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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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Diversification of Business during Covid: A Case Study of Bhagyashree Brass Band

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ABSTRACT

“Change is the only constant”- Heraclitus

Our world has seen a sea change in all facets of life due to the current pandemic scenario, thus leading to huge changes in the businesses. The pandemic has led to humongous change in all facets of life, agriculture being one of the primary ones. It must also be borne in mind that agriculture can be a sustainable business in the long run.

This case study presents the challenges faced by one such business Bhagyashree Brass Band in its journey during the pandemic times and how the owner of the business after being compelled to close down the band came up with an alternative business with a new approach. It made a difference to not only him but also to his customers. The owner started his new business by selling agricultural produce, and successfully prospered in the same.

Keywords: Agriculture, agricultural marketing, supply-chain disruption, business, sustainable business.

EXPECTED LEARNING OUTCOMES-

1. To understand how this new model helped the owner and his workers to sustain during COVID crisis.
2. To perceive the importance of agriculture for a country like India.
3. To prescribe to the government to promote such entrepreneurial endeavours.

1. INTRODUCTION

In early 2020, as countries and organizations began to recognize COVID-19 as a serious threat to people's health, the world saw a global lockdown spanning across all countries affecting businesses and supply chains in unprecedented ways.

The lockdown restricted farmer's access to mandis or a marketplace where farmers sell their produce to buyers through auctions. This in turn led to a disruption in the food supply chain across the country. Since farmers were not able to access mandis, there was no feasible way for the produce to be transported safely to the consumers.

Bhagyashree Brass Band employed about 115 people, mostly daily wage workers playing the band at various events. Before the pandemic struck, the business was doing well with about 18-19 weddings during the wedding season.

However due to the COVID-19 pandemic, all non-essential economic activity was restricted leaving the owner with no work. However, he did not succumb to the dire situation of the pandemic but found a way to create work both for himself and the employees that were dependent on his company for their living. He observed the poor access of the people to vegetables and fruits, the owner found an opportunity in this problem which enabled him to earn a modest income to support himself, his family and his workers despite the pandemic.

2. OBJECTIVES:

The goal of studying this case is that we can clearly understand the thought process of entrepreneurs like the owner who despite facing severe challenges, during the lockdown of the entire country kept people employed and enabled them to earn an income.

Cases like these are outliers as during the pandemic not everyone could have the foresight or courage to take such a big risk. After all, if the occurrence of the pandemic itself was so sudden, how could one predict what would happen the very next day?

3. HISTORY OF BHAGYASHREE BHAJI MARKET:

The owner of the Bhagyashree Brass Band came from a very humble background. Hailing from Pandarpur, he made his way to Pune to find work. He first worked at a washing center and then at the Pune Municipal Corporation.

Throughout his journey, he has met many people. Few of them encouraged him to start an event management business and this led to the establishment of Bhagyashree Brass band. Initially there were only three people in

the band. Eventually people started recognizing him and he started expanding his team. Before the lockdown he had a team of hundred people or so. During the marriage season his daily turnover was around two lakhs to 2.5 lakhs per day. He also provided the speakers and microphones to the people going to Shirdi yatra. He bought one vehicle before this yatra to Shirdi. His band was doing well until COVID-19 struck.

Once the restrictions and lockdowns were imposed, there were no events. People either canceled or postponed the events. With that, most of the band members went back home. There were 10-15 members who stayed back with him. Now that there were no events taking place, he tried to switch his business as he had to also take care of the other members. Initially he provided the police offers with the speakers and microphones that were used in his bands to make announcements and create awareness about the Covid-19 restrictions and precautions. Later on, he came up with an idea of selling vegetables. He bought a weighing machine and found a source from where he could get fresh vegetables and started this at a very small level. Moreover he also prepared food for the poor and gave it free of cost during the peak of COVID-19.

4. CHALLENGES FACED DURING COVID-19.

There were many challenges which people faced during the COVID-19. Bhagyashree Brass band also faced some problems. There were two major challenges that the band faced during the initial phase of COVID-19.

1. **Uncertainty about the future:** With all the lockdowns and restrictions being imposed, it was very difficult for any business to plan anything for future. Especially, this band, having 100 people in team, was not sure if it would get any of the event orders wherein, they could earn for their living. Without the events and no source of income it was very difficult for them to survive.

But the owner did not let this challenge affect himself or his members as well. Using some of his profits, he chose to sell vegetables to people. This not only helped him but also the people to have sufficient food stored in their house.

2. **Wellbeing of the members:** Due to the lockdown, the events were either cancelled or postponed. Even though many of the band members chose to go back to their villages, there were still people who stayed back. If the owner would have just relied on the band performances, there were possibilities that members would not have had sufficient income in the long run. With the drying up income, and the increasing number of COVID cases, going ahead with this business would have been very difficult. He decided to switch business. It was a small investment of buying a weighing scale and getting the vegetable baskets. The venue of the band office was utilized to sell the vegetables. This provided some source of income and also helped the members who stayed back with the owner.

Thus challenges were met to some extent by switching business. But, switching from one business venture to another is not easy. It has its own problems as well. The challenges that were faced by the owner as a vegetable vendor during COVID were :

1. **Transportation:** There were many restrictions in the mobility of people. Only the delivery of essential items was allowed. It included vegetables, but due to the restrictions on petrol/diesel consumption, the supply of the vegetables was severely affected. Thus, a fixed and assured supply could not be relied on.
2. **Temporary shutdown of wholesale markets:** For maintaining social distancing, the wholesale markets were temporarily closed. Hence it was not possible to buy from the wholesalers in bulk.
3. **Increasing prices of the vegetables:** Cost push inflation, resulted in restricted supply and the prices of the vegetables went up. Customers were not willing to buy at very high prices.
4. **Online shopping:** Since people feared going out to buy vegetables and they started using online platforms to buy groceries. This had a huge impact on small vendors like him.

5. CONCLUSION

Now that there are no restrictions in Pune, the owner has resumed the Brass band. With the spirit of never giving up and doing something for his living and that of his workers, the owner of Bhagyashree Brass Band and Bhaji market now owns two vintage cars and one Fortuner. He has showcased his business at various events.

The owner now chooses to run both the businesses, the brass band as well as the bhaji market. Though after COVID, the rates for his events have risen. He now charges Rs.25,000 per event if it is only the band. For the entire event he charges approximately rupees two lakh. He also lets out his two vintage cars for the events on rent ranging from rupees thirty to fifty thousand per day. Overcoming all the challenges, the owner of

Bhagyashree Brand and Bhaji market now earns a revenue of rupees 2-2.5 lakhs per day again. The workers are paid on daily basis again.

This Case Study highlights the fact that challenges and problems thrown at can be viewed as opportunities for newer ideas and innovations. With a risk appetite, the novel ideas can take shape into a sustainable businesses.

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Perception of Consumers towards Credit Cards in Mumbai

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ABSTRACT

The study investigates credit card ownership and usage in Indian metro cities, taking Mumbai into consideration, and their posited association with consumer demographics. In this study, we find that credit card usage behaviour in Mumbai is relatively high and that this appears to be influenced by consumer demographics and in particular income, age, gender and income as well as number of credit cards owned per person, i.e., ownership pattern. The growing popularity and ownership of credit cards in the western belt of India makes it relevant for such a research to be conducted taking a sample representative of the population of Mumbai. This will aid in interpreting the manner in which demographics influence the usage pattern. The study shows that the results obtained are inconsistent with the previous studies, where the usage was expected to increase with age and income, and males were expected to use credit cards more frequently. The study recommends segmenting the market in Mumbai based on consumer demographics. Keywords: Consumer Behaviour, Credit Cards, Mumbai.

OBJECTIVES OF THE STUDY:

The following are the objective of the study:-

- To understand the concept of credit card.
- To study the different types of cards used in making payments.
- To study the perception of bank customers towards different types of cards.
- To study the problems faced by customers in using cards.
- To study the problem faced by banks in the recovery of card dues.

RESEARCH METHODOLOGY

Primary Data:

Data collection is done in **two stages**: in the first stage a **pilot survey** was conducted to ascertain the research parameters and to test the validity and reliability of the instruments used in the study. In the second stage the primary data was collected using the instruments in the study. Instruments used were Questionnaires. A structured questionnaire was prepared and tested for its reliability and simultaneously validated by applying appropriate statistical tools like Cronbach's Alpha.

Secondary Data:

Existing data regarding the consumer perception on different financial products like credit cards will be considered for the study. And additional data will be collected from reference literature, books, journals, publication, media publication and e- resources.

The **Secondary Data** are very important for the start of any research. It is with the help, of secondary data any researcher can start framing the structure of the research. Secondary data are collected from various available sources through desk research including literature survey and referring e-libraries etc. Review of literature and other available information from various published and unpublished reports, Journals, books, newspapers etc (including databases like Ebsco, Pro-quest, India Business Insight Databases, Bank's Annual Report and others).

INTRODUCTION

The credit card business got momentum in the sixties and a number of banks entered the field in a big way. Credit card culture is an old hat in western countries. In India, it is relatively a new concept that is fast catching on. The present trend indicates that the coming years will witness a burgeoning growth of credit cards which will lead to a cashless society. Credit has become an important vehicle of trade promotion. Credit cards provide convenience and safety to the buying process. One of the important reasons for the popularity of credit cards is the sea of change witnessed in consumer behavior. Credit cards enable an individual to purchase products or services without paying immediately. The buyer only needs to present the credit cards at the cash counter and sign the bill. Credit card can, therefore, be considered as a good substitute for cash or cheques.

A Credit card is a card or mechanism which enables cardholders to purchase goods, travel and dine in a hotel without making immediate payments. The holders can use the cards to get credit from banks up to 50 days free of cost. The credit card relieves the consumers from botheration of the carrying cash and ensures safety. It is a convenience of extended credit without formality. Thus credit card is a passport to, "safety, convenience, prestige and credit. A credit card is a plastic card having a magnetic strip now recently replaced by chip card issued by a bank or business authorizing the holder to buy goods or services on credit. Any card, plate or coupon book that may be used repeatedly to borrow money or buy goods and services on credit is called credit card.

A credit card is a device which enables the holder to obtain goods on credit from specified supplies. The holder of the card, in some cases, has to pay the yearly subscription and the suppliers also have to pay commission on sales to the bank or the body issuing the card. The suppliers are paid promptly and so are protected against bad debts, while the holder makes a single monthly payment to cover all his purchases for that period. Credit cards are issued only after the applicant's credit worthiness has been accepted as satisfactory. According to credit rating, holder of the credit card may be allowed a specified Amount of credit from one month to another.

Things to consider while using credit card

A credit card can become quite difficult if the customer is not using it in a right way. Credit card user need to make payments on time to avoid late payment fees and associated interest charges. To maintain a good credit score one should avoid exhausting all the credit. If used in proper manner credit cards is very effective tool to handle and manage regular as well as sudden financial crisis as it not only offers credit but also various factors such as rewards, discounts, cash backs, etc. which play an important role in the rise of credit card usage. One can use any credit card to withdraw cash, however, it will attract cash advance fee and a higher interest rate that could affect your repayment capability. If rewards are offered by your credit cards, you also need to ensure that you redeem the rewards before they expire.

Credit Cards Trends in 2017

After demonetization, the Indian economy has found various ways of cash transactions. The government of India has introduced many alternatives to hard cash through Aadhaar Enabled Payment System (AEPS), Unstructured Supplementary Service Data (USSD), Unified Payments Interface (UPI), digital wallets etc. Many credit card offers, cash backs and benefits that have enabled individuals to prefer credit cards over hard cash were provided by the banks after demonetization.

Credit Card companies have come with a new feature of Twitter sync through which the customer could get extra benefits like discounts and offers by tweeting hash tag offer.

Many companies are going card less. McDonalds', KFC, burger king they have their mobile app through which costumer can not only order and pay but also have exciting offers according to the value of customer to the company.

Starbucks which is among the leading companies in mobile payment have launched a mobile card app through which the costumer just has to scan the barcode displayed while purchasing the product. This makes the transaction very easy and hassle free.

Updated Information on Credit Cards in India

As per the data of Reserve Bank of India, in 2016 the debt of an average Indian credit card user was rising at an alarming rate. Credit card outstanding amount of Rs.27, 000crore during the 2008 crisis period increased to Rs. 42,100crore at the end of May 2016 because the annual interest on credit card outstanding ranges between 36% to 48%.

These Standard credit cards are the most common and are readily available from most banks and financial groups. They are not secured, which means you do not have to put down a security deposit to prove the money can be repaid or given back. The yearly or annual percentage rate offered or calculated for these cards can vary.

Examples:

1. Balance transfer credit cards

This credit card allows the consumer to transfer a high interest credit card balance onto a credit card with a low interest rate. The terms of balance transfer credit cards varies between offers, so be sure to thoroughly read the terms and conditions for each and every card.

2. Low interest credit cards

This type of cards can be very useful when consumers need make a large purchase because it allows several months to a year to pay it off with very low or no interest. Before using a low interest card, read all the terms and conditions carefully.

3. Credit cards with rewards programs

Reward credit cards allow users to get and earn incentives for buying with their credit card. Points collected for each rupee charged on the card, and the cardholders can redeem these points for various rewards. Reward cards usually require better-than-average credit history and background for approval.

4. Cash back credit cards

This credit card allows you to earn cash rewards for making purchases. The more the card is used, the more cash rewards you receive. Most cash back cards earn users around 1 % of total purchases, excluding interest and finance charges. Some cards offer a higher cash back percentage with increased usage; this type of card is best for people who are loyal about paying off their balances each month. If used appropriately, a cash back credit card can earn the cardholder a large amount of money over time.

5. General reward point's credit cards

Reward credit cards are similar to cash back cards in that cardholders can accumulate or gather points toward a reward structure, which is based on how much the card is used again and again. This type of cards offer cardholders a variety of items to cash points in for: gift cards, electronics, hotel stays, plane tickets, gold etc. Reward programs and promotional offers often change; one should go through a card's terms and conditions before applying.

6. Hotel or travel points credit cards

This type of credit cards is exclusively used generally in hotels and travel. Some cards are co-branded with hotels. These credit cards allow you to earn points for all purchases, in addition to bonus points for Rupees spent on stays at the respective hotel chain. You can redeem your points for free nights and upgrades with the hotels your card is co-branded with.

Then there are broader hotel and travel cards with these points can be redeemed back for travel, theme park admission, stays at major hotel chains and more. Since these programs can be costly for credit card companies, many of these cards come with a yearly fee. If you are not a regular traveller, the yearly fee may annihilate the benefit of the rewards earned.

7. Retail rewards credit cards

These credit cards are co-branded with a major retailer, such as Disney or Online Shopping for Electronics; Points are accumulated by making everyday purchases.

8. Premium credit cards:

These are two types of cards that is gold and platinum. They come with more offers and come with higher credit limits. Some perks might include concierge services, exclusive airline lounges etc. This means that their processing is more costly for the merchant. In order to fund these rewards programs, issuers charge a high annual fees and higher merchant processing fees.

9. Secured credit cards:

To use secured credit cards, you need to deposit money with the company. Your credit limit is decided based on the deposit. These cards usually have higher rates of interest and an annual fee. They are mostly used by people with a bad credit history.

10. Secured credit cards

Secured credit cards require a security or collateral for approval. A security deposit of a known amount is needed in order to secure the credit card, and the security deposit generally needs to be of the same or equal or of greater value than the credit amount. Security can come in the form of a car, gold, diamond, bonds, stocks or anything else of monetary value.

11. Prepaid credit cards:

In this case the user already fills his account or loads his account with a sufficient amount of money that he requires. It is similar to a debit card expect that it is not linked to a bank account.

Prepaid cards are not credit cards but are used and accepted just like them. The advantages of prepaid cards is that there are no finance charges and they help you avoid debt in all purchases are paid for beforehand. With

these cards you can easily calculate the credit to be given to a particular credit card holder. This would potentially eliminate the risk of running up and creating credit card debt or bad debt and make the budgeting process and calculations much easier.

12. Specialty credit cards:

These types of cards are for consumers with different kind of needs for their credit use, such as business professionals and students. These credit card programs are designed tailor made accordingly to meet the needs of those individuals. These cards are offered through mostly partnerships with major brands. For example the If you book a ticket using BOOKMYSHOW. SBI, AXIS Card, offers two free movie tickets at any screens or any percentage of discounts the movie ticket.

13. Business credit cards

Business credit cards are available for business owners and have many of the same features as normal credit cards: low rates, cash back programs and airline rewards. The major difference in these cards is that they come with additional benefits and perks exclusively for those in the business world.

- HDFC Bank has also introduced Solitaire Premium Women's Credit Card with the welcome gift of one-time free wellness package from Apollo and Shoppers Stop voucher of worth ₹ 2,000 on cumulative spends of ₹ 2,00,000 every six months.
- Credit Cards for Students: State Bank of India has introduced SBI Student+ Advantage Card exclusively for education loan customers. The joining is free of cost and the users can enjoy up to 80% cash withdrawal limit.
- On 2nd October 2016, Bihar Chief minister launched credit card for students. It is an education loan in which the government pays back the interest. Under this scheme, students who have passed class 12th will be able to avail credit card and can avail an amount up to 4 lacs. **Features of Card**

The features of modern credit cards such as owner identification, credit limit for its cardholders and floor limit for its merchant establishments, convenience and safety to add value of cards, wider usage or popularity all over the world and dependence on technology to keep operating cost to the minimum, have been a runaway success for credit cards.

Along with convenient, accessible credit, credit cards offer consumers an easy way to track expenses, which is necessary for both monitoring personal expenditures and the tracking of work-related expenses for taxation and reimbursement. Credit cards are accepted worldwide, and are available with a large variety of credit limits, repayment arrangement, and other perks (such as rewards schemes in which points earned by purchasing goods with the card can be redeemed for further goods and services or credit card cash back).

A credit card is part of a system of payments named after the small plastic card issued to users of the system. The issuer of the card grants a line of credit to the consumer (or the user) from which the user can borrow money for payment to a merchant or as a cash advance to the user. A credit card is different from a charge card, which requires the balance to be paid in full each month. In contrast, credit cards allow the consumers to 'revolve' their balance, at the cost of having interest charged. Most credit cards are issued by local banks or credit unions, and have the same shape and size, as specified by the ISO 7810 standard.

Evolution and Growth of Card

The number of credit and debit card users in India is climbing fast, and rising affluence is likely to erode Indians' lingering reluctance to spend on credit. Indians have traditionally valued thrift and frugality. But the spread of affluence in the wake of rapid economic growth is challenging these values, at least for many middle-class and high-income families. One sign of this is the phenomenal growth in the number of credit and debit cards in India—in the past three years, the number of credit cards has more than doubled and the number of debit cards has almost quadrupled. Credits cards are a relatively recent development. The VISA Company, for example, traces its history back to 1958 when the Bank of America began its Bank Americard program. In the mid-1960s, the Bank of America began to license banks in the United States the rights to issue its special Bank Americard. In 1977 the name Visa was adopted internationally to cover all these cards. VISA became the first credit card to be recognized worldwide.

Credit cards are relatively new to India. Andhra Bank and Central Bank of India introduced credit cards in 1981. As of now there are about more than dozen major banks in Indian and foreign which have entered this line of business, besides some non-banking institutions. Since the plastic money has become as good as legal tender more people are using them in their day-to-day activities. The attitude of people towards credit cards has

changed. A phenomenal amount of money moves get transacted nowadays through electronic transfer, credit cards and debit cards. The Indian credit card market is in its growth phase, it recorded a growth of about 30 per cent a year. Debit cards are growing at 40 per cent

Working of credit card

A credit card is a plastic card with specific security and other features that is issued by a bank to its customer to enable the latter to use it as a payment medium. The card also entitles the cardholder to certain credit limits/funds such that a payment can be made even if the customer's account does not have adequate balance. Thus, a credit card is both an instrument of payment and a source of credit. Let us see how it works. Suppose one purchases grocery and pays the retailer's bill by means of a credit card. The retailer swipes the card and gives a credit slip which the buyer has to sign. Clearly, the buyer has not paid cash to the retailer. All that has happened is that the bill is charged to the buyer's credit card by way of signing the charge slip. In this process, the credit card account with the bank is charged with the amount of grocery purchased. But how does the retailer get his money? The answer is that the charge that the buyer incurred in buying grocery is 'acquired' by the retailer's bank. It will provide the retailer with the amount of transaction made by the buyer, less commission. This bank, called the 'acquiring bank', in turn will submit the charges to the bank (which issued the credit card) called the 'issuing bank' through the clearing mechanism maintained by the network sponsors like Visa or MasterCard. In turn, the issuing bank will send the bill (say, once a month) to the buyer/ person to whom the card was issued detailing all the transactions made by him/her with the credit card. The moment the buyer pays the due amount to the card issuing bank, the whole transaction cycle is completed.

Significance of numbers in a credit card:-

A credit card is identified by the issuer and a 16 digit number is seen on the face of the card. Each digit in the card has certain significance and security detail.

