothesis is accepted.

CONCLUSION:

There is a significant impact of Work Life conflict of the school teachers on their Job Satisfaction.

FINDING

There is a significant negative relationship between 'Work Life Conflict' and 'Job Satisfaction' of teachers. The p-value suggests that, as the Work Life conflict of the respondents increases, there is a certain significant decrease in their Job Satisfaction.

Further, using Friedman's test the mean ranks for the variable Work Life Conflict are calculated and the p-value is obtained. The p-value is 0.000, hence it is concluded that "Covid times has been a challenging time in the field of education" is the most important factor of Work Life Conflict, while "Job stress makes it difficult to fulfil family obligations" is the least important factor for the same.

Similarly, using Friedman's test the mean ranks for the variable Job Satisfaction are calculated and the p-value is obtained. The p-value is 0.000, hence it is concluded that "I am happy to accept responsibilities allotted to me by the institution" is the most important factor of Job Satisfaction, while "I am paid remuneration according to my qualification and experience" is the least important factor for the same.

Objective 2: To study the level of Job Satisfaction according to the demographic factors.

To investigate the aforementioned objective, the following hypothesis is developed and tested for statistical significance..

Null Hypothesis H₀₂: There is no significant difference in the level of Job Satisfaction for school teachers across their Gender, type of institution, stream of teaching and Job status.

Alternate Hypothesis H₁₂: There is a significant difference in the level of Job Satisfaction for school teachers across their Gender, type of institution, stream of teaching and Job status.

Null Hypothesis is tested by using ANOVA is used and F-test is applied. Results are shown in the table below:

ANOVA results for Job Satisfaction		
Demographic factor	p-value	Result
Gender	0.076	Not Significant
Type of institution	0.000	Significant
Stream of teaching	0.021	Significant
Job Status	0.000	Significant

INTERPRETATION

The table shows that the p-values of all demographic factors in the ANOVA for Job Satisfaction are less than 0.05 except for Gender. Therefore, F test is rejected for all demographics factors except for Gender. Hence Null hypothesis is rejected and Alternate hypothesis. The Hypothesis is accepted for all demographic factors except for Gender.

CONCLUSION

There is a significant difference in the Satisfaction level for school teachers across their type of institution, stream of teaching and Job status. We find no significant difference in the Satisfaction level for school teachers across their gender. It is higher for the respondents working in aided schools, also it is higher for the respondents teaching in the Secondary section and also for those who hold a permanent job. But the level of satisfaction is similar for both, male and female school teachers. This is represented in the table below.

Report			
Job Satisfaction			
Q2. Gender	Mean	N	Std. Deviation
Male	81.39	18	16.432
Female	74.18	92	15.412
Total	75.36	110	15.734

The above table indicates that the mean score of Job Satisfaction is highest at 81.39 percent for male teachers, while it is lowest at 74.18 percent for the female teachers. The Difference is not significant according to the F test. Thus, it implies that male and female respondents have similar level of Job satisfaction .

Job Satisfaction			
Q3. Type of Institution	Mean	N	Std. Deviation
Aided	82.45	51	10.553
Unaided	69.24	59	16.938
Total	75.36	110	15.734

The table shows that the mean score of Job Satisfaction found is highest at 82.45 percent for teachers working in Aided schools, and lowest at 69.24 percent for the teachers working in Unaided schools. Thus, it implies that the teachers working in Aided schools have higher level of Job satisfaction.

Job Satisfaction			
Q4 What is present stream of teaching?	Mean	N	Std. Deviation
Primary	70.87	23	13.706
Secondary	78.38	71	14.136
Higher Secondary	68.44	16	21.581
Total	75.36	110	15.734

The above table indicates that the mean score of Job Satisfaction is highest at 78.38 percent for teachers teaching the Secondary sections, while it is lowest at 68.44 percent for the teachers teaching the Higher Secondary sections. Thus, it implies that the teachers teaching Secondary sections have higher level of Job satisfaction .

Report			
Job Satisfaction			
Q6 Job Status	Mean	N	Std. Deviation
Permanent	78.28	87	14.504
Temporary	66.11	18	15.297
Ad hoc/Contract	58.00	5	16.808
Total	75.36	110	15.734

The mean score of Job Satisfaction is highest at 78.28 percent for teachers having a permanent job, and low at 58.00 percent for the teachers working on Ad hoc/Contract basis. Thus, it implies that the teachers having permanent job have higher level of Job satisfaction .

Findings and Recommendations

The data analysis reveals a significant inverse relationship between work-life conflict and job satisfaction among primary, secondary, and higher secondary school teachers. A negative relationship indicates that as work-life conflict increases, job satisfaction decreases. It is suggested that educational institutions learn about the causes of work-life conflict and try to control them. The relationship between these two also suggests that, as a result of the increase in work-life conflict, school teachers will be more satisfied with their jobs. Work-life conflict is observed to increase in covid times, according to the study. It has been a difficult period in the field of education. There was a sudden shift in the method of knowledge delivery, and no training in online teaching was provided. They are teaching from home with limited access to technology, and infrastructure cause a high level of work-life conflict. During the study of job satisfaction, there is no significant difference in male and female teachers' satisfaction. Analysis of data indicates that job satisfaction for teachers belongs to aided Institute is significantly higher than teachers belonging to aided institutions. The job satisfaction level is highest for secondary teachers, and satisfaction is lesser for primary and Higher Secondary teachers. It is recommended that Educational Institute main understand other reasons of the decline of job satisfaction of primary and higher secondary teachers and accordingly decide policies to improve satisfaction level.

LIMITATIONS

The study is confined to the perception of work life conflict and the satisfaction level of the school teachers. These two variable are only taken in this study. We acknowledge several limitations. The sampling method used is convenient sampling on online platform which basically depends on the interpretation and the understanding of the respondents. The study is restricted to only the city of Mumbai.

CONCLUSION

There is a need for restructuring of the policies related to School teachers for managing of the work life conflict and having increased job satisfaction. An open deliberation is needed with the management. Private schools are not greatly monitored by the Government. Their salary structure, Work Load, Training and Research related areas need a serious consideration.. Unnecessary Administrative work has kept them more involved at work and this hampers their family life. Digital learning which is the need of the hour for every teacher, proper training and infrastructure set up is required to be given to every teacher to help them overcome the problems in the remote learning era.

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