The first digit in a credit card number signified the system as follows:

- Travel/entertainment cards (such as American Express and Dinners Club)
- Visa
- Master Card
- Discover Card.
- Issuer Identification Number (IIN) – In case of credit card, IIN represents the issuing bank. IIN is the first 4 to 6 digits of the credit card.
- Account number: In case of credit card, the next few numbers indicate the bank number and account number.
- Check digit: The very last digit is used to verify the overall validity of identification number.

The structure of the card number varies with the system. Through IIN one can identify the institution that has issued the card.

- Master Card IIN has first 4 digits in the range 51-55
- Visa IIN always begins with digit 4
- American Express IIN always begin with 34 or 37
- Diners club IIN always begin with 36 to 38
- Discover card IIN always begin with 6011 or 65

While Visa and Master Card are issued in 16 digits format, American express has 15 digits format.

The backside of the card is also important. The stripe on the back of a credit card is a magnetic stripe, often called a magstripe. The magstripe is made up of tiny iron- based particles in a plastic – like film. The magstripe on the back of the card is very similar to a piece of cassette tape. ANSI Standard X4. 13-1983 is the system used by most national and international credit card systems.

A magstripe reader can understand the information on the three – track stripe. The magnetic stripe is divided into following 3 tracks.

Track 1: Track one stores the primary account number, account holder's name, card expiration date, service code, discretionary data (data to verify pin and security code) and the longitudinal check (LRC).

Track 2: This track stores data for the banking industry and is used on debit cards. The data included with this track is primary account number, expiration date, service code, discretionary data and the LRC.

Track 3: Track three is almost never used. Many of the major companies like VISA or MasterCard don't use it. While the other two tracks can only read data, track three allows for 'write-back' of information. Each track is about one-tenth of an inch wide. The ISO/IEC standard 7811, which is used by banks, specifies that:

1.13 Deciding which credit card to get

Which credit card is right for you primarily depends on how you plan to use it. Most people use credit cards as a convenient alternative to cash or cheque, to make big purchases, or to travel. Depending on how you'll use your credit card, consider these points when shopping for the best value.

If you're a Shopaholic	If you're a big spender	If you're a frequent traveler
You'll use your card instead of cash or cheque for all your routine purchases (e.g., at the grocery store, the gas stations, the pharmacy, the video store). You'll generally pay off the entire balance each month.	You'll use your card either to make many purchases all at once (e.g., holiday shopping) or to make a large purchase sooner than you otherwise could (e.g., a new refrigerator when it's on sale). You'll generally stretch out your payments.	You'll use your card for frequent business or pleasure trips. You want a card that's accepted all over the world, and you'd prefer an issuer who offers travel-related services
What to look for	What to look for	What to look for
<ul style="list-style-type: none"> • A bank card with no annual fee • No (or low) transaction fees • A long grace period (so your purchases don't start to accrue interest immediately) • A low interest rate (just in case you can't pay off the entire balance) • As an alternative, consider a debit card affiliated with a payment card plan (e.g., Visa or MasterCard) 	<ul style="list-style-type: none"> • A bank card with a high credit limit • A low interest rate • An outstanding balance calculation method that minimizes finance charges (e.g., an adjusted balance, previous balance, or average daily balance excluding new purchases method) • No (or a low) annual fee • No transaction fees • Merchandise or cash-back rewards 	<ul style="list-style-type: none"> • A travel card with no (or a high) credit limit • No (or low) transaction fees, especially on cash advances, currency exchanges, and foreign currency purchases • Free services (e.g., hotel or flight reservations, car rental or travel insurance) • Travel-related perks (e.g., frequent-flyer miles, discounts on meals or accommodations)

The Indian Scenario

The beginning of credit cards in India dates back to the year 1980, when Central Bank of India introduced a credit card known as 'Central card'. In India, credit cards and debit cards have started playing a bigger role as an instrument of payment system. The number of credit cards increased substantially to 27.5 million during the year 2007-08. However looking at the financial crisis which has, engulfed the world and increase in defaults in payment of credit card dues, the credit card issuers adopted a cautious approach in extending unsecured debt. Credit card issuers adopted a cautious approach in extending unsecured debt. Credit card is basically an unsecured exposure. As on 31st March 2012, the total number of outstanding credit cards was 17.65 million². On the other hand, as more and more people started using debit cards, the rise in debit cards has been quite phenomenal. As on 31-03-2007, the number of outstanding debit cards was 75 million. As against this, as on 32-03-2012, there were 278.3 million debit cards, of which more than three-fourth were issued by public sector banks. In contrast to this more than half of the outstanding credit cards were issued by new private sector banks.

Some of the important players in the Indian credit cards industry are:

Andhra Bank	ABN Amro Bank
Indian Overseas Bank	Kotak Mahindra Bank
Axis Bank	Bank of Baroda

ICICI Bank	Punjab National Bank
Bank of India	Syndicate Bank
Barclays Bank	Union Bank of India
Barclays Bank	Canara Bank
Corporation Bank	Standard Chartered Bank
Citi bank	Vijaya Bank
HDFC	Central Bank of India
Deutsche Bank	SBI Cards and Payment Services
American Express Bank	Diners Club
HSBC	

Current Scenario

In order to encourage the use of card, the policy initiatives and the regulatory stance of the Reserve Bank of India have been focusing on increasing the acceptance and penetration of safe, secure and efficient non-cash payment modes comprising cheques, credit/debit cards and transactions through ECS/RTGS/NEFT, over the years. The total number of outstanding credit cards and debit cards as at the end of March 2012 was 17.65 million and 278million respectively. Although the credit receivables as a percentage to the total retail loan portfolio remained at 2.56% during 2010-11 and 2011-12, the increase in the absolute amount in card receivables was Rs.36 billion constituting an increase of 20% during the aforesaid years. In the last decade, while the issuance of credit cards declined, cards showed a positive growth trend. Today, opening an account, a customer is given an ATM cum Debit card. This is one of the reasons why the increase in debit cards has been more than credit cards. It has been seen that some consumers shy away from credit cards in view of high rates of interest on credit and penal rates on delay/default. As per the report of RBI, more than three-fourths of the total debit cards issued / in use, as at the end of March 2012, were issued by public sector banks. In contrast, more than half of the credit cards were issued by new private sector banks and foreign banks.

Knowledge about various aspects of credit card is important such that customer gets the best service. A good understanding of the nuances of card will also result in fault less customer service. This is important because, according to the category-wise data on complaints sourced by the Central Bank from all 15 Banking Ombudsman offices, complaints regarding credit/ debit cards are high. Besides, there are regular reports about fraud, with the misuse of credit card transactions. The increasing cyber-crimes, originating from data theft and hacking are also a matter of concern. The Central Bank has therefore issued guidelines on the security measures to be put in place by the card issuers. With these initiatives, credit usage is expected to increase in the years to come.

The multiplicity of frauds involving debit & credit card has prompted the Reserve bank of India (RBI) to introduce a set of risk management measures for electronic transactions.' With cyber-attack becoming more unpredictable and electronic payment system becoming vulnerable to new types of misuse, it is imperative that banks introduce certain minimum checks and balance to minimize the impact of such attacks "the banking regulator said in a notification on February 28, 2013

While the steps are intended to protect the card holders from swindlers, the risk of fraud remains for customers who are not carefully in using plastic money. The new norms, some fear, may also encourage customers to transfer more in cash despite banks' effort to provide an additional layer of security, card holders are now required to key in their personal identification number (PIN) while using debit cards in retail outlets like departmental stores, restaurants and fuel station. It appears that many are actually reluctant to punch in their pins in crowded shops. They prefer to in cash instead

There are few instances where card holders were asked to share the pin with the shopkeeper instead of typing it in to the POS machine. Kushal Roy (head of payment & unsecured loans at ICICI Bank) says "these changes are for the better. Teething problem crop up whenever a new process or system gets introduced. I believes it will be matter of only three to four months before issues are resolved. It is just a question of merchants as well as consumer getting used to this new way of life"

The limited supply of portable POS machine, especially in restaurants, is probably an issue that needs to be resolved. Customers are not always keen to walk up to the counter to make the payment. Banker says that non portable POS devices are more popular with merchants because they cost less, half the price of portable machine in some cases POS devices are generally priced between 15000rs & 40000 depending on the brand features & portability. Lenders explain that there is no regulatory mandate on merchant establishment in

choosing the type of POS device. Hence, the inexpensive ones are preferred by most. There are two types of fees that retailers pay for use POS machines at their outlets. If the transaction volume is low, then the retailer is asked to pay a monthly rental to the bank setting up the POS device. In addition the retailer also pays a fixed percentage-based fee, known as merchant discount rate, for facilitating electronic transaction at their stores. This fee is shared by the bank providing POS machine, the card issuer & the company offering the payment platform.

As per the RBI data, there were 965910 online POS machine in the country at the end of August 2013. But customer's complaint that many of them are not functioning properly and transaction requests are often declined despite entering in the correct PIN. Bankers admit that such instances occasionally crop up but assure that the issues are now being resolved.

5 Product Variations and Operational Issues

"Instead of shopper items, banks offer administrations, while achievement or disappointment is characteristic element of any business, banks at times understand that they are occupied with the most troublesome attempt of showcasing elusive budgetary administrations" (Shoscot L. G., 1977) "Maybe one approach to get over the trouble of building the business portrayal appropriately is to discuss the administrations as though they are substantial items, to drive the upside of physical substances of other purchaser items" (Thomas D. R., 1978).

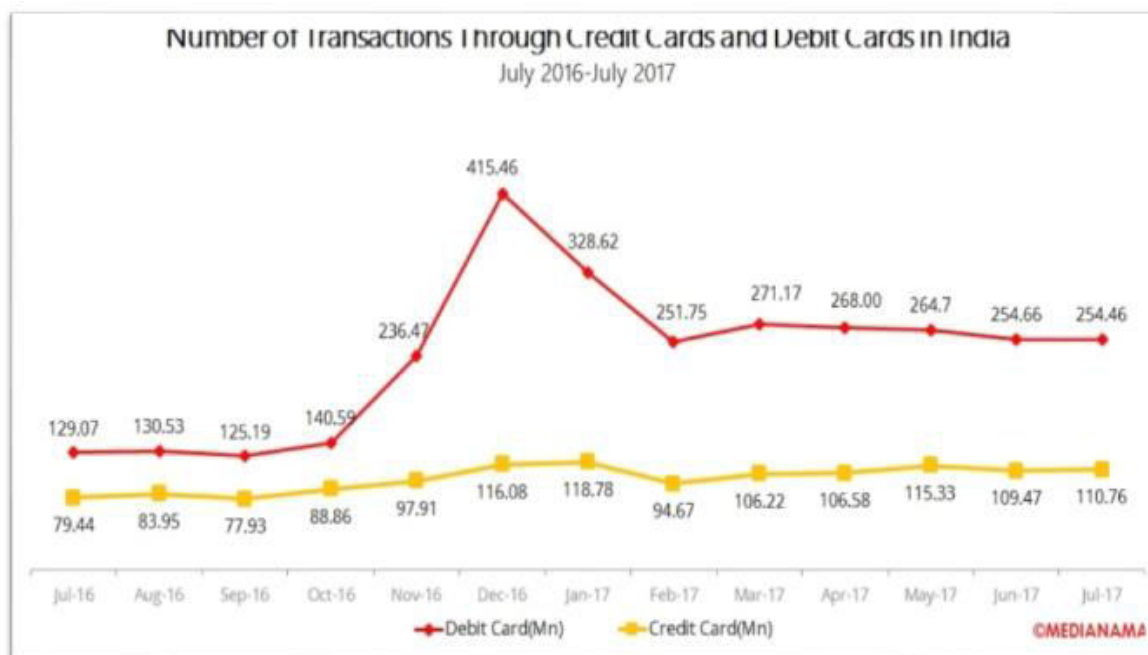
Keeping in mind the end goal to do that, endeavours were made to advance the advantages of different sorts of charge cards as though it is an unmistakable item. Essentially, a Visa is for giving here and now credit to the cardholder regardless of the reality whether he is the bank's account holder or not. Henceforth around there, an exertion has been made to present distinctive sorts of MasterCard's to the clients. Credit is an understanding between a loaning association, (for example, a bank, store or charge card organization) and the borrower. It's an assertion that gives trade out hand or in a bank or on a charge card for moment utilize. The terms of reimbursement, including premium charges, are generally set up the credit supplier and are administered by an understanding between the card client and the issuing bank.

"The study among charge cards holders uncovers that the Visa is for the most part issued to individuals in the upper or in the center pay gathering. It uncovers an unexpected circumstance that these charge cards are issued to individuals who are reliable instead of the individuals who need credit. This idea of financial soundness when connected limits the market for Visas to the high society who doesn't generally require credit. The two classes of Visa purchasers are out and out various and henceforth the present system to showcase as far as possible it's across the board agreeableness". (Mathew L. and Slocum J., 1969)

The accommodation advantage to the wealthy that may not require credit and the comfort of credit to the center salary assemble whose credit could be evaluated and acknowledged, has added to the broad acknowledgment of the charge cards. Deliberately the bank would improve the situation on the off chance that they can give charge cards to fit the requirements of the individual pay fragment. It is conceivable to construct volume offers of the Visas, as the bank issuing the card can decide the suitable credit restrain per card subject to tasteful reference and monetary ability of the cardholder. For instance, an office assistant may be conceded an insignificant breaking point while an agent may get a considerably higher credit on his card. Regardless, there is a roof on single buy up to which the shipper will unreservedly permit buys on the charge card. In light of these criteria there are distinctive classes of charge card offered and they are as per the following:

- Classic/Standard Card – It is the most fundamental card (sans all laces) offered by backers. The standard card ordinarily issued by VISA is known as the Classic Card.
- Gold Card/Executive Card – It is a MasterCard that offers a higher sum of credit than a standard card. Pay qualification for such cards is likewise higher. What's more, issuing bans give additional focuses or motivating forces to cardholders.
- Platinum Card/Premium card – Is a MasterCard with a higher cut-off than a gold card and has extra livens and offices.
- Titanium Card/Exclusive card – It is a charge card with a considerably higher confine than a platinum card" indeed, it is the individuals from a tip top gathering, for example, sports identities, film-stars and the 'rich and the well-known who streak these cards. It opens entryways universally for any administration that might be required.

Types of Cards usage transaction wise



Source: Medianama 2017

CONCLUSION

Credit cards issuers should use a rewards system on tracking system where the customer should know how much they are going to earn with every purchase. As there are different types of product in terms of offerings, but the majority of credit cards are perceived as the same credit card, so differentiation must be communicated to target groups and they should encourage target groups to choose their card wisely. With expanding access to individual credit, charge cards are presently unavoidably held by most customers in created nations. This report outlines the scholarly discoveries on Visa decision and use by customers over the most recent two decades. The charge card showcase is ending up more focused and buyers are by and large acting soundly to expand their own particular utility. In any case, buyers are still appeared to abuse their MasterCard's, commit evident errors, experience the ill effects of different behavioral inclinations and at times endure misuse by the banks. This requires the insurance of buyers in the charge card advertise, which is likewise the fundamental statutory goal of numerous open approach controllers.

This survey draws some particular suggestions that controllers may depend on for arrangement makings to upgrade buyer insurance. It is vital to make shopper familiarity with valuable issues, for example, the advantages of currently scanning for low loan costs, the expenses of reimbursing at the base level, and the potential behavioral predispositions that might influence purchasers. This may be refined by means of a TV or promoting and propelling instructive projects for the less taught customers. Different recommendations are the expanded directions on the card backers. For instance, it has ended up being helpful to constrain the banks' capacities to charge different expenses on buyers and present the correlation of elective installment decisions versus the base installment. It would likewise be used to command more successful revelation to lessen the multifaceted nature of the agreements and improve buyers' understanding, by decreasing the measure of paltry data uncovered and giving a more conservative archive that abridges key data

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Small & Medium Enterprise - Initial Public Offer in India 2022

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Executive Summary

Primary Market

In a **primary market**, securities are created for the first time for investors to purchase. New securities are issued in this market through a stock exchange, enabling the government as well as companies to raise capital.

For a transaction taking place in this market, there are three entities involved. It would include a company, investors, and an underwriter. A company issues security in a primary market as an initial public offering (IPO), and the sale price of such new issue is determined by a concerned underwriter, which may or may not be a financial institution. An underwriter also facilitates and monitors the new issue offering. Investors purchase the newly issued securities in the primary market. Such a market is regulated by the Securities and Exchange Board of India (SEBI).

The entity which issues securities may be looking to expand its operations, fund other business targets or increase its physical presence among others.

Small & Medium Enterprise Initial Public Offer in India 2022

An SME IPO is a way for a privately owned **Small and medium enterprises (SME)** company to **sell its shares to the public for the first time** and gets **listed at BSE SME or NSE Emerge platform**. Companies with minimum post-issue capital of Rs 1 crore and a maximum of Rs 25 crores are eligible for SME IPO in India. BSE SME and NSE Emerge platforms allow SME companies to raise funds and get listed at the exchange through an SME IPO.

Retail investors can **apply in SME IPOs in India** by submitting an online IPO application form through their stockbroker or bank. Brokers offer UPI-based online IPO applications and the banks offer both UPI as well as ASBA IPO applications.

Objective of Study:

1. To Study Number of SME Companies Made Public Issue.
2. To Study the reason of SME Companies making Public Issue.
3. To Study Profit or Loss on Listing of SME Companies on BSE or NSE
4. To Study increase in Retail Investment in Secondary market

RESEARCH METHODOLOGY:

The study is based on an extensive secondary research. News articles, websites and government websites.

Data Analysis: The List of Companies made Public issue during January 2022 to September 2022 & Change of Price from Issue price is given below:

No	Company Name	Date of Issue	Industry	Issue Price	Listing Price	% of Earning / Loss	Reason for Public Issue
1.	Alkesign Limited	21 st January 2022	Miscellaneous	45/-	45.25/-	33.8% Profit after Listing till 23/9/2022	a. Prepayment / repayment of certain secured borrowings availed by the company. b. Funding working capital requirements.
2.	Precision Metaliks	24 th January	Metal	51/-	75/-	47.05% Profit on Listing	a. Funding working capital requirements.

	Limited	2022					b. General corporate purpose
3.	Safa Systems & Technologies Limited	28 th January 2022	Consumer Durables	10/-	16.55/-	65.5% Profit on Listing	a. Funding working capital requirements. b. General corporate purpose
4.	Richa Info Systems IPO	9 th Feb 2022	Electricals	125/-	125/-	No Profit No Loss on Listing	a. Funding working capital requirements. b. General corporate purpose
5.	Maruti Interior Products Limited	3 rd Feb 2022	Miscellaneous	55/-	68.5/-	24.5% Profit on Listing, 235.2% Profit till 23/9/2022	a. To set up fully automatic Nickel/Chrome Plating Plant and Powder Coating Plant b. Working capital requirements c. General corporate purpose
6.	Vaidya Sane Ayurved Laboratories Limited IPO	23 rd Feb 2022	Healthcare	73/-	102/-	39.72% Profit on Listing.	a. Funding Branding and Advertising expenses b. General corporate purpose
7.	Ekennis Software Service Limited	24 th Feb 2022	Information Technology	72/-	80/-	11.11% Profit on Listing. 150% Profit till 23/9/2022	a. To purchase plant & machinery b. Meet working capital requirements.
8.	Shigan Quantum Technologies Limited	28 th Feb 2022	Automobile	50/-	61/-	22% Profit on Listing.	a. To purchase plant & machinery b. Meet working capital requirements.
9.	SP Refractories Limited	9 th March 2022	Construction	90/-	90.2/-	0.22% Profit on Listing.	a. Funding working capital requirements. b. General corporate purpose
10.	Cool Caps Industries Limited	10 th March 2022	Plastic Product	38/-	35.90/-	5.5% Loss on listing & 414.2% Profit after listing as on 23/9/2022.	a. Funding working capital requirements. b. General corporate purpose
11.	Bhatia Colour Chem Limited	14 th March 2022	Chemicals	80/-	40/-	50% LOSS on Listing	a. Acquire partnership firm M/s Polychem Exports. b. Funding working capital. requirements.

							c. General corporate purpose.
12.	Swaraj Suiting Limited	15 th March 2022	Textile	56/-	49.95/-	10% LOSS on Listing	a. To meet the working capital requirements for the new expansion of production capacity at Neemuch, Madhya Pradesh. b. Meet issue related expense. c. General corporate purpose.
13.	Achyut Healthcare Limited	22 nd March 2022	Trading	20/-	20.15/-	0.75% Profit on Listing.	a. Funding purchases of machinery and equipment. b. General corporate purpose.
14.	Krishna Defence and Allied Industries Limited	29 th March 2022	Iron & Steel	39/-	75/-	92.30% Profit on Listing	a. Funding working capital. Requirements. b. General corporate purpose.
15.	Sunrise Efficient Marketing Limited	30 th March 2022	Trading	121/-	121.25/-	0.20% Profit on Listing	a. Funding working capital. Requirements. b. General corporate purpose.
16.	Dhyaani Tile And Marblez Limited	31 st March 2022	Trading	51/-	52.25/-	2.45% Profit on Listing`	a. Funding working capital. Requirements. b. General corporate purpose.
17.	Jeena Sikho Lifecare Limited	7 th April 2022	Trading	150/-	165.10/-	10.06% Profit on Listing.	a. To undertake marketing and sales promotion. b. To repay the short-term loan. c. To meet the Working Capital requirements of the Company. d. To meet out the General Corporate Purposes. e. To meet out the Issue Expenses.
18.	Eighty Jewellers Limited	5 th April 2022	Trading	41/-	42/-	2.43% Profit on Listing	a. Funding working capital. Requirements. b. General corporate

							purpose.
19.	Shashwat Furnishing Solutions Limited	25 th April 2022	FMCG	45/-	45/-	No Profit No Loss	a. Funding working capital. Requirements. b. General corporate purpose.
20.	Global Longlife Hospital and Research Limited	25 th April 2022	Health Care	140/-	141.10/-	0.78% Profit on Listing	a. Acquire land on leasehold basis. b. Repayment of Loan. c. General corporate purposes.
21.	Fone4 Communications	25 th April 2022	E – Commerce	10/-	10/-	No Profit No Loss	a. Funding working capital. Requirements. b. General corporate purpose.
22.	Nanavati Ventures Limited	27 th April 2022	Trading	50/-	41.30/-	17.4% Loss on Listing	a. Funding working capital. Requirements. b. General corporate purpose.
23.	Le Merite Exports Limited	28 th April 2022	Textile	75/-	75/-	No Profit No Loss	a. Funding working capital. Requirements. b. General corporate purpose.
24.	Sonu Infratech Limited	5 th May 2022	Infrastructure	36/-	36/-	No Profit No Loss	a. Funding working capital. Requirements. b. General corporate purpose.
25.	Rachana Infrastructure Limited	20 th May 2022	Infrastructure	135/-	138/-	2.22% Profit on Listing & 375.3% Profit after listing as on 23/9/2022.	a. Repayment of Secured Loans. b. Working capital requirement. c. General Corporate Purpose. d. Meeting Public Issue Expenses.
26.	Fidel Softech Limited	30 th May 2022	IT – Software	37/-	59.10/-	59.72% Profit on Listing	a. Funding working capital. Requirements. b. General corporate purpose.
27.	Silver Pearl Hospitality & Luxury Spaces Ltd	6 th June 2022	Hotel, Resort & Restaurant	18/-	8.5/-	52.77% Loss on Listing	a. Purchase of Hotel Property in Goa. b. General Corporate Purposes.
28.	Scarnose International Limited	14 th June 2022	Trading	55/-	55.5/-	0.90 Profit on Listing	a. To meet the working capital requirements. b. To make the

							repayment of Unsecured Loan. c. To meet the Issue Expenses. d. General Corporate Purposes.
29.	Goel Food Products Limited	20 th June 2022	FMCG	72/-	75/-	4.16% Profit on Listing 164% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose.
30.	Modi's Navnirman Limited	28 th June 2022	Reality	180/-	189/-	5% Profit on Listing	a. Investment in subsidiary company - SMNPL for Repayment of its outstanding unsecured loans. b. General corporate purpose.
31.	KCK Industries Limited	30 th June 2022	Trading	30/-	25/-	20% Loss on Listing	a. Funding working capital. Requirements. b. General corporate purpose.
32.	Sailani Tours N Travels Limited	30 th June 2022	Hospitality	15/-	15.5/-	3.33% Profit on Listing & 342% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose.
33.	Mangalam Worldwide Limited	4 th July 2022	Iron & Steel	101/-	102/-	1% Profit on Listing & 13% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose.
34.	Kesar India Limited	4 th July 2022	Reality	170/-	172.5/-	1.47% Profit on Listing 32.4% Profit after listing as on 23/9/2022.	a. To finance development Expenses of our Projects & upcoming Projects. b. Acquisition of land or land development right; and c. General corporate purposes.
35.	SKP Bearing Industries Limited	5 th July 2022	Automobile	70/-	73/-	4.28% Profit on Listing 95.5% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose
36.	Jayant	5 th July	Infrastructure	67/-	76/-	13.43% Profit	a. To make payment of

	Infratech Limited	2022				on Listing, 486% Profit after listing as on 23/9/2022.	Security Deposit for renting office space. b. Funding working capital. Requirements. c. General corporate purpose
37	B Right Real estate Limited	5 th July 2022	Reality	153/-	155/-	1.29% Profit on Listing	a. Funding working capital. Requirements. b. General corporate purpose
38.	Healthy Life Agritech Limited	18 th July 2022	Trading	10/-	8.9/-	11% Loss on Listing	a. Funding working capital. Requirements. b. General corporate purpose
39.	Agni Green Power Limited	22 nd July 2022	Infrastructure	10/-	25/-	150% Profit on Listing	a. Funding working capital. Requirements. b. General corporate purpose
40.	Upsurge Seeds of Agriculture Limited	2 nd August 2022	Agriculture	120/-	140/-	16.66% Profit on Listing, 148.7% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose
41.	Veekayem Fashion and Apparels Limited	11 th August 2022	Textile	28/-	49.9/-	78.21% Profit on Listing.	a. Funding working capital. Requirements. b. General corporate purpose
42.	Olatech Solutions Limited	19 th August 2022	IT	27/-	51.3/-	90% Profit on Listing, 192.2% Profit after listing as on 23/9/2022.	a. Funding working capital. Requirements. b. General corporate purpose
43.	Rhetan TMT Limited	25 th August 2022	Iron & Steel	70/-	70/-	No Profit No Loss	a. Funding capital expenditure for expansion and modernization b. Funding working capital. Requirements. c. General corporate purpose
44.	JFL Life Sciences Limited	30 th August 2022	Health Care	61/-	70/-	14.75% Profit on Listing.	a. Funding capital expenditure for expansion and modernization b. Funding working capital. Requirements. c. General corporate

							purpose
45	Ameya Precision Engineers Ltd	30 th August 2022	Capital Goods	34/-	68/-	100% Profit on Listing.	a. Funding capital expenditure for expansion and modernization b. Funding working capital. Requirements. c. General corporate purpose
46.	Dipna Pharmachem Limited	30 th August 2022	Trading	38/-	32/-	18.75% LOSS on Listing	a. Funding working capital. Requirements. b. General corporate purpose
47.	Jay Jalaram Technologies Ltd	30 th August 2022	Retailing	36/-	50/-	38.88% Profit on Listing.	a. Funding working capital. Requirements. b. General corporate purpose
48.	EP Biocomposites Limited	5 th Sep 2022	Miscellaneous	126/-	160.25/-	27.182% Profit on Listing. 97.1% Profit after listing as on 23/9/2022.	a. Prepayment / repayment of certain secured borrowings availed by the company. b. Funding working capital requirements.
49.	Virtuoso Optoelectronics Limited	5 th Sep 2022	Capital Goods	56/-	117/-	108.9% Profit on Listing.	a. Funding working capital. Requirements. b. General corporate purpose
50.	Viviana Power Tech Limited	8 th Sep 2022	Infrastructure	55/-	90/-	63.63% Profit on Listing.	a. Funding working capital. Requirements. b. General corporate purpose

FINDINGS

1. **More than 50** Companies made their Initial Public Offer from January – September 2022.
2. Many Companies made their public issue for Funding working capital Requirements, General corporate purpose.
3. Many Companies made their public issue for repayment of Debt, as it increases burden on their profitability.
4. Real estate Companies made their Public Issue for Capital Expenditure & Working Capital Requirement, which performed well in secondary market
5. Trading Companies made their public Issue; due to current situation it doesn't Performed.
6. Hospitality & Tourism Industry also made their Public Issue which performed well in secondary market.
7. Chemical & Agricultural Companies made their share Public for Capital Expenditure & Working Capital Requirement.
8. Textile Companies Shares were also issued to Public, due to current situation it doesn't Performed.

9. Oversubscription were Observed during many of the public Issues.
10. Because of heavy demand share price of many companies were on bullish rally.
11. This study observed that NIFTY and Sensex were having positively strong correlation with IPO Index.

CONCLUSION

We conclude the analysis on Small & Medium Enterprise - Initial Public Offer in India 2022. Many Retail Investors has shown their interest in Primary market for listing gains & Secondary markets for high returns. This study had proven that Indian equity market is influenced by economy positively. Small & Medium Enterprise Companies had opportunity for growth; many companies went for expansion which is good sign for Economy. Its positive impact on Investor as well as for company future expansion.

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Shrinkflation: Misleading and Deceptive Marketing Tactics

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ABSTRACT

The study is designed to understand the concept of Shrinkflation and its impact on consumers' shopping bags. To comprehend the effect of downsizing the product, a self-administrated questionnaire was framed with 112 respondents focusing on three important sections of the study. Section 'A' talks about demography information, section 'B' is about awareness and perception towards shrinkflation and section 'C' evaluate consumers' satisfaction and loyalty toward product after realizing the shrinkflation. The Likert scale is used to calculate the consumer's perception, satisfaction level, and loyalty toward downsized products. The result illustrates the consumer's disappointment toward shrinkflation. They prefer to use local brands which are not affected by shrinkflation. It indicates that manufacturer marketers and policymakers to consider customers' opinions about shrinkflation and work on some better way to minimize the effect of Inflation on everyone.

Keywords: - Shrinkflation consumers loyalty, Consumer satisfaction, consumers perception.

INTRODUCTION

Consumers are shocked after discovering the increase in the price of groceries item due a to surge in the rate of inflation. But it's more shocking for a consumer to know that their favours brand shrinking in size. This means the favourite brand's size is reduced but the price remains the same. This terminology of shrinking the product without affecting its price and quality was brainchild by British economist Pippa Malmgren in 2009 as 'Shrinkflation'. It is the process of lowering a product's size while keeping its suggested retail price. It is also known as package downsizing. The concept of shrinkflation is a combination of two words shrink means reduce the size and flation is part of inflation.

Shrinkflation is a form of unseen inflation which is not noticed by the people. Even most consumers don't notice the change in the size of products therefore companies choose to reduce the size of products instead of raising their prices because they are aware that consumers will not notice a small amount of shrinking. Instead of raising costs, businesses can make more money instead of raising costs by charging the same amount for a bundle with a tiny bit less content. A lot of manufacturers in the food and beverage sector use shrinkflation to deal with their inflation issues.

Illustrations of shrinkflation

"Even some of the most well-known businesses and brands now use shrinkflation in with their goods, including:

- Coca-Cola: In 2014, Coca-Cola changed its large bottle capacity from 2 litres to 1.75 litres.
- Toblerone bars were reduced in weight by Kraft from 20 grams to 17 grams in 2010.
- Tetley: In 2010, Tetley decreased from 100 to 88 thumbprints of teabags sold in a package"¹.

What are the root causes of shrinkflation?

The one big reason for adding shrinkflation on consumer bags is to enhance the manufacturer's profit margin and safeguard the size of the gain in this increasing inflation rate without making the consumers notice. The root cause of shrinkflation can be understood as follows.



1. Increased Manufacturing Cost

Manufacturing cost includes the cost of raw materials, labour, rent, power, and so on. The cost of raw materials, labour, rent, and power has enlarged as a result decrease in the profit margin of manufacturers. To cope with that manufacturer can't increase the price of the product. As it will hurt the consumers. So to make up for their profit margin with rising manufacturing costs the only choice left with the manufacturer is to shrink the size rather than spiking the price or compromising the quality.

2. Tough Level of Competition

The other strong reason for the manufacturer to favour shrinkflation is the increasing competition level in the market. To meet the stiff competition and hold maximum market share. A producer like to adopt shrinkflation. An increase in the price of a product may lead consumers to withdraw their preference for goods and switch to the other brand.

NEED OF THE STUDY

After the post-pandemic condition, the inflation rate had increase the price of all commodities. This phenomenon has resulted in finding the mid-way to maintaining profit without affecting the consumer's pocket. By shrinking the small size of the product without making the consumers realise much. But do this practice ethically correct are the consumers misled or manipulated by the manufacturer?

1. <https://corporatefinanceinstitute.com/resources/knowledge/economics/shrinkflation/>

OBJECTIVE OF THE STUDY

- To evaluate the awareness among consumers about Shrinkflation.
- To study the consumers' perception, satisfaction level, and loyalty toward Shrinkflation product
- To understand the relationship between the brand preference of Shrinkflation products and respondents' income, and age.

HYPOTHESIS

- H₀ = There is no significant relationship between the brand preference for downsized products and respondents' income.
- H₁ = There is a significant relationship between the brand preference for downsized products and respondents' income.
- H₀ = There is no significant relationship between the brand preference for downsized products and respondents' age.
- H₁ = There is a significant relationship between the brand preference for downsized products product and respondents' age.

RESEARCH METHODOLOGY

The exploratory qualitative research design was used to understand the awareness and perception of consumers towards shrinkflation. 112 simple random sampling and purposive sampling method from the Kalyan area was used to evaluate consumer satisfaction level and loyalty towards the product with the shrinkflation effect.

DATA COLLECTION

The study includes combining primary and secondary data to understand and evaluate consumers' awareness, perception, satisfaction level and loyalty towards shrinkflation. A well-structured questionnaire was drafted focusing on the above objectives and was enlisted to collect the relevant data and satisfy the study's objective. It also includes research journals, reports and web articles to support the primary survey.

DATA ANALYSIS

The data collected through the questionnaire are presented in tabular, pie charts, bar charts, Column charts and percentages. With the help of the questionnaire, an attempt has been made to awareness, perception, satisfaction level and loyalty of consumers towards shrinkflation.

STATISTICAL TOOLS

- Percentage Analysis
- Likert scales
- ANOVA was used to get the statistics result.

Percentage Analysis

Section A Table 1: Demographic information of Respondents

Particulars	Number of the Respondents	Percentage of Respondents
Gender		
Male	46	41.07

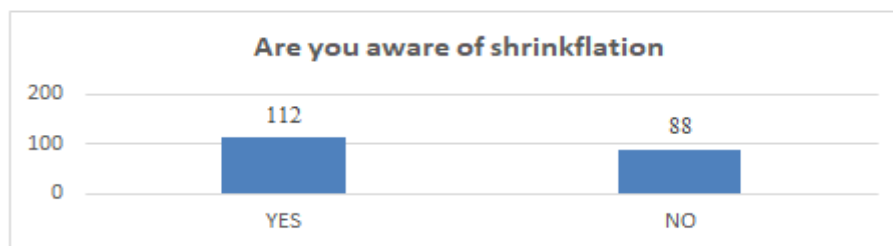
Female	66	58.93
Total	112	100.00
Age		
18 – 29	23	20.54
30 - 49	45	40.18
50 - 64	33	29.46
65 & above	11	9.82
Total	112	100.00
Education		
SSC	12	10.71
HSC	32	28.57
Graduation	45	40.18
Post-Graduation	17	15.18
Professional	6	5.36
Total	112	100.00
Income (Per Annum)		
2,00,000-5,00,000	24	21.42
5,00,001- 10,00,000	71	63.41
10,00,000 & Above	17	15.17
Total	112	100.00

Source Primary Data

Section B Consumers' awareness and perception towards shrinkflation

- Are you aware of shrinkflation (reduction in the size of the product without change in price and quality)

Chart No. 1

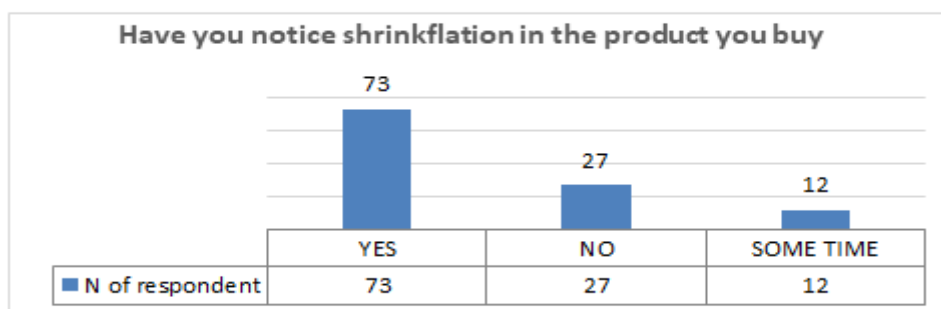


Source: Primary Data

Analysis

- The researcher has distributed 200 questionnaires to the respondents out of which only 112 respondents are aware of shrinkflation.
 - So here the researcher has decided to have 12 as a sample size. According to the sample size, all the respondents are well aware of shrinkflation.
- Have you noticed shrinkflation in the product you buy?

Chart No. 2



Source: Primary Data

Analysis

- Among 112 respondents the study reveals 65.18% of respondents have noticed shrinkflation.
 - Whereas 24.11% of respondents haven't noticed shrinkflation and 10.71% of respondents have noticed shrinkflation sometimes.
3. Please tell us which product you have noticed practice in shrinkflation

Chart No. 3

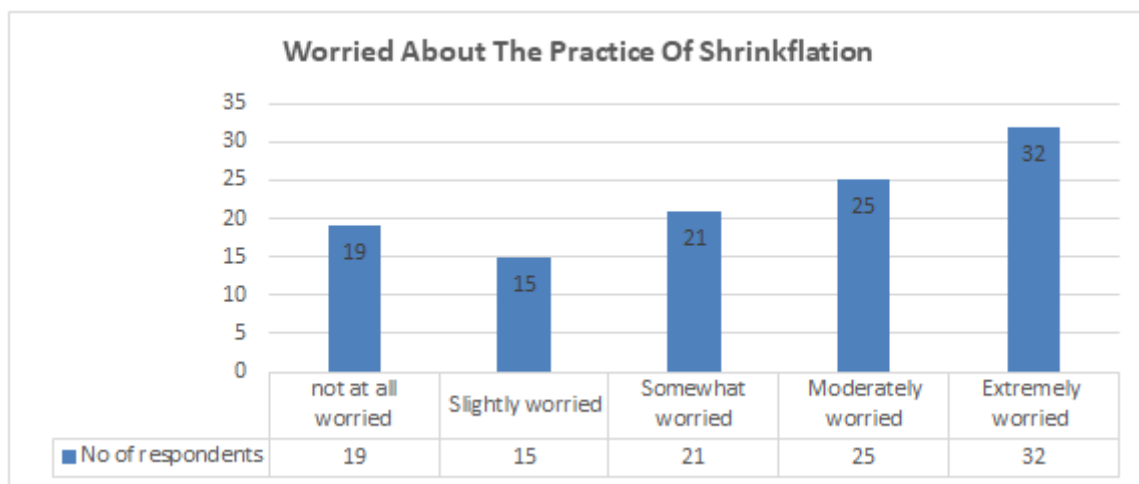


Source: Primary Data

Analysis

- In about data 22.32% of respondents believe snacks are the major item in which this shrinkflation.
 - Thereafter it is followed by pantry items with 19.64%.
 - Very less amount of shrinkflation is seen in dairy products with 8.04% of respondents confirming.
4. Are you worried about the practice of shrinkflation

Chart No. 4

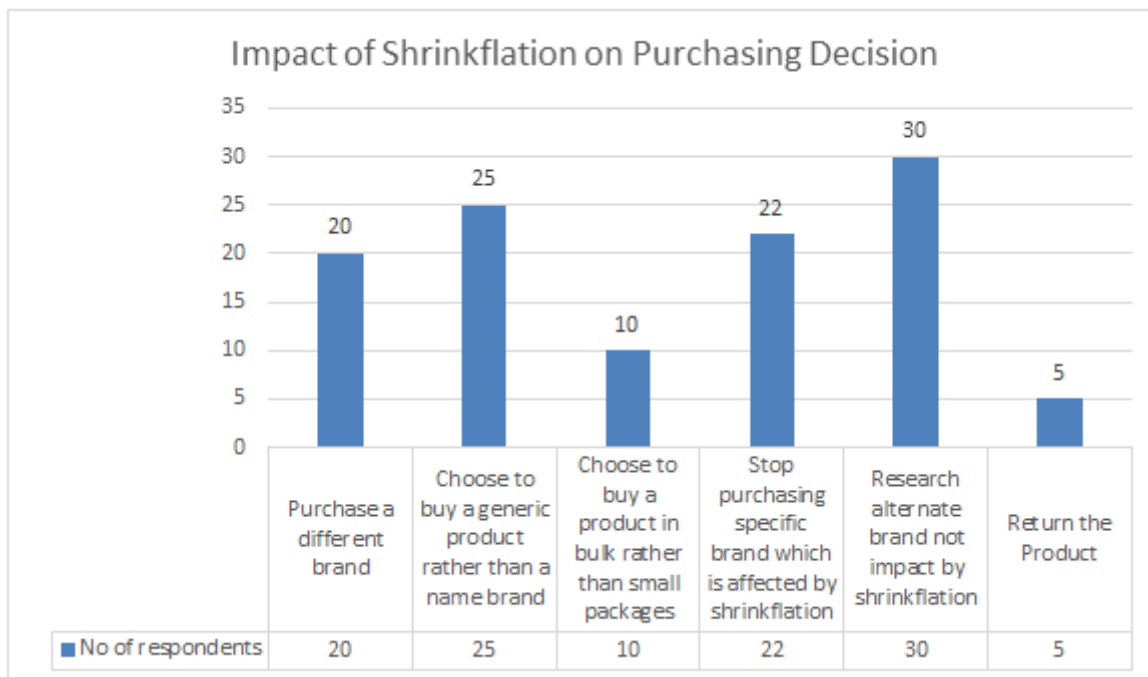


Source: Primary Data

Analysis

- 83.03% of respondents stated that they are worried about shrinkflation practices in their favourite brands.
 - 16.97% of responders are not at all worried about the shrinkflation effect on their favourite brands.
5. How does shrinkflation impact your purchasing decision and perception of the brand

Chart No. 5



Source: Primary Data

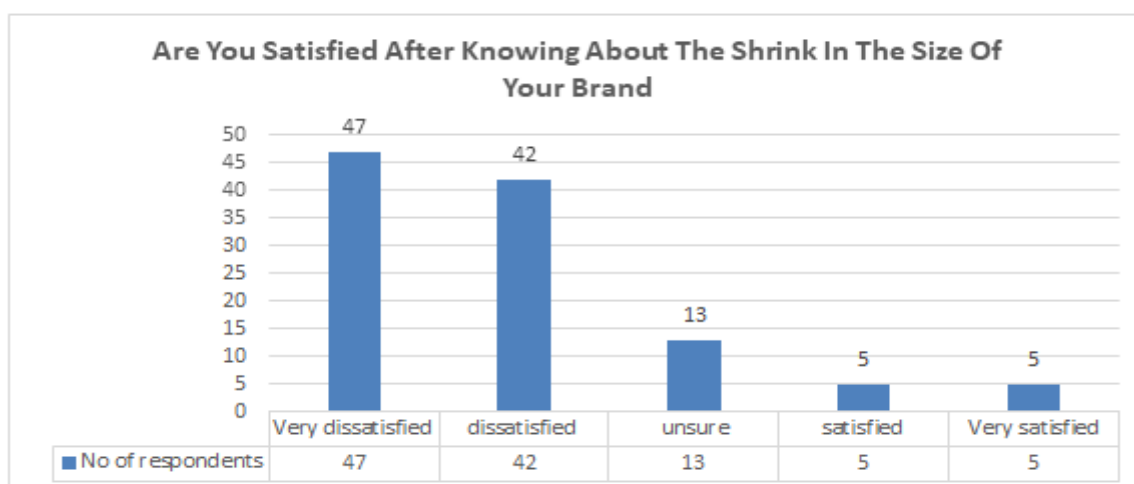
Analysis

- The above graph depicts the impact of shrinkflation on purchasing decisions of consumers.
- 26.79% of consumer stated that they will research alternate brand which is not impacted by inflation
- While 22.32% of respondents commented that they are going to purchase generic products rather than the branded one
- 19.64% of respondents mention that they are going to stop the purchase of a specific brand which is impacted by shrinkflation.
- 17.86% of respondents decided to purchase a different brand and 4.46% of respondents comment to return the product.

Section C Consumers' satisfaction and loyalty towards shrinkflation

6. Are you satisfied after knowing about the shrink in the size of your brand?

Chart No. 6

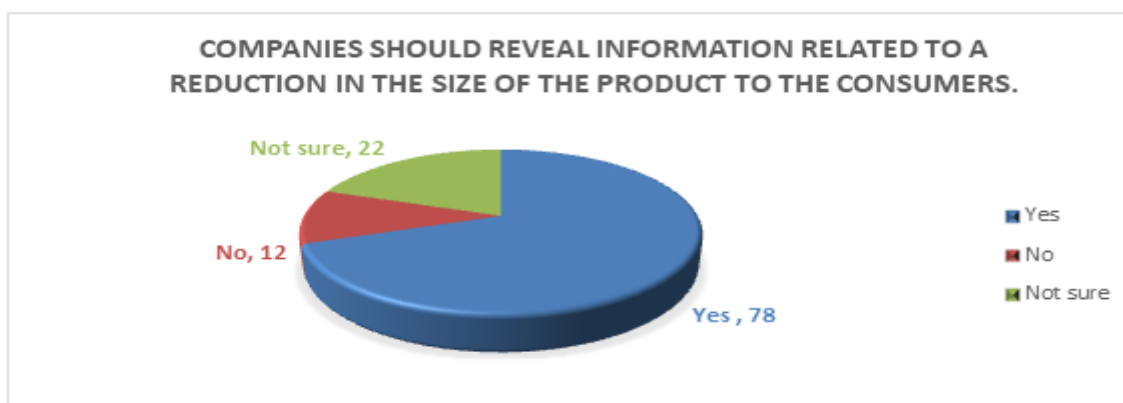


Source: Primary Data

Analysis

- 79.46 person of respondents are not satisfied after knowing about a shrink in the size of their favourite brand.
 - However 11.61% of consumers are not sure about their opinion, and only 8.92% of consumers are ready to sacrifice their favourite brand for shrinkflation.
7. Companies should reveal information related to a reduction in the size of the product to the consumers.

Chart No. 7

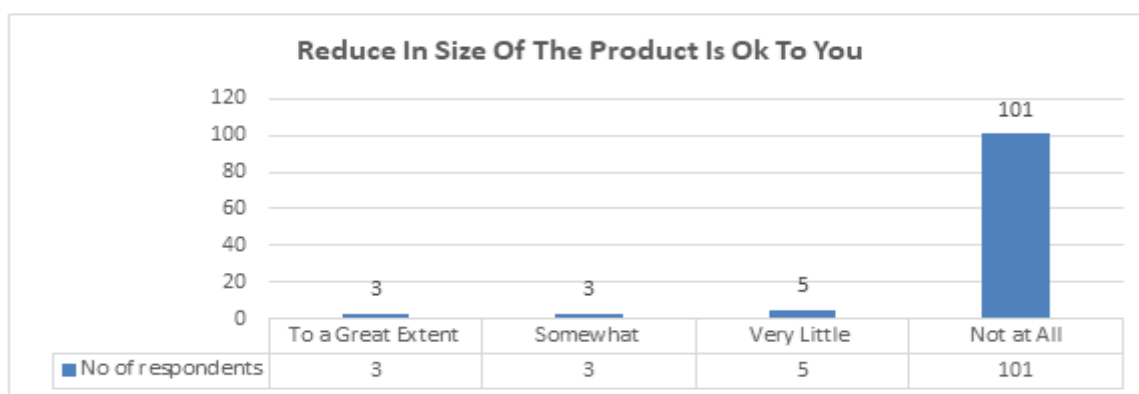


Source: Primary Data

Analysis

- 69.64% of consumers agreed that the companies should reveal the information related to the reduction in the size of the product in bold letters highlighting it.
 - 10.71% of respondents said that it doesn't affect us whereas 19.64% of respondents are not sure about the opinion.
8. Reduction in size of the product is ok with you.

Chart No. 8

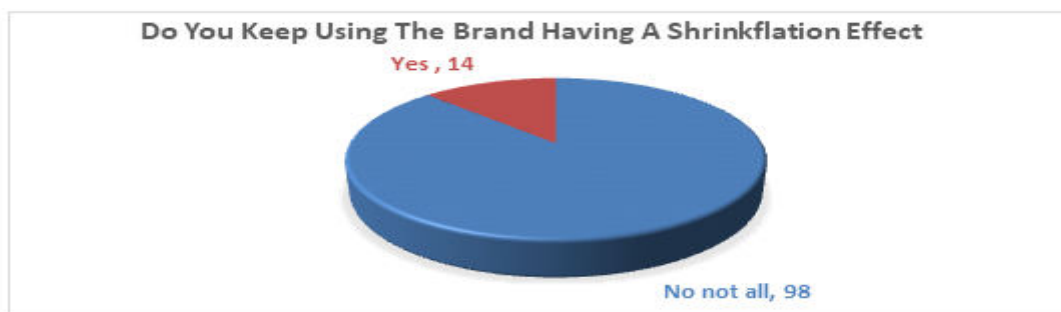


Source: Primary Data

Analysis

- To know respondents' willingness to accept the shrinkflation the researcher from the above question and responses are
 - 90.18% of respondents stated they are not okay with the reduction in the size of the product
 - Although 9.82% of respondents stated it's okay for them to have a reduction in the size of their favourite brand.
9. Do you keep using the brand having a shrinkflation effect?

Chart No. 9



Source: Primary Data

Analysis

- Further researcher wants to know the loyalty of the respondents towards the brand affected by shrinkflation.
- 87.5% of respondents stated they are not going to use this brand shortly and 12.5% of respondents state they will continue with the brand if there is no other alternative better product.

Hypothesis testing: ANOVA Computation

To test the hypothesis, ANOVA was carried out. The results are given below.

Table 2: Data Analysis between brand preferences for downsizing products and respondents' income

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	36.96875	1	36.96875	155.4	2.18E-27	3.8836876
Within Groups	52.8125	222	0.237894			
Total	89.78125	223				

Interpretation: we can see from the above table that the P-value is more than the alpha level selected (0.05). Therefore, we have evidence to accept the null hypothesis and reject the alternate hypothesis. It means there is no statistically significant relationship between brand preferences of downsize products and respondents' income.

Table 3: Data Analysis between brand preferences of downsized products and respondents' age.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	75.44643	1	75.44643	162.4437	2.76E-28	3.883688
Within Groups	103.1071	222	0.464447			
Total	178.5536	223				

Interpretation: we can see from the above table that the P-value is more than the alpha level selected (0.05). Therefore, we have evidence to accept the null hypothesis and reject the alternate hypothesis. It means there is no statistically significant relationship between brand preferences of downsize products and respondents' age.

CONCLUSIONS

- The demographic population used in the study are a blend of male and female but since the study focuses on downsizing grocery products so, 58.93% of female are included.
- 60.72% of population belongs to the age group 18 to 49 which means the decision-making age group is involved more.
- 68.75% of respondents have completed their basic education of HSC & graduation. It indicates better economic decision-making ability.
- The study also embraces better spending ability respondents with 68.14% belonging to the above-average income group.

- Most of the respondents are aware of the concept of Shrinkflation but only 65.18% of respondents could noticed it
- The study reflects the high level of inflation on products like snacks item and pantry items and a limited level of Shrinkflation on dairy products. As these products are utmost frequently purchased by each age group.
- 83.03% of respondents are not at all happy with the practice of Shrinkflation on their favourite brands. At the same time, 16.97% of the respondents are not worried about Shrinkflation.
- The impact of inflation can be analysed by the consumer's reaction for searching another alternate brand which is not impacted by Shrinkflation. Whereas few consumer States that they are going to add local product in their shopping bag rather than the branded one.
- The respondents are not at all satisfied after knowing about a string in the size of their favourite brand they want the manufacturer to find some other way of facing inflation rather than crabbing their favourite brand.
- Here the customer strongly feels that the manufacturer's duty is to be fair and honest with the consumer by making them aware of the downsizing of the product. But Shrinkflation sacrifices the duty by not being honest and participating in conflicts of interest without prior notice to the consumers.
- The study also stay most of the consumers are not okay with a reduction in the size of the product and they're not going to use that brand again shortly. But still, here 12.5% of respondents state they will continue with the brand if they do not get any other alternative better product.
- Although shrinkflation is an effective strategy used by manufacturers to retain their customer base and profitability, its practice shall be limited; otherwise, it may clue to argumentative effects.

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Non Banking Financial Companies (NBFCs) in the Context of Growth in Shadow Banking With Reference to Greater Mumbai

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ABSTRACT

The accessibility and acceptance among the rural and underdeveloped population has not reached to the levels as expected by the Government and the efforts dedicated towards this has not yielded the expected results unlike what was started in the developed economies. In India too, the initial focus was to make the commercial banks to include the portfolio of these non-customers and bringing them in to the mainstream financial service sector. But unfortunately, the acceptance rate has not been very good in this regard. It took a while for the policy makers to understand the fact that the commercial banks with their multi-product and complex operating structures would not be ideal to serve the new segment of customers whose needs, interests, and expectations on one hand and the banks existing capabilities and resources do not match which resulted in widening the anomalies.

The simplest reason which attributed to the failure of the commercial banks is the demographics of the employees of the bank with reference to their existing customer demographics and the demographics of the new segment of rural and low income customers. The development needs of a commercial bank customer whose average earnings cross 5 lakhs per annum is far different from that of a customer whose annual income is less than a lakh per year. These differences initially pose a huge vacuum in understanding the development needs of the new set of consumers by the employees of commercial banks who has to serve these customers. Another important grey area is the lack of proper documentation for the process of credit among the new target segment, which ideally would pose to be a huge risk in terms of credit being provided to them. This in fact leads in to a state of unsecured credit, which the commercial banks are not very comfortable with considering their existing outstanding and operational processes. This leads the banks to deploy human resources who aren't very much interested in satisfying the objectives for which they have been assigned onto leading to disinterest in them and not performing their tasks and delivering as per expectations.

INTRODUCTION

Over the past decade the Non banking Financial Institutions (NBFI), which are an integral part of shadow banking has gained importance in terms of financial stability owing to the growing interconnectedness among the banking sector. Their potential impact on financial stability have urged many policy makers as well as researchers to drive their attention towards this sector of shadow banking in particular. In emerging markets like India these institutions as apart of the shadow banking structure provide a peculiar structure, which is directly related to overall development of the economy by catering to unique consumer segments which were not considered before. India has a unique financial landscape which consists of chit funds, gold loan companies, Nidhis, pawn brokers, plantation companies which have always been a part of the shadow banking system, and has helped in catering to the needs of the rural and underprivileged customer segments who were not a part of the commercial banking systems. They had to be included in a proper system which is accountable and that is where the NBFC's in India come in to the picture. In a research report published by PWC, India entitled "Non banking financial companies- the changing landscape", in 2016, the following are the key points regarding the status of NBFC's in India.

CONTRIBUTION TO THE ECONOMY:

The contribution of the NBFC's towards the economy has been growing significantly since 2006 as it can be seen that their contribution has grown from 6.4% to almost 14% by the end of the year 2015.

- CAGR of the Sector:

From the period 2005 to 2015 the NBFC's have shown a compounded annual growth rate of over 19% and is also expected to be in similar levels till the end of 2018-19.

- Opportunity:

The mounting bad debts and Net performing assets (NPA) growing drastically in terms for the commercial banks, their appetite towards lending is definitely going to be deteriorating which will provide a huge opportunity for the NBFC's to tap in to the void and gain mileage by catering to many new customer segments.

• Key success factors (KSF):

Some of the KSF's which has been instrumental in the development of the NBFC's in India have been 6

o Wider and Effective reach in the market

- Better product lines
- Lower costs
- Better risk management capabilities in ensuring lower NPA and bad debts
- Closer and better understanding of the target consumer segments than the commercial banks.
- Undivided focus on a very few service categories such as passenger and commercial vehicle finance.
- Bargaining in to the key forts of personal and housing loan segment which were the initial bread winning segments of the commercial banks and creating substantial Assets Under Management (AUM) in those product segments.
- Better macro economic condition
- Higher credit penetration
- Stress on public sector units
- Increased consumer consumption
- Increasing digital disruptive trends.

Future growth:

NBFC's, owing to these multiple reasons are going to be a long term phenomenon and their growth levels are expected between 5% to 8% annually.

Objectives of the Study:

Based upon the above said requirements the researcher has developed the following objectives of the Study:

- To analyze the market share of NBFC's as a constituent of shadow banking in India and its trend with special reference to Greater Mumbai
- To analyze the implication of NBFCs on the financial aspects relating to Greater Mumbai vis-a- vis other institutions in financial intermediation and how this has generated the growth of shadow banking
- To assess the trends in the activities of NBFCs
- To examine whether NBFCs extending loans has any role in influencing the pricing pattern of instruments with reference to financial intermediation
- To examine the sources of funds of NBFCs for loans, especially their borrowings from the banking system, to make an assessment of systemic implications;

These objectives will serve as a guideline towards conducting the research and employ the tools,

Introduction:

In the previous chapter the researcher dealt with an extensive survey of literature pertaining to shadow banking, multiple aspects of shadow banking, its advantages the development in that sector. More emphasis was given to NBFC's their history, types, rules and regulations governing them and the way forward was analysed. This chapter will exclusively include the statement of the problem, the objectives of the research, the research methodology, which will be employed, the research considerations and the hypothesis of the study. It will further describe the survey method, the survey instrument which will be used to collect the primary data, the universe, and the sampling technique and sample size and the rationale for using the same will be discussed. Also, the scope and limitations of the study will be discussed.

- To analyse the market share of NBFC's as a constituent of shadow banking in India and its trend with special reference to Greater Mumbai
- To analyze the implication of NBFCs on the financial aspects relating to Greater Mumbai vis-a-vis other institutions in financial intermediation and how this has generated the growth of shadow banking

- To assess the trends in the activities of NBFCs
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Data Collection

Data is the ultimate and most vital aspect of any research. Studies that are conducted in different fields of study can be different in methodology but every research will be based on data, which is analyzed and interpreted to arrive at the findings. There are two

i) Primary sources

ii) Secondary sources of data collection.

- Secondary sources as the name suggests gives a basic idea about the topic of discussion and can be collected from diverse source of documents, past literature or electronically stored information available from trusted sites.
- Primary data is a data originated by the researcher for the specific purpose of addressing the research problem and collected from the sample or targeted population whereas secondary data collected from available sources for some purpose other than the problem at hand, but related to the topic of the discussion.

A. Primary Data:

- In this study, a structured Limited probing questionnaire was developed and used to elicit responses from the NBFC's Customers about their preferences, needs, expectations and satisfaction with regard to the NBFC's that they are either associated with or have associated in the past. Primary data collected from the sample is representative of the target population of NBFC customers who are not accessible to the traditional banking system and it will yield data that will be valid for the entire population.

- The geographical scope of the study was pre decided as Greater Mumbai, the customers belonging to greater Mumbai which extends from Colaba in the south to Mulund and Dahisar in the north is taken in to consideration. This gives the researcher a blend of financially savvy customers as well customers who do not fall in to the category of traditional banking system. And then for the stakeholders the same geography is being taken and stakeholders are chosen with reference to the same geographical area to provide spread of opinion.

Primary data collection needs plan and execution schedule; Accordingly researcher the prepared the research plan for this study and collected primary data required within time span of six months. The well designed and well structured 'Questionnaire', used in this study to collect the responses from the NBFC customers as well as stakeholders is being discussed in the following section.

Tool Used for Data Collection: Questionnaire.

In this study we have used 2 questionnaires, first for the stakeholders of financial Services and the second for the customers of NBFC's. let's discuss about the structure of these questionnaires in detail.

Secondary data

The researcher is well aware of the importance of secondary data and how it can aid in a research study. According to the understanding, secondary data is the type of quantitative data that has already been collected by someone else for a different purpose other than the current research.

There are several uses to Secondary data. They are

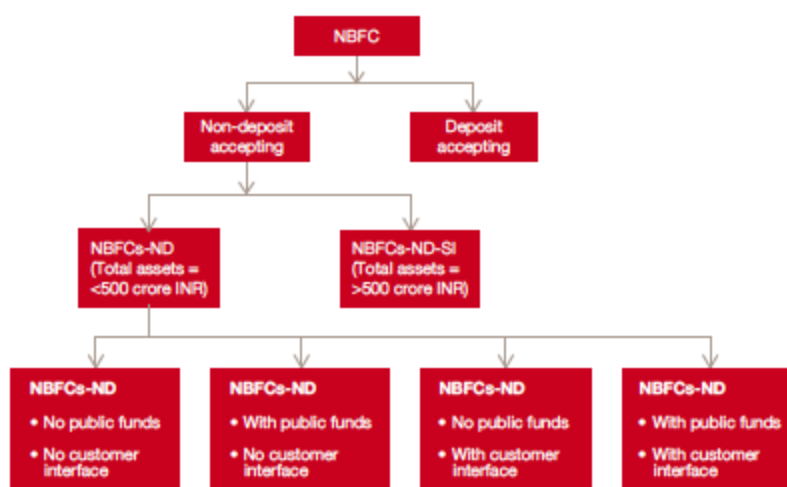
It can be directly used in the study as a source of information and act as source for information clarity and can be in the main introduction or literature review as support or evidence for the argument.

Secondary data can used to analyze it or re-interpret it for a different purpose to the original then the most likely place would be in the 'Analysis of findings' section of the dissertation.

Since secondary data has been collected for a different purpose rather than the current study it should be treated with care. The basic questions about secondary data that should be asked before using it are:

- Source of the data

- Is it geographically relevant?
- Is it current
- **NBFC – Regulatory Framework:**
- The contribution of the NBFC's as a financial intermediary over the past years have been highly commendable especially in the small and medium enterprise as well as the retail sectors. Also they have been instrumental in making financial inclusion possible by dedicated focus in the underserved areas and under-banked sectors. In a way they have been acting as growth – engines towards the concept of financial inclusion. As their importance grows rapidly in the Indian financial sector, their impact on the framework of how they should be governed also has undergone a rapid change. In fact, there has been a cyclical change in the regulatory framework governing the NBFC's ranging from a phase to simplified regulations to a level of highly stringent and extensive regulations, which are an integral part of the recently revised NBFC framework. Before getting in to the regulations it is imperative to understand the classification of NBFC's in India. The following figure 1.1 will give a clear understanding of the existing classification of NBFC's.



- **Increase in lending limits for Microfinance NBFC's:**
- In accordance with the recommendations as proposed by the Nachiket Mor committee in 'Comprehensive Financial services for small businesses and Low income households, the following borrowing limits have been changed for the NBFC- MFI's as proposed in the fig 1.2
- Figure 1.2

	Existing norms	Revised norms
Total indebtedness	50,000 INR	1,00,000 INR
Household annual income	Rural: 60,000 INR Urban and semi-urban:1,20,000 INR	Rural: 1,00,000 INR Urban and semi-urban:1,60,000 INR
Loan ticket size	1st cycle: 35,000 INR Subsequent cycles: 50,000 INR	1st cycle: 60,000 INR Subsequent cycles: 1,00,000 INR
% of loans for income generation	70%	50%
Loan limit requiring mandatory tenure of 24 months	15,000 INR	30,000 INR

²⁴ DNBR (PD) CC. No. 003/22.10.91/2014-15 dated 10 November 2014

²⁵ DNBS (PD) CC No.397/03.02.001/2014-15 dated 1 July 2014

²⁶ Notification No.DNBR.014/CGM (CDS)-2015 dated 8 April 2015, and Notification No. DNBR. 033/CGM (CDS)-2015 dated 26 November 2015

- Reasons for Preferring NBFC's:

- Rate of Interest provided by the NBFC is the primary reason for choosing them as cited by 62.5% of the respondents.
- Providing loans without collateral is the primary reason for choosing NBFC's as cited by 62.5% of the respondents.
- Better and faster processing times provided by the NBFC is the primary reason for choosing them as cited by 62.5% of the respondents.
- The ease of access provided by the NBFC is the primary reason for choosing them as cited by 75% of the respondents
- 62.5% of the respondents feel that the NBFC provide all the benefits such as better rate of interest, provide loans without collateral, better and faster processing times and ease of access which are the reasons for preferring them

SUGGESTIONS:

- NBFC's have a huge market share among other shadow banking companies
- NBFC's improves the financial status of consumers
- NBFC's are a tool for financial development:
- There is a positive correlation between the quality of services offered by NBFC and customer satisfaction
- NBFC's help in financial development of SME businesses in Greater Mumbai:
- NBFC's follow all the regulatory norms in taking care of customer needs:
- There is a positive correlation between NBFC and development of unorganized business.

RECOMMENDATIONS FOR NBFC BUSINESS:

- The Financial inclusion schemes can be used as an opportunity by the NBFC's to spread their existence. The Pradhan Mantri Jan-DhanYojna(PMJDY), has caused a substantial increase in bank accounts yet there is a huge number of customers who are yet to make those accounts active. This provides an opportunity for the NBFC's.
- Principal banking licenses are in the process to be handled over to many financial institutions to qualify as banks and this is the time when the existing NBFC's have a scope to emerge out of the shadow and become full fledged financial institutions.
- Several unified payment systems are in place like the Unified Payment interface(UPI), NCPI and Bharat Bill payments systems. For the NBFC's this provides a scope for expanding their lines in the digital payment verticals, which further enhance their acceptance among the customers.
- If the NBFC's are able to develop a partnership with the payment banks, bill payment providers and other financial institutions including he insurance and asset management companies it will provide them an opportunity to come up with a comprehensive set of financial services under a single umbrella.
- As the growth of digital life among the citizens of India is growing at unprecedented levels, including the rapid growth in smartphones which has taken India as the second largest smartphone market in the world, it provides an opportunity for the NBFC to capitalize on this. They can work on their product and positioning, processes and end to end experience of the customers.

The social and digital data available also provides an opportunity for NBFC where they can use the digital social data as a surrogate in order to make better credit decisions.

CONCLUSION

In this research paper we have done the effort towards understanding the role of NBFC's an integral part of the financial system in India and how they have been impacting the growth of alternate banking in the specified geography. The primary objectives include the impact of NBFC's their operations, their impact and what do the customers and stakeholders think about the NBFC's. With these objectives the researcher had undertaken a comprehensive literature review on the topics of Shadow banking and especially the NBFC's which gave a first hand idea about the concepts of shadow banking and NBFC's. The growth of NBFC's as well as the issues faced by them was taken in to consideration. With this understanding the researcher had developed a descriptive research design and started data collection by using tow sets of questionnaires targeted towards the customers of

NBFC's as well as the stakeholders in NBFC business. The questionnaire included all the questions related to the objectives of the study and the data collection was undertaken.

From the study the researcher is able to understand the fact that NBFC's have been able to be an integral part of the banking system in India but yet they have not been able to create the impact which they are expected to. Also from the study it can be found that there are many issues with relation to the perception that the customers and stakeholders have on NBFC's as well as their satisfaction and opinions about lot of parameters related to NBFC's. The findings and suggestions have been developed by the researcher in order to provide a guideline to take the NBFC business forward.

During the course of the study there were many instances which required a lot of deviations from the standards of research methodology and comprise to make the work easier. But the researcher has tried their level best to maintain the sanctity of the research

Measures to Improve Cybersecurity in Indian Organizations: An Empirical Study

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ABSTRACT

Cyber security methods are frequently discussed in public papers to safeguard an organization's or user's online environment. It is in charge of the toolkit that guards against unauthorized access to networks, applications, and data integrity. The term "information technology security" can also refer to a collection of tools and practices. The field is becoming increasingly significant due to our growing reliance on computer systems, including smartphones, T.V.s, and the many small gadgets that make up the Internet of Things. Cybersecurity is securing information and information systems using the appropriate technological and procedural security methods (networks, computers, databases, data centers, and apps). Although necessary for protecting user data and computer networks, firewalls, antivirus software, and other technological solutions are not enough to guarantee security. We must educate our citizens on using this technology as our country quickly develops its cyber infrastructure.

Keywords: Cyber Safety, Cybersecurity in India, Privacy, Secure Internet, Online payments

INTRODUCTION

With a population of 1.25 billion, India has 0.35 billion internet users, or 28% of the population. This represents 10.83% of all internet users worldwide, placing it second on the list of internet users worldwide. The most significant use of computers and the internet is online shopping. "We have them in the government (e-governance, online portals, etc.), banking (ATM, debit card, online banking, mobile banking, etc.), education (online lectures, smart boards, etc.), entertainment (facebook, twitters, online cinema ticket booking, etc.), ticket reservations (online air ticket, online railway ticket, etc.), information retrieval (google, wikipedia etc.), and entertainment (online lectures, smart boards Many things have changed and are still evolving." Most Indians use the internet for various purposes, but they are also unaware of the hazards and vulnerabilities associated with it. There is a critical need for some weaponry to safeguard internet users in this situation.

Singh, Kumar & Gupta (2016) said that in the 1990s, India began a phase of economic liberalization. To encourage foreign investment, one of the primary aspects of this strategy has been to simplify laws and regulations. This makes India more accessible from a legislative and business standpoint. However, there are still challenges to be solved, one of which is the outsourcing company's need to comply with Indian privacy requirements. Although India lacks specific privacy and data protection rules, proxy laws and other indirect protections give businesses that outsource services appropriate protection. The Indian I.T. Act provides the primary legal framework and other related statutes.

Following liberalization, the private sector invested significantly in the telecom, power, and information technology (I.T.) sectors. Many developing nations, including India, are pursuing infrastructure development utilizing private investment. Concerningly, regulatory frameworks provide little attention to catastrophe preparedness and recovery. Because no company has complete control over the I.T., telecom, or power sectors, it is up to many parties to plan for and recover from crises. All business owners are motivated by the "bottom line," and they cannot spend money on ventures that do not generate revenue. Customers at the enterprise level value dependable service, including sufficient disaster preparedness and recovery levels. They would have been willing to pay for the business-critical ICT infrastructure's dependability and durability. However, the status quo is upheld in the absence of systematic risk research and benchmarking of ICT infrastructure (Shairgojri & Dar, 2022)

LITERATURE REVIEW

Singh and Malik (2021) opined that cybersecurity threats are a recurring issue that comes from various sources. They act riotously by using themselves in a succession of disruptive acts directed at people, large corporations, governmental institutions, and other digital infrastructure. The effects of such hostile actions may significantly affect public welfare, economic stability, national security, and general well-being. It might be challenging to pinpoint the attack's origin and the perpetrator's identity. It is challenging to pinpoint the attacker or attackers since they often substitute other networks hacked by other systems. Such disruptive I.T. use puts the finer points of the digital world's pragmatism to the test. In order to protect data and information, including numerous other

internet-based services, cyber security is essential. Cybersecurity may be summed up as the defence of information against hostile actions and the defence of equipment that can be used to access information, including servers, computers, smartphones, mobile phones, tablets, and other electronic systems. Information technology security and electronic information security are other names for cyber security (Awan et al. 2017).

Any malicious attempt to infiltrate or hack into a computer or network of a person or organization to cause injury, damage, or destruction is a cyber-attack. A cyber-attack often has two predetermined goals: first, to cripple or destroy the designated target facility or digital infrastructure, and second, to get access to the sensitive data kept on the computer or network. Depending on its severity, scope, and character, a cyber-attack can be classified as cyber-terrorism, cyber-campaign, or cyberwarfare. A culprit looks for weaknesses in a computer or network to conduct cybercrime. These weaknesses might be caused by faulty hardware or software. The offender uses a variety of strategies and tactics to take advantage of these vulnerabilities (Chaturvedi et al., 2014).

Saxena et al. (2012) said that Cyber terrorism is any act of terrorism that uses digital technology to cause the malfunction or destruction of cyberspace. It may also be described as the fusion of terrorism and the internet. In order to intimidate or compel a government or its citizens in the service of political or social aims, it is typically characterized as ugly illicit assaults on computers, networks, and information, as well as threats of attacks on these targets. An act of cyber terrorism is defined as the use of cyberspace by terrorist groups or any other illegal organization to plan terrorist attacks, recruit people under the guise of false ideologies, disseminate malicious context and false propaganda to brainwash people, obtain funding from online sources, or pursue illegal political or economic objectives.

P.S. et al. (2018) says that what we mean when we talk about cyber-security is the defence of computer systems and electronic devices against malicious cyberattacks, opportunist malware, and unintentional malware installation by users. Globally, the range of cyber threats is constantly growing. Every year, attempts are undertaken in the modern world to steal data and sensitive, private, or classified documents to reveal information for political or commercial benefit. The population of India hail from a wide range of social and economic backgrounds. People use various technologies, from pricey, highly protected technological devices to affordable cell phones, depending on their financial status. Because of this, it is challenging to create a unified set of legal and technological standards that govern data protection.

Additionally, the general public has poor digital literacy and familiarity. Cybersecurity is a growing issue that concerns all governmental entities, businesses, and individuals. As more and more elements of our lives are being recorded online, such as our credit card information, travel diaries, and adorable kitten videos, maintaining the security of our personal data has elevated to a top concern. Virus assaults, ransomware, phishing, and other threats are only a handful of the numerous threats to cyber security.

Kshetri (2016) found that international politics, which are heavily preoccupied with the fault lines from the Cold War, have been unable to come to an agreement on either internet governance or cyber security measures. Major medical facilities, cyber enterprises, financial activities, and essential infrastructure are all connected to the internet. Governments do not all now perceive the same threats. Russian and Chinese concerns include the use of social media, the materials posted there, and their power to influence politics, if the western governments support sustaining the freedom and independence of the internet, free speech, and their own cyber laws. The security of networks, their capacity to transmit accurate information, and their independence from state-sponsored or criminal networks are major issues for Western countries. The management of these networks and the information being sent through them are the main concerns of the Chinese and Russian populations as well as those of other authoritarian governments. Through the recommendations of the Governments' Group of Experts (GGE) of the United Nations, a global consensus on internet regulation is gradually emerging. The GGE has gradually come to some agreement on cyber security concerns following several failures (Kim et al. 2009).

Bahuguna et al. (2019) stated that professionals in information and security are no longer certain that their critical systems won't be compromised. Therefore, it is crucial to continuously and repeatedly analyze and improve their proficiency. Cyber challenges trainings and a number of current training resources help security professionals become more realistic at mitigating a cyberattack. To further limit the surface of attack, a novel and creative strategy must be adopted. It is made clear from the literature that several researchers have proposed gloomy strategies, such as masking I.P. addresses or making them anonymous, and some have even invented dynamic addressing, but they have not yet been put into practice. This essay examines many perspectives on the discovery of a novel key that combines proper research with active defence in order to adapt dynamic

transformation (Srinivas & Vivek, 2014). The majority of cyberattacks against cyber systems are often carried out using contemporary technological methods with an information technology system as their target. However, as attackers have expanded their attention on and participation with end users over the past few years, the landscape of security events has altered significantly. In terms of cyberattacks, phishing, spam, and ransomware are the most focused assaults that are frequently used to target end-users' sensitive information. A third of the firms are concerned about the protection of their employees' sensitive data. This is even more pertinent when users, researchers, and technologists consider the processing, storage, and vulnerability of virtualized assets that reside in cloud-based infrastructures (Parasuraman & Kumar, 2019).

Because of its reliance on information technology, India's economy is expanding at one of the quickest rates in the world. The greater reliance on technology has given rise to new issues. According to statistics, the majority of hackers are motivated by financial gain. Due to the complexity of contemporary banking and financial services, both state-sponsored and non-state attacks are conceivable. Due of the connection between contemporary technology and crime, it is now simpler to conduct fraud, theft, and other wrongdoings. "Economic instability will result from a lack of cybersecurity, which is essential for economic security. Network security breaches, data loss, and other white-collar crimes have increased in India's financial sector, placing the banking sector at risk of significant losses (Kumar et al., 2020).

Shairgojri & Dar (2022) founded that The face of modern warfare has altered as a result of the development of cyberspace. Today, cyber warfare is viewed as the fifth sphere of conflict. A nation state using a malicious computer program, virus, or worm to undermine, harm, damage, or destroy the digital infrastructure of another nation-state can be said to be engaging in cyber warfare. This can have serious repercussions, including loss of life and property, economic instability, damage to various military installations, disruption of technologies, and a breach in national security (Awan. et al. 2017).

OBJECTIVES

1. To ascertain measures to Improve Cyber-security in Indian Organizations.
2. To identify important methods of ensuring cyber-security.

METHODOLOGY

The study is empirical in nature. Number of participants was 179. Structured questionnaire was used to collect data. To identify outcome of the Mean and t-test were applied. Sampling method was convenience sampling.

OUTCOME

Table 1 displays Respondent's gender, male respondents are 56.98%, and females are 43.02%. Looking at the Age, 23 to 26 years are 24.02%, 26 to 30 years are 31.84%, and more than 30 years are 44.13%. Regarding Organization type, Finance / Banking are 28.49%, Automobiles are 26.26%, Manufacturing are 21.79%, and other are 23.46%. With reference to the Departments, Legal Department are 29.61%, Operations / Back office are 26.26%, Compliance are 21.79 and other are 22.34%.

Table1: Respondent's Demographic Details

Variable	Number of respondents	Percentage %
Gender		
Male	102	56.98%
Female	77	43.02%
Total	179	100 %
Age		
23 to 26 years	43	24.02%
26 to 30 years	57	31.84%
More than 30 years	79	44.13%
Total	179	100 %
Organization Type		
Finance / Banking	51	28.49%
Automobiles	47	26.26%
Manufacturing	39	21.79%
Other	42	23.46%
Total	179	100 %
Departments		

Legal Department	53	29.61%
Operations / Back office	47	26.26%
Compliance	39	21.79%
Others	40	22.34%
Total	179	100 %

Table2: Measures to Improve Cyber-security in Indian Organizations

Sr. No.	Survey Statement	Mean Value	T-Value	Sig.
1.	The rule of implementing password is the best and easiest way of improving cyber-security	4.33	18.107	0.000
2.	Updating system and computer applications on regular basis maintain cyber-security in Indian organizations	4.12	15.345	0.000
3.	Implementation of VPN (Virtual private network connection) for every connection is another way of maintaining cyber-security	4.09	15.171	0.000
4.	Applications or services that are not in use should be removed or uninstalled	4.00	13.638	0.000
5.	To improve cyber-security awareness among employees in organization special training programs must be conducted	4.19	16.496	0.000
6.	Security surveys must be conducted on regular basis to assess the security of the organization	4.07	14.582	0.000
7.	Multi-factor checkpoints must be implemented for authentication of system and applications	4.23	16.921	0.000
8.	Another essential cyber-security tip is encrypting important files wherever it is possible, and also create backups of all files	4.21	16.720	0.000
9.	Anti-virus software must be installed on all computer systems as it is the best way to ensure cyber-security	4.03	14.061	0.000
10.	Management of risk of third-party vendor as they usually do not follow security measures	3.49	6.806	0.000

Table 2 shows mean values of the “Measures to Improve Cyber-security in Indian Organizations” the first statements of T-test is the rule of implementing passwords - The rule of implementing password is the best and easiest way of improving cyber-security (4.33), next statement is Updating system and computer applications on regular basis maintain cyber-security in Indian organizations (4.12), Implementation of VPN (Virtual private network connection) for every connection is another way of maintaining cyber-security (4.09). Un-installing unused application is also important - Applications or services that are not in use should be removed or uninstalled (4.00), to improve cyber-security awareness among employees in organization special training programs must be conducted (4.19), Security surveys must be conducted on regular basis to assess the security of the organization (4.07), Multi-factor checkpoints must be implemented for authentication of system and applications (4.23). Another essential cyber-security tip is encrypting important files wherever it is possible, and also create backups of all files (4.21), Anti-virus software must be installed on all computer systems as it is the best way to ensure cyber-security (4.03), Management of risk of third-party vendor as they usually do not follow security measures (3.49). T-value of each statement of the survey in the context of Measures to Improve Cyber-security in Indian Organizations are significant because t-value of statements are positively significant as the value is less than 0.05.

CONCLUSION

India's vital infrastructure, which consists of the energy, banking, defence, and telecommunications sectors, is vulnerable to cyberattacks that might have a negative effect on both the economic and public safety of the nation. The protection of vital informational infrastructure has been elevated to a position of considerable importance in the framework of the country's overall security, following the practices employed by other digital nations. Indians shouldn't wait to create a national security strategy that includes cybersecurity as a significant part of the strategy, as other countries across the world have done. This has been done effectively by other countries. The quantity and complexity of cybercrimes are increasing in India's current criminal landscape,

mostly due to the internet's recent growth surge, which is due to the internet's accessibility and availability via smartphones, which have recently become more affordable and powerful. This has made a large portion of this country's technically untrained populace a target for cybercriminals. The government's recent decision to demonetize outdated currency notes has given this movement further momentum. The problem is made worse by the fact that security was not given top priority while designing the current computer and communication infrastructure. As a result, the cybersecurity must be enforced through implementation, which will always fall short of security-by-design.

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The Impact of Psychological Factors that Affect Spoken Discourse: A Survey

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ABSTRACT

The study examines the psychological aspects that influence students' language acquisition. This study examines learners' views at various stages and sheds light on the many facets of second language acquisition. It aids in the analysis of the language learner's difficulties. It highlights cognitive approaches to language development. Speaking is one of the key abilities in learning a language, especially English. The study results indicate that psychological obstacles are more significant than pedagogical techniques. By using self-administered questionnaires, 200 ESL students provided primary quantitative data. The results of the data through statistical analysis showed that the only internal elements influencing students' L2 learning were their motivation and personal goals. This research may interest scholars who look at second language acquisition in the Indian educational system.

INTRODUCTION

Language is a crucial component because learning a second language is influenced by a variety of circumstances. The second language learner's linguistic faculty is a key factor in determining the learner's proficiency. There are two variables. Age, ability, motivation, temperament, learning ability, and learning strategies are internal variables. "External influences include social context, educational background, etc. Both internal and external influences influence effective learning. The most important factor is motivation and other affective variables. The interaction of the variables affects second language acquisition" (Gaybulloyevna, 2022, p.277).

Several general characteristics also influence the learning of a second language. They include L2, language prowess, vocabulary, etc. The foundational element of learning a second language is vocabulary. While very little can be said without grammar, nothing can be communicated without vocabulary. The single most important aspect of learning a language is vocabulary.

According to Waluyo and Vidákovich(2022), "Numerous elements impact language learning. An individual encounters numerous difficulties both inside and outside while learning to speak. Confusion, fear, and anxiety are a few issues that have grown inside the person. Some of the issues that the person faces externally include criticism and negative reinforcement. A person's biggest issue comes from their peer group, which criticizes and makes fun of them. This results in an inferiority complex, which stops language learning. The situation reaffirms their belief that they cannot develop language competence in L2." (p.4). The peer influence should help the person learn the language, but their unhelpful behaviour could cause an inferiority mentality to grow. Instructing someone in their L2 in a multilingual nation like India is important.

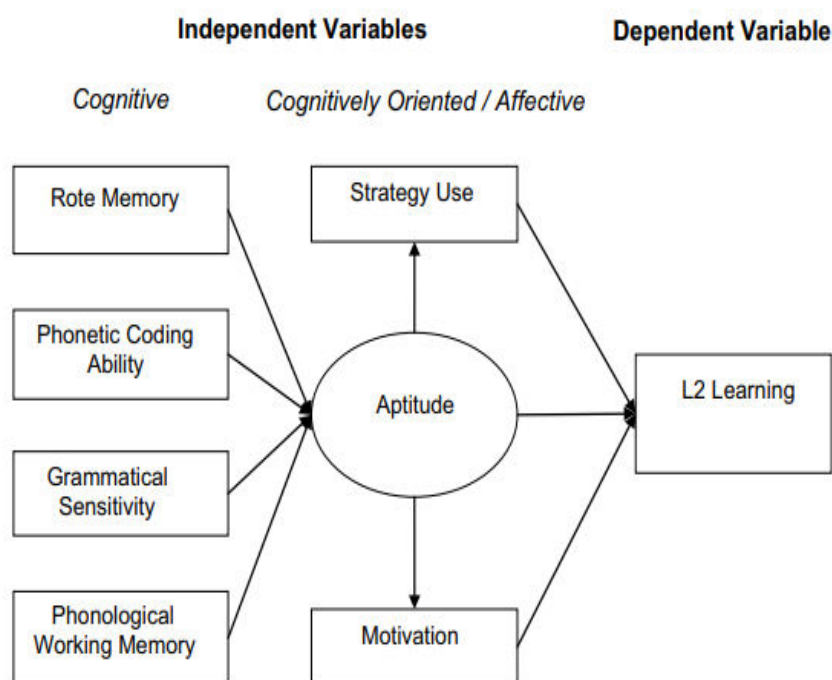
According to psychology and SLA theories, the efficiency of teaching to users of second languages is controlled by both the external interaction in which pupils exist and by their internal features. The effectiveness of instructor communication and the enthusiasm of English teachers are examples of external environmental influences. Internal factors that affect L2 learners are typically linked to personal objectives and motivations, attitudes, age, gender, self-perceptions, and motivation.

PSYCHOLOGICAL FACTORS AFFECTING L2 LEARNING

Although the outside environment impacts how ESL students acquire their second language, it is generally agreed that internal factors have a greater impact. The motivation, attitudes, beliefs, and perceptions of students are implied by these elements, together with other affective and cognitive characteristics. The corpus of material currently in existence indicates a high correlation between motivation and L2 competency in international students. For instance, Alavi, Dashtestani, & Mellati(2022). discovered that motivated language learners were successful. Additionally, their motivation assisted students in producing learning and overcoming challenges they faced during the L2 learning process. Likewise, motivation can have either an extrinsic or an inner origin.

According to this fact, L2 students' desire to acquire their L2, which is related to behavioural variables made by their attitudes and views and the social milieu in which they dwell. As shown in figure 1, cognitive factors like motivation, strategy use, aptitude, memory, phonology, and grammar significantly influence language learning. The main factor influencing L2 learning among the independent factors is motivation. The affective variables are shown in figure-1

Figure: 1 Cognitive and affective variables in Language Learning



According to Quirk (2021), one of the internal motivational elements that influenced students' performance in learning L2 was their objectives and motivations for learning. Alavi, Dashtestani, & Mellati (2022) discovered that learners motivated by their objectives and motives were more successful at learning a second language than those not (p.472). However, Hsu & Lin (2022), focused on how the outside environment affects students' L2 learning. The extrinsic motivational theory proposes that this atmosphere needs to be welcoming and encouraging for pupils to succeed.

Like motivation, attitudes among students are seen as the most crucial element influencing their L2 competency (Armakolas, Panagiotakopoulos, & Karatrantou, 2021). According to Mayr & Morris (2021), "students may have both favourable and unfavourable attitudes about the L2 they are learning. On the one hand, L2 students may have favourable perceptions of Speakers of a language and the cultures they represent" (p.13). According to Wang, Derakhshan, & Zhang (2021), these real exposure help students acquire L2 since they are eager to interact with native speakers.

Therefore, L2 students may be more motivated to learn the target language. Negative attitudes, on either hand, are thought to hinder L2 learning. Lou & Noels (2019) claims that "L2 students' unfavourable attitudes are typically brought on by issues with the teacher or native speakers as well as a lack of motivation. However, not all negative attitudes result in undesirable consequences". (p.1021) Students who have trouble learning a second language could still succeed in the process, as mentioned in (Hafis & Widya, 2021, p.266)

There is also widespread agreement among prior scholars regarding the importance of age in L2 learning. Li, S. (2022) said, "TESOL programmes were more effective and successful for young students than adults. The fact that children's brains are suppler than adults' is one hypothesis that might apply (p.16). In addition, Gul, M., & Muhammad (2022) observed that because adults could get started more quickly than children, they were better L2 learners. Soroka (2018) made an effort to determine how gender affected learning a foreign language. He concluded that their learning processes were also different because society established diverse social roles for men and women. This claim is consistent with social constructivism, which contends that pupils' ability to speak another language is influenced by the environment in which they live (Rano, 2022). was unable to determine whether or not male and female students' success in learning L2 differed in response to the use of various learning strategies.

According to Rezaeian & Seyyedrezaei (2021), "Self-concept beliefs are among the elements that influence pupils' capacity to acquire language. Students that exhibit a high degree of self-confidence are more effective in their L2 learning" (p.59). In addition, because anxiety prevents students from feeling completely happy with their achievements, it has a detrimental impact on their capacity to acquire a second language. Similarly, Umida, Zarina, & Shahram, A. (2020) observed that nervous learners had several traits in common with

competent speakers, which led to a greater concern about their mistakes than non-anxious students. According to Young D (1990), the degree of anxiety and pupils' success in learning L2 go hand in hand. For instance, as per Sharmin (2019), "individuals who are feeling anxious or angry are more likely to eliminate barriers in their way, which can lead to academic success" (p.41)

"L2 acquisition is impacted by motivation in a variety of ways. It is a fundamental prerequisite for L2 acquisition, and acquisition must be healthily maintained throughout time" (Mercer, S., & Kostoulas, 2018, p.19). Motivation is a long-term determinant of L2 learning (Skander, S., & Benadda, 2021). Though motivation has been interpreted differently in these and other research studies, most studies deal with motivation from a social-psychological standpoint. In other words, an L2 learner who is extremely motivated will wish to fit in with native speakers. The desire to fit in as a respectable member of the L2 speaker community is known as integrativeness.

It appears more complicated that social anxiety is indeed a psychological factor. If a learner has the opportunity to engage with people, his fear levels increase, causing him to struggle and harming his ability to develop language. Promoting social chances can aid in overcoming social anxiety, and more of these behaviours lead to positive changes and advancements in life.

There are numerous difficulties that students from rural and urban areas have when learning a language. The trainees face the language learning challenge with illiterate guardians. One from an educated family will have fewer problems than someone who lives in an urban area. The objective language is improved sufficiently when considering children from educated families. Contrary to expectations, the provincial territory receives minimal attention when developing fluency in the objective language. One of the emotional challenges that students deal with is their financial situation. They require additional funds to receive top-notch instruction. Compared to pupils from lower socioeconomic backgrounds, students from wealthy homes receive superior language instruction. This causes the students from low-income families to feel inadequate.

The fundamental cause of language acquisition failure is a lack of training. The learner should practice all four skills: listening, speaking, reading, and writing. The aptitudes are anticipated to enhance with proper pedagogy. All students learning languages must address the severe problem of lack of training. Without instruction, a person's ability to speak another language will vanish from memory.

In learning, psychological aspects are important. The elements that formulate, excite, and advance learning in various ways are psychological. Mental processes have a strong hold over language ability. Positive and negative psychological elements both reveal themselves. These elements play a significant role in learning and using the second language. It can be the biggest challenge to students' speech performance. Most intriguingly, research has revealed a connection between L2 learning tactics and motivation (Abdullaev, 2021, p.821). More motivated learners employ more cognitive approaches more frequently, resulting in greater or better learning. The simultaneous moderating effect of motivation and technique utilisation should therefore be examined in a comprehensive framework of L2 learning that considers the influence of L2 potential on learning. The researcher is unaware of any research that has done this so far.

STRATEGY AND DATA COLLECTION

For the sake of this project, the survey strategy, a part of the deductive approach, has been chosen. Since surveys make it possible to collect primary data incredibly cost-effectively, they are popular among researchers and practitioners in the field of Education (Fowler Jr, 2013). Questionnaires are two main methods of gathering data used in the survey strategy. Due to their capacity to quickly produce a huge amount of data, self-administered surveys are consistent with this investigation (Soroka, 2018). Additionally, collecting quantitative data, which is easily assimilated graphically and statistically, is the primary goal of self-administered surveys. Finally, this decision is reinforced because self-administered surveys are typically employed to establish a cause-and-effect link between variables. This data collection method was chosen since the study aims to investigate how socio-psychological factors affect students' acquisition of a second language.

Although using self-administered questionnaires has several benefits, the data obtained using this method is not as diverse as that obtained using other methods (Samson, S., & Karthiga, 2022). "Self-administered questionnaires, a substitute for open-ended surveys, do not let respondents provide in-depth responses. Instead, participants are given a choice between several predetermined responses, some of which might not necessarily reflect their beliefs and perceptions" (Alamar, A. (2022, p.168). Another drawback is this data collection method's lack of accuracy and dependability compared to interviews. The key point is that the investigator is not participating in the data collection procedure during a questionnaire survey. There is, therefore, no assurance

that questions are completed by genuine target population participants or are even completed at all (Saqr, Viberg, & Peeters, 2021, p.16). This fact draws attention to another drawback of questionnaire surveys: a reduced response rate.

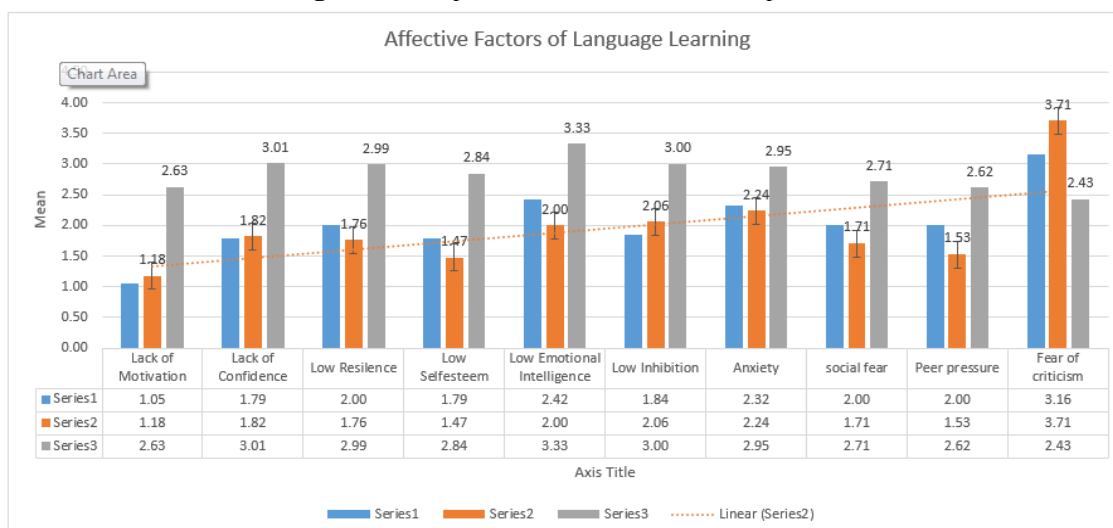
SRM University served as the project's sample. Potential responders were sent about 300 questionnaires via social networking sites. Due to missing data, only 224 of the 400 questionnaires returned to the researcher were used in the final sample. Both statistical and graphical analysis techniques were used to process the gathered data. The analysis tools utilised in this dissertation were variance analyses (ANOVA), descriptive analysis, linear regression, and visual presentation. Excel and SPSS were used for all calculations. All the analysed variables are shown and defined in the following table.

Table: 1 Data of Affective Factors

Description	Cluster		
	1	2	3
Lack of Motivation	1.05	1.18	2.63
Lack of Confidence	1.79	1.82	3.01
Low Resilience	2.00	1.76	2.99
Low Self-esteem	1.79	1.47	2.84
Low Emotional Intelligence	2.42	2.00	3.33
Low Inhibition	1.84	2.06	3.00
Anxiety	2.32	2.24	2.95
social fear	2.00	1.71	2.71
Peer pressure	2.00	1.53	2.62
Fear of criticism	3.16	3.71	2.43
Average Value	2.04	1.95	2.99
	Low	Medium	High

As mentioned in Table1, there were ten variables. All the ten variables were related to affective filters. There were three measurements, namely, low, medium and high. All the blue bars indicate a low level of acceptance; all the orange bars indicate a moderate level, and the grey ones indicate a high level of acceptance. The effective variable is the term used to describe how people feel during the learning process and how these feelings and attitudes affect motivation. (Lukashevich, K. K. (2020). Scientific research shows that emotion and cognition are essential and interrelated features of human neural activity. The significance of emotional elements in acquisition has been described by (Newton et al., 2019). How information is stored in the brain and later recalled, cognitive techniques employed, attention and working memory, and motivation are all influenced by effect. Learning can be controlled by employing effective tactics, such as lowering anxiety, supporting oneself, and keeping an eye on one's feelings (Wei, Gao, K., & Wang, 2019). The successful application of such emotive techniques can result in cognitive advantages such as maximum control over student learning. Klieme (2021) concludes that effective methods are just as important for effective language learning as metacognitive and cognitive strategies. The graphical indication of the responses of the affective variables is given in figure-2.

Figure: 2 Graphical indication of the responses



Since descriptive statistics are insufficient for a conclusive analysis, a two-way ANOVA was performed. When examining three or more variables, an ANOVA is useful. It resembles numerous two-sample t-tests. But it contains low type I flaws and is suitable for various problems. ANOVA comprises distributing the variation across several sources and classifies differences by contrasting the means of every group. The results of ANOVA are mentioned in table-2.

Description	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
Motivation	7.822	224	.800	224	9.778	.000
Confidence	.256	224	.104	224	2.455	.005
Resilience	.255	224	.512	224	1.498	.210
Low self-esteem	.461	224	.742	224	1.622	.000
Emotional Intelligence	8.982	224	.691	224	13.005	.000
Inhibition	7.600	224	.435	224	17.487	.000
Anxiety	3.047	224	.410	224	7.440	.001
social fear	5.215	224	.589	224	8.852	.000
Peer pressure	5.687	224	.503	224	11.295	.000
Fear of criticism	7.822	224	.800	224	9.778	.000

The Annova table shows the significance of the questionnaire. An alpha value of less than 0.5 shows the significance of each construct. Except for resilience, the significance was high in all constructs indicating high reliability of the questionnaire.

ANALYSIS OF THE CONSTRUCTS IN THE QUESTIONNAIRE

Q1. Motivation

In motivation, the F value was 9.778. The significance is .000. When learning a language, motivation is crucial. Motivation fosters self-confidence in individuals, resulting in competent second-language communicators. Additionally, it successfully develops lifelong learners who remain active even after achieving a specific objective. In-class and extracurricular strategies are required for English teachers to inspire their students. Harlen & Deakin Crick (2003) asserts that "positive self-concept, high self-esteem, positive attitude, clear comprehension of the goals for language acquisition, constant active engagement in the language learning process, and the relevance of conducive environment could contribute to the accomplishment of language learning" (p.171) They claim that attitudes, self-perceptions, objectives, engagement, contextual factors, and personal characteristics are the six elements that have the most influence on motivation for language learning. Above all, it is firmly considered that three aspects contribute to motivation for language learning: self-assurance, success and satisfaction experienced, and positive teacher-learner and learner-learner connections. All three elements are related to one another in the early stages of developing motivation.

Q2 Self-Confidence

Self-confidence is the second construct in the researcher's questionnaire. With a value of .000, the reaction was significant for this variable as well. This concept gives students the drive and inspiration to feel good about their accomplishments. Additionally, it motivates individuals to learn the desired language, take pleasure in classroom activities, and engage in genuine communication. A person's belief in their capacity to complete the job is at the core of all learning (Adams, T. M., & Ewen, G. W. 2009). In general, language learners who succeed appear to have stronger self-esteem than unsuccessful language learners. He is prevented from completing that task by pursuing a specific language accomplishment by lacking confidence in his abilities. Furthermore, it is generally accepted that once pupils develop self-confidence, it gradually grows along with success, happiness, and positive connections.

Q.3 Resilience

The third construct is resilience, with a value of .210. Students who have achieved achievement have more motivation to seek new objectives. Resilience enables language learners to appreciate the value of effort and enjoy conversing with others. Some people may feel fortunate when they can express their ideas to others, while others may feel accomplished when they successfully execute a difficult task in a certain language. The learner consistently has a sense of success when he recognizes the extent of his growth and accomplishment.

On the contrary, some people value compliments made by others. According to De Kraker, J. (2017)., "fostering a sense of achievement is closely tied to receiving external recognition for one's progress. The feelings of contentment and achievement are comparable; people are always satisfied with success, regardless of whether they are learning a language or anything else".(p.103). In a nutshell, it is firmly held that experiencing achievement and feeling satisfied go hand in hand.

A learner will struggle to excel in a pressured setting, claims Russell, Smith, & Larsen (2020). Students must be able to apply the knowledge they have learned in the classroom to tasks other than those they were particularly instructed on. This suggests that for L2 learners to succeed and feel satisfied, teachers must provide a comfortable learning atmosphere so pupils may perform well. A language lesson should also include a variety of exercises and resources that target each essential skill.

Q.4. Self-esteem

The fourth factor relating to self-esteem was equally important. Self-esteem is the total perception of oneself, including one's perception of one's strengths and weaknesses. When pupils have good self-esteem, they feel good about themselves and believe they are worthy of other people's regard. Low self-esteem causes people to place little importance on their ideas and opinions.

Q.5 Emotional intelligence

The fifth variable is emotional intelligence. Emotionally intelligent students can better analyze situations. Students benefit from improved interpersonal interactions and are more composed in their approach to academic challenges. A student who is more in charge of a problem, the better they can handle it.

Q.6 Inhibition

Aside from physical issues, one of the most important parts of learning a language is "inhibition, " which describes a temperamental propensity to show caution, apprehension, or restraint in response to strange people, things, and circumstances. In this study, an overwhelming majority of them have admitted that they are inhibited in language classes.

Q7 Anxiety

Low academic progress in learning a second or foreign language apparently correlates with high linguistic anxiety levels. Second, language anxiety is socially associated with a predisposition to avoid verbal relationships more frequently. One of the psychological phenomena that have received the most research is anxiety. The concept of anxiety encompasses introspective sensations that are ontologically inaccessible and a combination of overt behavioural traits that may be scientifically researched. Anxiety is generally the experience of tension, trepidation, nervousness, and worry. Communication apprehension, perceived stress, and negative mood are the three categories into which anxiety has traditionally been divided. Although there isn't a clear distinction between these three groups, the differences can be roughly distinguished along a spectrum from consistency to impermanence, with predisposition anxiety associated with a generally stable propensity to feel anxious in a variety of situations on one end and a moment-to-moment encounter of a transitory psychological response on the other. Situational anxiety, which represents the likelihood of being apprehensive in a certain situation, lies in the middle of the continuum. This question was asked to comprehend linguistic anxiety within a larger framework.

Q8 Social Fear

Most of the students expressed that they have social fear of speaking. Most students encounter tension or anxiety at a certain point in their lives, which typically goes away when it is relieved. However, if the emotions persist, they might prevent you from reaching your objectives.

Q9 Peer Pressure in Learning

Most of the students in the study faced peer pressure. Peer pressure occurs when students are persuaded to take a particular action, usually one that is not favourable, by their classmates. This happens to a lot of students. Some parents witness their formerly well-behaved peers change their tune and exhibit negative behaviour. According to a recent study, peer pressure may lead some students to forego potentially fruitful educational options. If they worry about what their peers think of them, some learners may forego intellectual chances in college.

Q10 Fear of Criticism

The final variable in the study is fear of criticism. The f-value is 9.778. Fear of criticism brings on several psychological issues. The fear of criticism deprives us of self-esteem, diminishes our ability to take the initiative, shreds our sense of strength and sufficiency, eliminates self-reliance, and has many other detrimental

impacts. Children suffer significant psychological injury when their parents critique their behaviour more than they praise and support it.

FINDINGS

These results show that the sample was chosen from among the students, who comprise a representative sample. This distribution is useful for the study since it determines if the age variable affects the respondents' L2 learning. This study sought to determine how socio-psychological factors affected second language acquisition within the framework of the higher education system in India. This goal was achieved using self-administered questionnaires to gather primary statistical results from 224 ESL students. ANOVA, descriptive statistics, linear regression, and graphic representation were the analysis techniques used in this study. The initial study goal was to review the most pertinent second language theories based on the body of existing research. According to research findings, it is crucial to conclude that second language learning is mediated by affective elements as its internal qualities, such as perceptions, values, and attitudes (Haines, A., & Jones, 1994).

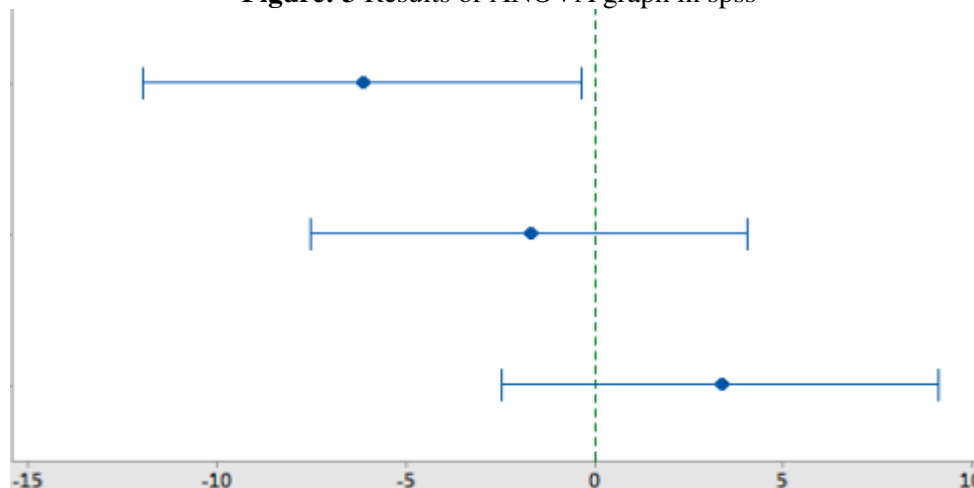
The second goal was to determine the internal and environmental factors that affect how well second language students pick up their second language. This goal was only partially met in the literature review. Using the review's findings, it is crucial to conclude that various internal and environmental factors influence international students' capacity to learn their second language. For instance, the support and skill of teachers and the social context in which L2 learners are present are typically considered internal factors. Additionally, it is widely believed that students' motivation, personal objectives, attitudes, and perceptions are some irrelevant elements that determine the effectiveness of their L2 learning.

However, the empirical research findings suggest that not all of these characteristics influence L2 learning in international students. The second goal was to pinpoint the psychological variables most crucial for international students learning L2 in India. The investigation and conclusions chapter completely met this goal. It can be inferred that the only internal elements influencing students' L2 language learning are their motivation and personal goals. The analysis's findings have shown that L2 students perform better in their L2 studies the more interested they are in developing their English language skills and the more enthusiastic and open-minded they are about learning this language.

Similarly, Van Bavel et al. (2019) discovered that ESL students' motivation and second language skills were highly associated. The investigation also failed to find any statistically significant connection between the outside factors and L2 learning. In contrast to this experiment, Wigfield A. & Koenka (2020) reported that students' second language acquisition was impacted by the personalities and enthusiasm of their professors. It was also determined that there was little correlation between students' second language skill and their age or gender.

Considering the analysis findings, it can be concluded that psychological factors significantly impact students' second language learning. The figure-3 of the graph obtained from SPSS ANOVA proves that a significant number of students had responded to the questionnaire. The first line shows the low acceptance of the study's questionnaires. The second level shows a moderate level of acceptance, and the final line shows a higher level of acceptance. This study indicates a higher level of acceptance in all the ten questions. Therefore, this study was significant. The significance is shown in figure-3.

Figure: 3 Results of ANOVA graph in spss



CONCLUSION

As an adult learner, several disparate components must converge to achieve advanced competence in a second language. The student requires top-notch exposure to language, lots of chances to produce various sorts of activities, and a lot of incentives. The learner must have access to linguistic concepts which explain the pragmatic competence of the language, find efficient language learning techniques, and, as any learner is aware, see genuine, concrete results from their learning efforts. It is only reasonable for linguists to look for a specific explanation for why certain languages flourish, and others fail. However, a lot of people reach an advanced level of language proficiency. Advanced-level competency may arrive a few semesters earlier or later for any person working toward it if their approach to learning changes, independent of their cognitive talents. The results of this study's data show that it may be impractical to operationalize aptitude as a construct susceptible to such tiny variations in L2 learning. The findings of this study give us important data that aid in conceptualizing the components that contribute to speakers' acquisition of English in an L2 context.

The findings show that L2 aptitude comprised of rote memorization, phonological ability, grammatical awareness, and linguistic competence is insufficient. Affective variables are far more important. Additionally, the affective factors of motivation and strategy utilisation modulate the effects of L2 capability on advanced-level learning. L2 aptitude predicts end-of-course performance in the intensive course on language learning. Future studies may concentrate on the interconnected, reciprocal aspects of motivation and strategy use that are seen in these data, on the different effects that aptitude, motivation, and strategy use have on the various L2 skill development domains, or on the connections between rote memorization and the other L2 aptitude factors.

To learn a language, one needs motivation. It boosts the self-confidence of language learners. Additionally, it motivates individuals to learn the desired language, take pleasure in the educational process, and engage in genuine communication. Additionally, motivation is closely related to past achievement and satisfaction. Students usually feel successful when they recognize their growth and accomplishments. Creating a stress-free environment and designing integrated-tasks lessons is necessary to ensure those language learners are satisfied with a lesson. For students to communicate effectively in a target language, there must be trust between the teacher and the students.

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Different Routes for Synthesis of Nanomaterial's

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INTRODUCTION

Nanotechnology is a very diverse field, ranging from extensions of conventional device physics to completely new approaches based upon molecular self-assembly. It is orienting at developing new materials with dimensions on the Nano scale and investigating whether we can directly control matter on the atomic scale. Nanotechnology has the potential to create many new materials and devices with a vast range of applications, such as in medicine, electronics and energy production. As particle size drop from microns to tens of nanometres, nanoparticles cease to behave as bulk and begin exhibiting quantum mechanical behaviour similar to that of individual atoms. Ten hydrogen atoms stacked side-by-side measure only a single nano-meter. The lure of nanotechnology is not just making small devices; but to construct the smallest physical structures possible. The goal of molecular manufacturing is to manipulate atoms individually and place them in a pattern to produce a desired structure. Experts sometimes disagree about what constitutes the Nano scale; but in general, you can think of nanotechnology dealing with anything measuring between 1 and 100 nm. Unusual physical, chemical and biological properties can emerge in materials at the Nano scale. These properties may differ in important ways from the properties of bulk materials or single atoms or molecules. A single atom is only a tenth of a nanometre in diameter.

Nano materials can be synthesised by two methods:

(1) Physical methods and

(2) Chemical methods.

2.2 Physical Methods

Several different physical methods are currently in use for the synthesis and commercial production of nano structured materials. To name a few gas evaporation technique, sputtering, molecular beam epitaxy and pulsed laser ablation. [1-4]

2.2.1 Sputtering

Sputtering is another technique used to produce nanostructured materials clusters as well as a variety of thin films. This method involves the ejection of atoms or clusters of designated materials by subjecting them to an accelerated and highly focused beam of inert gas such as argon or helium. [5]

2.2.2 Molecular Beam Epitaxy

Self-assembled quantum dots nucleate spontaneously under certain conditions during molecular beam epitaxy [MBE] and metal organic vapour phase epitaxy [MOVPE], when a material is grown on a substrate to which it is not lattice matched. The resulting strain produces coherently strained islands on top of a two dimensional "wetting layer". This growth mode is known as Stranski—Krastanov growth. The islands can be subsequently buried to form the quantum dot. This fabrication method has potential applications in quantum cryptography (i.e. single photon sources) and quantum computation. The main limitations of this method are the cost of fabrication and the lack of control over positioning of individual dots.

[6-10]

2.2.3 Chemical Vapour Deposition

Nanostructured materials are also prepared by chemical vapour deposition (CVD) or chemical vapour condensation (CVC) which are used to produce high—purity, high-performance solid materials. That means a chemical precursor is converted to the gas phase and it then undergoes decomposition at either low or atmospheric pressure to generate the nanostructured particles. Precursor gases (often diluted in carrier gases) are delivered into the reaction chamber at approximately ambient temperatures. As they pass over or come into contact with a heated substrate, they react or decompose forming a solid phase and are deposited onto the substrate. The process is often used in the semiconductor industry to produce thin films. CVD is an extremely versatile process that can be used to process almost any metallic or ceramic compound. Some of these include elements, metals, alloys, carbides, nitrides, borides, oxides and intermetallic compounds. It has applications in coatings for a variety of applications such as wear resistance, corrosion resistance, high temperature protection,

erosion protection etc. They also find applications in integrated circuits, sensors and optoelectronic devices, production of novel powders and fibres and optical fibres for telecommunications. [11-12]

Laser Ablation:

Laser ablation means the removal of material from a surface by means of laser irradiation. The term “laser ablation” is used to emphasize the non-equilibrium vapour/plasma conditions created at the surface by intense laser pulse, to distinguish from “laser evaporation,” which is heating and evaporation of material in condition of thermodynamic equilibrium. A typical schematic diagram of laser ablation is shown in the following figure. Briefly, there are two essential parts in the laser ablation device, a pulsed laser (CO₂ laser, Nd-YAG laser, ArF excimer laser, or XeCl excimer laser) and an ablation chamber. The high power of the laser beam induces large light absorption on the surface of target, which makes temperature of the absorbing material increase rapidly. As a result, the material on the surface of target vaporizes into laser plume. In some cases, the vaporized materials condensate into cluster and particle without any chemical reaction. In some other cases, the vaporized material reacts with introduced reactants to form new materials. The condensed particle will be either deposited on a substrate or collected through a filter system consisting of a glass fiber mesh. Then, the collected nanoparticle can be coated on a substrate through drop-coating or screen printing process. Also, liquid phase—pulsed laser ablation technique (LP-PLA) has been evolved as a synthesis technique for the preparation of nanoparticles [13]. Liquid phase pulsed laser ablation (LP-PLA) involves the focusing of high intense laser beam (UV nanosecond pulsed laser source such as the frequency tripled (355 nm) or quadrupled (266 nm) solid state Nd:YAG laser or the KrF (248 nm) or ArF (193 nm) excimer laser) onto the surface of a solid target, which is submerged beneath a liquid.

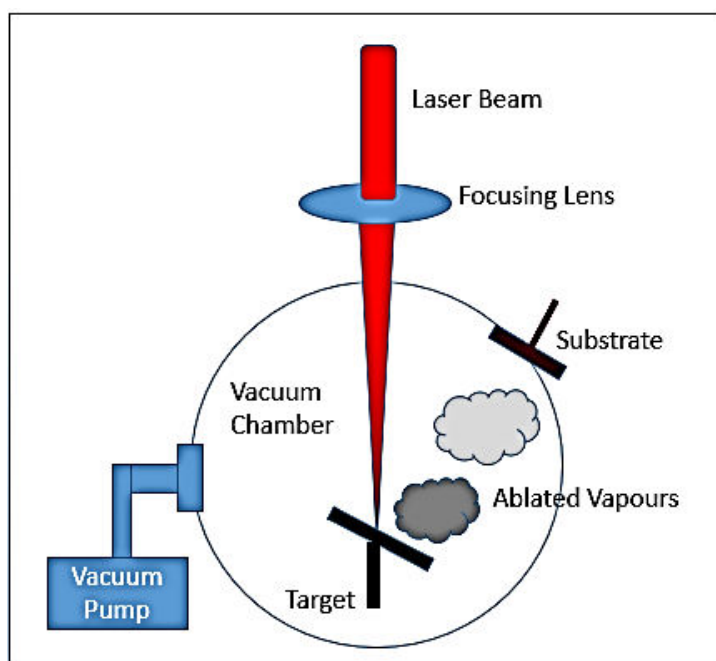


Figure 2.1: Laser Ablation technique.

2.3 Chemical Methods

Recent advances in the synthesis of various nanoparticles using colloidal chemical approaches involve either rapid injection of reagents into hot surfactant solution followed by ageing at high temperature or the mixing of reagents at a low temperature and slow heating under controlled conditions. The advantage of chemical synthesis is its versatility in designing and synthesizing new materials that can be refined into a final product. The primary advantage of the chemical processes over other methods is its good chemical homogeneity, as chemical synthesis offers mixing at the molecular level. Molecular chemistry can be designed to prepare new materials by understanding how matter is assembled on an atomic or molecular level and the consequent effects on the desired material macroscopic properties. A basic understanding on the principles of crystal chemistry, thermodynamics and phase equilibrium and reaction kinetics is important to take advantage of the many benefits that chemical processing has to offer. There are certain difficulties in general chemical processing. Contamination can also result from the by-products being generated or side reactions in the chemical process. Agglomeration can also be a major cause of concern at any stage in a synthetic process and it can dramatically alter the properties of the materials. A few chemical methods are discussed as under.

2.3.1 Solvothermal Synthesis

Solvothermal synthesis is a method for preparing a variety of materials such as metals, semiconductors, ceramics, and polymers. The process involves the use of a solvent under moderate to high pressure (typically between 1 atm and 10,000 atm) and temperature (typically between 100 °C and 1000 °C) that facilitates the interaction of precursors during synthesis. The process can be used to prepare many geometries including thin films, bulk powders, single crystals, and nanocrystals. In addition, the morphology (sphere (3D), rod (2D), or wire (1D)) of the crystals formed is controlled by manipulating the solvent super saturation, chemical of interest concentration, and kinetic control. The method can be used to prepare thermodynamically stable and metastable states including novel materials that cannot be easily formed from other synthetic routes.

2.3.2 Hydrothermal Synthesis

If water is used as the solvent, the method is called "hydrothermal synthesis." The synthesis under hydrothermal conditions is usually performed below the supercritical temperature of water (374 °C).

2.3.3 Spray Pyrolysis

It is basically a solution process and has been widely used in the preparation of metal and metal oxide powders. The process can be simply described as converting micro-sized liquid droplets of precursor or precursor mixture into solid particles through heating. In practice, spray pyrolysis involves several steps: (1) generating micro-sized droplets of liquid precursor or precursor solution, (2) evaporation of solvent, (3) condensation of solute, (4) decomposition and reaction of solute, and (5) sintering of solid particles.

2.3.4 Sol Gel Processing

The sol gel process involves the combination of chemical reactions which turns a homogeneous solution of reactants into infinite weight polymer. This polymer is a three dimensional interconnected pores. The polymer is isotropic, homogeneous and uniform and it replicates its mould exactly and miniaturizes all its features with distortion. Thus the polymer network provides nanostructure and nanophase porosity [15].

2.3.5 Chemical Co-Precipitation Method

Chemical co-precipitation method is widely used for synthesis of nanoparticles and nano structured materials. The method possesses a variety of advantages which include size tenability, improved dispersibility in different solvents, cost effective etc. Nucleation and growth of the nanoparticles are the crucial factors for controlling the size of nanoparticles formed. This is usually achieved by choice of suitable capping agents and functionality of capping agents to prevent the growth mechanism [15]. This method relies on the precipitation of nanometer-sized particles within a continuous fluid solvent. An inorganic metal salts such as chloride, nitride and so on, is dissolved in water (solvent). Metal cations exist in the form of metal hydrate species, for example, $Al(H_2O)^{3+}$ or $Fe(H_2O_6)^{3+}$. These hydrates are added with basic solutions, such as NaOH or Na₄OH. The hydrolysed species condense and then washed, filtered, dried and calcined in order to obtain the final product. During my research work I have extensively used this chemical route for synthesising nanoparticles. Using water as a solvent and inorganic metal salts CdCl₂ and ZnCl₂ as base to react with Na₂S to form CdS and ZnS nanoparticles. The nanoparticles are doped with Nd³⁺, Li²⁺ and Cs. L-Arginine is used as capping agent to control the particle size. Ping Yang and co-workers synthesized ZnS nanoparticles doped with Ni²⁺ and Mn²⁺ by co-precipitation from homogeneous solutions of Zn, Ni and Mn salt compounds, with S₂₋ as precipitating anion formed by decomposition of thioacetamide (TAA).[16]

2.3.6 Micro emulsion

The synthesis of nanoparticles can be achieved by confining the reaction in a restricted in space. This method is exemplified by the synthesis of nanoparticles inside micelles or in microemulsion. A microemulsion is a thermodynamically stable dispersion of two immiscible liquids with the assistance of an emulsifier or surfactant. For example, water-in-oil (w/o) microemulsions appear when water is dispersed homogeneously in an organic media. The w/o microemulsions have attracted considerable interest due to their application in the preparation of metallic nanoparticles, semiconductor quantum dots and polymeric nanoparticles. Microemulsion-based method can be used to synthesize micro homogeneous products with desired stoichiometry, whereas expensive or special instruments are not needed. [17-21]

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Review on Medical Applications of Titanium Dioxide Nanoparticles

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ABSTRACT

Metal oxide nanoparticles (NPs) with liposomes, micelles, quantum dots, dendrimers or fullerenes, metals, and titania NPs are among the polymer NPs currently being produced. It has the potential to be used in medical treatment. It is gaining a growing amount of attention. Titanium dioxide (titanium oxide (IV), titanium oxide, TiO₂) is an inorganic molecule whose photoactivity has sparked contemporary scientific attention. TiO₂ produces a range of reactive oxygen species when exposed to ultraviolet light in an aqueous media (ROS). Photodynamic treatment (PDT) uses the ability to generate ROS and trigger cell death to treat a wide range of disorders, from psoriasis to cancer. The use of titanium dioxide NP as a photosensitizer in the treatment of malignant tumors and the photodynamic inactivation of antibiotic-resistant bacteria has been investigated. Both TiO₂ NP and its composites, as well as other compounds and biomolecules, can be employed as photosensitizers for PDT with success.

Keywords: Titanium dioxide, composite material, nanoparticles, photodynamic treatment, Photosensitizer etc.

INTRODUCTION

In recent years, photodynamic treatment (PDT) has undergone rapid growth. Look for new photosensitizers and media that can be used to administer them. The combination of dyes and nanoparticles (NPs) is one of the many potential ways for photodynamic research that has resulted in increased photosensitizer (PS) selectivity and/or therapeutic impact. Field of paddy. To begin, it's important to understand that NP refers to a certain sort of particle with a size of 1100 nm (including the surrounding boundary layer). "A nano item having all threenanoscale exterior dimensions, and no substantial difference between its longest and shortest axis," according to ISO technical specification 8004[1,2].

Studies on titanium dioxide (also known as titanium (IV) oxide, titania, or TiO₂) nanoparticles, which fall under the category of metallic NPs, are discussed in the current study. Notably, this work was motivated by an evaluation of current TiO₂ functionalization techniques as well as the biological and medicinal impacts of these NPs. Early in the 20th century, TiO₂ was mass-produced as a non-toxic alternative to a white paint colour. Today, more than four million tonnes of TiO₂ are produced annually, and this molecule is used in a wide range of everyday products as an excipient in the pharmaceutical industry, a colourant in white plastics, a sun cream excipient in the cosmetics industry, and as a relatively inexpensive and nontoxic food pigment that has been approved by the relevant European Union authorities for the safety of food additives [3]. When one of the earliest papers on the topic of photocatalytic disinfection was published in 1985, research on the potential uses of TiO₂ NPs began [4]. Since then, TiO₂ NPs have been increasingly used in research on photodynamic treatment. It relates to the photodynamic inactivation of antibiotic-resistant bacteria and the use of TiO₂ NPs as photosensitizing agents in the treatment of cancer. TiO₂ NPs were effectively investigated as photosensitizers in photodynamic therapy, both by themselves and in composites, combinations, or hybrids with other molecules. In order to treat cancerous tumours, titanium (IV) oxide nanoparticles were used, among other things, in the synthesis of bioconjugates with cell-specific monoclonal antibodies or in the creation of black TiO₂ NPs for the treatment of bacteria that have developed resistance to antibiotics [5,6].

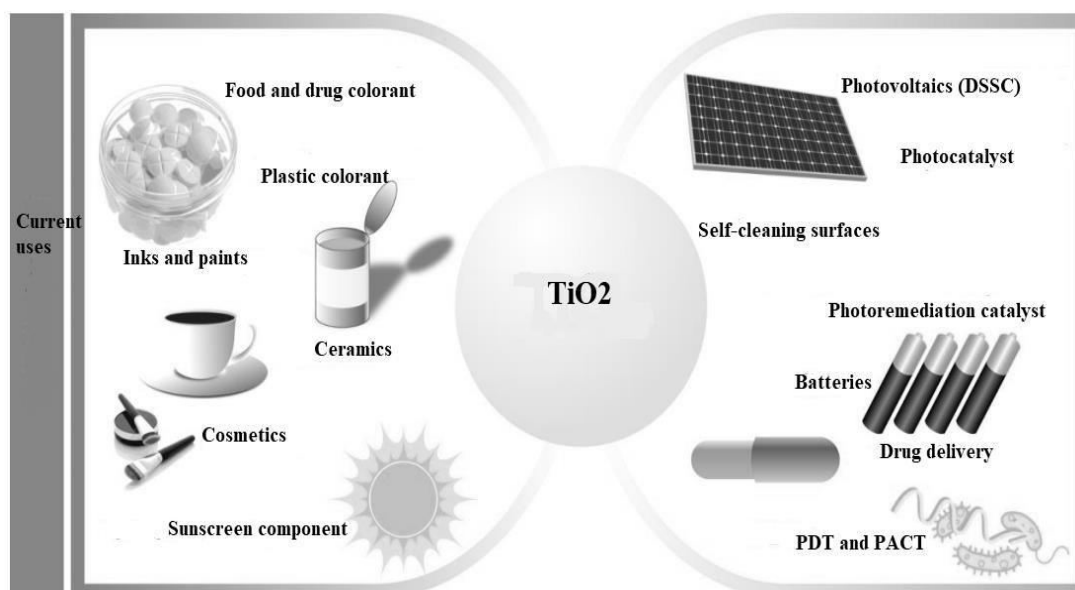


Figure 1. DSSC stands for dye-sensitized solar cell. PDT stands for photodynamic therapy. PACT stands for antimicrobial photodynamic therapy.

Due to their size restriction and abundance of corner surface sites, oxide nanoparticles (NPs) can display special physical and chemical characteristics [7]. Due to their low price, excellent chemical stability, high refractive index, strong oxidation characteristics, and oxygen vacancies in their lattice, titanium oxide (TiO₂) NPs are among the most useful and well-known oxides, with an annual output of more than 10,000 tonnes in 2011 [8]. One of the essential characteristics for using titanium dioxide nanoparticles (TiO₂-NPs) as semiconductors in industrial optical applications is their broad band gap [9,10]. TiO₂-NPs can be further customised to find use in the field of sensors and electronic devices due to their distinctive electrical or ionic properties. They can be utilised as a pigment in the paint industry and are a white, water-insoluble powder with an extremely high refractive index, $n = 2.4$ [11]. Rutile, anatase, and brookite are the three polymorphic forms of TiO₂ that naturally exist and have crystalline structures. These materials are widely utilised in the gemstone industry [7]. As photocatalysts for the degradation of wastewater pollutants [12,13], as anti-microbial and antibacterial agents [14,15], as food additives [16], and as cosmetics, TiO₂-NPs are also widely and successfully used in a variety of sensor-related disciplines. So, as opposed to bulk powders, a simple mediated synthesis is an essential step to regulate the morphology and structure of NPs. Therefore, in this review, we discuss a green chemistry method for the synthesis of TiO₂-NPS that is non-toxic, ecologically safe, and has advantages over the traditional industrial method in terms of reagent handling and safety procedures. To the best of our ability, we have also made an effort to condense the many green synthesis research philosophies for TiO₂-NPS. The simultaneous discussion of their numerous biological (i.e., antibacterial, anticancer, antifungal, and antiviral) and environmental uses may have helped to clarify this topic and may have peaked our interest in more complex nanostructures in the future [17,18].

The Tio and Nanoparticle Synthesis

Nanotubes, nanofibers, nanosheets, nanorods, and linked Medicare are just a few of the different sizes and shapes of TiO₂ nanoparticles. Common synthetic techniques include hot water, sol-gel, solvothermal, vapour deposition, oxidation, and pyrolysis. Different methods have been used in the successful manufacture of TiO₂ nanoparticles, including non-sol limitation, electrode location, Son chemistry, microwave assistance, micelle and reverse micelle techniques [19-22].

Pyrolysis Technique

Over the past ten years, numerous researchers have created TiO₂ nanoparticles using the pyrolysis method. For instance, Moravec Tal is created by pyrolyzing TTIP vapour at 300° C. TiO₂ nanoparticles seem to have been produced at first inspection. The working gas (dry, particle-free, deoxidized nitrogen) was saturated with TT vapour in an externally heated saturator. It was first recognised that the production of high-quality TiO₂ nanoparticles was caused by the heterogeneous breakdown of TTIP. In all of the other tests, titanium (IV) n-butoxide was pyrolyzed in 1,4-butanediol to produce TiO₂ nanoparticles. Additionally, the reaction was run for two hours at 300

°C and 25 °C in an autoclave. The resulting nanoparticles were combined and calcined at 500 ° C for 2 hours in a box furnace to produce crystals of anatase-type TiO₂ nanoparticles with a common diameter of 15 nm. Furthermore, by processing precursor titanium sulphate with stand-in chemicals such hydrogen peroxide, urea hydrogen peroxide, and ammonium persulfate, a pyrolysis method is used to quickly produce TiO₂ nanoparticles with improved photocatalytic capabilities. I removed TiO₂ nanoparticles from the anatase segment in hydrogen peroxide, urea-hydrogen peroxide, and ammonium persulfate-per-oxo-containing phases using annealing temperatures of 600, 850, and 700 ° C in the air for 60 minutes, respectively. I've got

it figured out. I am the other, and I stand out from the crowd. I've been waiting for you for six hours. To create 10 nm TiO nanoparticles, titanium-containing natural metal frameworks (referred to as MILonehundred25 and MILonehundred25NH₂) were pyrolyzed in the air at 350 °C[23-24].

Oxidation Method

By utilising an oxidant or anodic procedure to directly oxidise detailed titanium, this technique creates nanoparticles. Varghese et al. TiO produced fully structured nanotubes at a voltage of 20 V and 0.5 percent hydrogen fluoride. The titanium anodized plate needed to be anodized. In the presence of oxygen at 500 ° C for 6 hours to produce nanotubes. The diameter and length of nanotubes can change depending on the transmission voltage, it was found. Making advantage of to encourage titanium oxidation, metallic titanium was dissolved in 50 mL of hydrogen peroxide solution. found to be efficient in the synthesis of TiO nanotubes over 72 hours at 353 K. (30 wt. percent). That's what happened[24-26].

"Biomedical applications of Metallic, Bimetallic, and Metal oxide Nanoparticles" Nanoparticles Made of Metal

Without harming healthy cells, apoptosis was used to measure cell death. Colloidal silver has been authorised for use as a cancer treatment. The lesser-known silver nanoparticles-chitosan nanocarriers were assembled in phosphate buffer (PBS), and the needed amount was added to cell culture and grown for 24 hours. Researchers used morphological (fluorescent and scanning electron microscopy) and biochemical (cell viability assay and wave cytometry) studies to determine whether chitosan nanocarriers caused cell death. The assessment was used to test the cells.

Utilization of Silver Nanoparticles in the Treatment of Most Cancers and Medication Delivery According to studies, silver nanoparticles are utilised as anti-cancer medications, diagnostic tools, and drug delivery systems in a number of biomedical applications. Colloidal silver was used as an anticancer agent in human breast cancer cells, according to a study by Franco Molina et al. The MCF7 human breast cancer cells were grown and used at various concentrations to determine whether colloidal silver nanoparticles had a fatal effect. Cell viability was assessed using the trypan blue exclusion method, a common dye for identifying dead cells. The method of cell death was determined using mon oligonucleotides, which are DNA pieces associated to proteins (histones). The findings showed that most human breast cancer cell lines are cytotoxic to colloidal silver in a dose-dependent manner. Use Fe-Pt nanoparticles for MRI and fluorescence. Fe-Pt nanoparticles were created via a high-temperature chemical reduction[27-29].

Bimetallic or Steel Alloyed Nanoparticle

Due to their precise chemical and magnetic locations, superparamagnetic properties, excessive coercive force, chemical stability, oxidation resistance and biocompatibility, Fe-Pt nanoparticles are a potential biomedicine programme. The quantity of scientists who are gaining in attention. We are investigating the application of Fe-Pt nanoparticles in biological systems programmes like hyperthermia, medicine distribution (including the majority of anti-cancer medications) and due of these flats' biosensors, an individual who purchases and sells products and services can be evaluated using an MRI[30].

Fe-Pt nanoparticles

Fushimi et al. are present in the majority of anti-cancer drugs and graded drug delivery systems. Investigations were conducted into the impact of magnetically permeable Fe-Pt nanoparticles loaded with anti-cancer medications on the rapid drug delivery to the majority of cancer molecular lines in the stomach and lungs. To create a full tablet with a Fe-Pt nanoparticles shell, porous Fe-Pt nanoparticles were created using hydrothermal agents from Fe-Pt / PDDA-silica

composite debris. The entire area was then covered with a lipid barrier to stop leakage before the anti-cancer drug doxorubicin (DOX) was applied. The cytotoxic effects of these medications have evolved when used on the majority of molecular cancer lines of the stomach (MKN74) and lungs (RERFA1). The Fe-Pt-Dox medications and doxorubicin alone were used to develop the molecular strains in the magnetic material[31].

Nanoparticles of Metal Oxides

The substance titanium dioxide (TiO₂) has been extensively studied. It is used in a variety of products, including toothpaste, cosmetics, medications, food colouring, and paint pigments. TiO₂ is a desirable material for application in the biomedical industry due to its many distinctive traits, including precise biocompatibility, low toxicity, chemical balance, and photocatalytic properties. This graphic illustrates the significance of drug loading techniques on TiO₂ nanoparticles. Mesoporous titanium dioxide nanoparticles have been studied by Wu et al. for use in medication delivery. Mesoporous titanium oxide nanoparticles were produced through carefully controlled hydrolysis. The cytotoxicity of these nanoparticles is evaluated using the Human Breast Cancer (BT20) Molecular Line and MTT Assay. TiO₂ nanoparticles in quintal form as nanocarriers for the delivery of certain medications We were interested in determining whether drug loading on nanoparticles affected efficacy. Doxorubicin (DOX) is loaded into TiO₂ nanoparticles using both primary non-covalent bonds (TiO₂ DOX) and secondary covalent linkages (TiO₂ DOX) (TiO₂-DOX). To improve their binding to various biomolecules, the oleic acid coating of the TiO₂- OA nanoparticles was changed to TiO₂-TETT, which is a silane carboxylate (TETT) exchange. This finding shows that for loading DOX, non-covalent complex formation (TiO₂ / DOX) is more detrimental than unbound DOX and covalent complex formation (TiO₂-DOX). Confocal laser scanning microscopy results showed that the cell nucleus contained DOX created by the complex creation approach (TiO₂ / DOX)[32-35].

PDT photosensitizer Dealers Made of TiO₂ Nanoparticles

TiO₂ nanoparticles may be used in photocatalytic cancer treatment, according to research by Lagopati et al. TiO₂ aqueous dispersions were organised using the sol-gel technique. MCF-7 and MDA-MB-436 most cancer epithelial molecular traces were grown in two breasts for this study. The beautiful molecular trails were seeded with various concentrations of TiO₂ nanoparticles before being subjected to UV-A light at a wavelength of 350 nm for 20 minutes. Following a 48-hour growth period, molecular viability testing, float cytometry, and western blot analyses of these cells were carried out. The results showed that cells were molecularly poisonous to TiO₂ nanoparticles. The MDA-MB-436 molecular line displayed evidence of apoptosis after exposure to the same amount, whereas the MCF-7 cells did not. More study is required to enhance this photocatalytic cancer therapy because UVA radiation may harm healthy cells. In order to stop the proliferation of malignant glioma cells, Wang et al. investigated the use of photoexcitation of TiO₂ nanoparticles. The U87-MG brain cancer molecular line and female BALB/c-nude mice, which were injected with glioma cells and the TiO₂ suspension was injected beneath the skin, were used in in vitro and in vivo investigations. In vitro TiO₂ nanoparticle suspension treatment was applied to the U87-MG cells for 4, 12, and 24 hours. UVA irradiation was finished using a UV lamp with a wavelength of 330 nm. Additionally, investigations on cytotoxicity and microscopy were performed. According to TEM examination, TiO₂ nanoparticles were

immediately ingested and entered the cells through phagocytosis. It was shown that TiO₂ nanoparticles had no detrimental effects on cells. After moderate UVA irradiation, the molecular viability of the TiO₂ debris was reduced to 40%[36,37].

NANOPARTICLE-BASED CANCER TREATMENT

Photodynamic Therapy (PDT) is a Type of photo (PDT)

A photosensitive substance is activated by illumination of the target area during photodynamic therapy (PDT), a method of treating cancer. All cells, even healthy cells, aid in absorbing photosensitive substances, however cancer cells use this technique for a considerable amount of time. The PDT vendor will then use the graphical stimulus to deliver cytotoxic oxygen species, which will destroy the target cells as a result. According to research, PDT can directly kill tumour cells or indirectly use rising antitumor immunity to cause the loss of cancer cells. The photosensitizers used in PDT are no longer nanoparticles thanks to those currently in use, but many of them can be

improved and have promise for cancer treatment. For instance, the photosensitizer phthalocyanine (Pc) produces cytotoxicity, generates reactive oxygen species, and kills tumour cells [40]. The two types of nanoparticles utilised in PDT to reduce Pc toxicity are passive and active nanoparticles. While passive nanoparticles include photosensitive components, active nanoparticles aggravate the image graphic. Gold, silicon dioxide, and polyacrylamide are examples of passive nanoparticles, while titanium dioxide is an example of a biological nanoparticle (TiO₂). TiO₂ is a photocatalyst that reacts with water to create oxidative radicals that can damage adjacent cells when UV light is present [38,39].

Photodynamic Therapy (PDT) is a type of Photodynamic Therapy That Uses Light to (SDT)

Due of PDT challenges, the majority of cancer treatments require novel methodologies. SDT, short for "no dynamic drug," is one such method that employs ultrasound and ultrasonic sensitizers (US). Ultrasonic sensitizer particles are stimulated by ultrasound and enter tumour cells more deeply than UV. Reactive oxygen species are therefore produced in a prison cell by the activated ultrasonic sensitizer (ROS). Ultrasonic sensitizers can be created from nanoparticles, which typically comprise TiO₂NP coupled to metal or antibodies. According to recent research in light of Ogino et al., the cytotoxicity of TiO₂NP to HepG2 cells was examined. TiO₂ nanoparticles have been discovered to destroy glioma cells impregnated with nanoparticles after ultrasonic stimulation (2014).

PreS1 and S2 antibodies are recognised using hepatocytes coupled to TiO₂NP. It has been shown that this binding increases the cytotoxicity of the NPS. You and your co-workers looked at and studied hydrophilized titanium dioxide nanoparticles (HTiO₂ NPS) that are continuously circulated in a dynamic treatment. Titanium dioxide does not often breakdown via ROS, which makes HTiO₂NP very elastic, whereas usual ultrasonic sensitizers disintegrate quickly. The hydrophilic polymer carboxymethyl dextran (CMD) is used to coat the NP in order to boost blood circulation stability and boom time. Micelles have been stabilised, their biocompatibility increased, and their cytotoxicity decreased using polyethylene glycol, a polymer that is frequently utilised in clinical applications [40-42].

TiO₂ Nanoparticles as a Vehicle for Chemotherapeutics

One of the biggest problems facing contemporary medicine today is cancer. The first line of therapy is the surgical excision of the tumour and radiotherapy, notwithstanding the ongoing development of contemporary cancer treatment techniques. Chemotherapy is typically used as a supplemental therapy; however, it has

significant limitations. First of all, chemotherapy is incredibly hazardous to the human body's rapidly reproducing healthy and cancerous tissues. In order to lessen the systemic effects of the therapy and boost tissue selectivity, innovative delivery techniques are continuously being sought after. The multidrug resistance (MDR) mechanism, which is exhibited by cancer cells and connected to the overexpression of some ABC superfamily of efflux transporters that treat the drug as a toxin and remove it from the matrix, renders many chemotherapeutic treatments useless as well [43,44]. Doxorubicin is one of the chemotherapy drugs that is currently being researched the most (DOX). Although doxorubicin has several benefits for the treatment of different tumours, it is also associated with side effects, the most serious and hazardous of which is cardiotoxicity [45]. Using nanoparticles and combining chemotherapy with photodynamic or photothermal therapy could be potential solutions to both issues. Titania nanoparticles offer important benefits in this area by facilitating effective drug molecule distribution, improving pharmacokinetics, and enabling tailored drug delivery [46,47].

Similar to organic photosensitizers, inorganic photosensitizers like TiO₂ NPs can be utilised for PDT, as was mentioned before. After doping with organic photosensitizers, TiO₂ NPs were examined for PDT under the stimulation of UV or visible light. It is important to investigate NIR-triggered inorganic photosensitizers for the non-invasive PDT in deep tissues due to various limitations of UV light, particularly those related to adverse effects on the human body and limited tissue penetration. By connecting two distinct NPs, such as up-conversion NPs (UC NPs) and TiO₂ NPs, it is possible to produce rare-earth-doped nanoparticles that convert NIR into UV light and NIR-triggered PDT of TiO₂ inorganic photosensitizers. To create a core-shell structure, UC NPs can be coated with TiO₂ inorganic photosensitizers, or they can be mixed with TiO₂ to create a UC/TiO₂ nanocomposite with a non-core-shell structure. As a system that can be used for chemotherapy and NIR-triggered

inorganic PDT, the development of nanocomposite appears to be more advantageous. By releasing the medicine selectively at the desired site of action, DOX can more effectively target cancer cells. As a result, the anticancer agent's toxicity would be reduced and its concentration in cancer cells would increase, allowing for the use of lower doses and a decrease in the likelihood of side effects.

Doping of TiO₂ Nanoparticles with Inorganic Compounds and Carbon-Based Nanomaterials

Due to a variety of factors, titanium dioxide NPs require a lot of energy to be excited bandgap. Only UV light, then, carries enough energy to activate titania[48]. Colloidal TiO₂ NPs have a serious issue with their pH-dependent propensity to aggregate, which lowers their photo reactivity and diminishes the useful surface area [49]. Their lack of cell-specific accumulation and poor selectivity are additional barriers to the wider application of pristine TiO₂ NPs. Doping is the process of introducing inorganic substances into the structure of TiO₂ NPs as they are being created or altering the structure of TiO₂ NPs that have already been created. This procedure reduces the activation energy and narrows the bandgap in the TiO₂ NPs structure. Numerous compounds, both organic and inorganic—both metals and nonmetals can be doped into titanium. To optimise their ability to absorb visible light, TiO₂ NPs have been the subject of numerous investigations. For instance, it was discovered that doping or altering the TiO₂ NP surface causes the absorption maxima to shift towards longer wavelengths, hence deepening tissue penetration [50]. By reducing the particles and causing the creation of Ti³⁺ ions on the TiO₂ surface, titania can be transformed into so-called black TiO₂ NPs, which can increase the efficiency of TiO₂-based photodynamic treatment. Ni et al. used a simple calcination approach in conjunction with an in situ controlled solid-state reaction method to create these black TiO₂ NPs starting with titanium dioxide (P25, 71 percent anatase and 29 percent rutile)

powder that is commercially available. The presence of Ti³⁺ defects and oxygen vacancies in the black TiO₂ during this process was confirmed by UV-Vis DRS measurements and X-ray photoelectron spectroscopy (XPS). On a human bladder cancer cell line, researchers used black TiO₂ NPs as a near-infrared light-triggered PDT photosensitizer with a maximum absorbance of 808 nm (T24). Following an incubation with the photosensitizing NPs, bladder cancer cells were exposed to laser radiation at 808 nm for 0–7 min. As anticipated, an increase in anticancer activity corresponded with an increase in photosensitizer concentration. At a concentration of 500 g/mL and an exposure time of 7 min, minimal cell viability (54.32 percent) was seen. The scientists point out that the applied black TiO₂ NPs' flexible dosage and great anti-cancer action make them an ideal photosensitizer. Additionally, black TiO₂ NPs were the most active in comparison to non-doped TiO₂ NPs invisible light and NIR. In order to enhance the photochemical characteristics of TiO₂ NPs, extensive research is now being done on a variety of combinations of TiO₂ NPs with other inorganic elements and compounds. Cerium-doped (Ce-doped) TiO₂ thin films were created by Kayani et al. using the sol-gel dip-coating method [51]. With an increase in Ce doping percentage, the band gap of the Ce doped TiO₂ marginally dropped from

3.93 eV to 3.79 eV. The produced NPs demonstrated positive ferromagnetic sensitivity changes that were positively linked with the rise in cerium concentration. Sadly, these modifications had no impact on the formulation's biological activity. On *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumoniae*, and *Staphylococcus aureus*, cerium-doped TiO₂ NPs were investigated. According to the findings, even when the compound's concentration in the agar medium was increased (16 mg/mL), the NPs did not exhibit any photodynamic activity. This may possibly be connected to the measurement issues that were encountered since the examined NPs precipitated in the agar and did not properly mix with the agar medium [51].

Shah et al. [52] have recently evaluated the anti-cancer activity of modified and unmodified titanium (IV) oxide NPs. Their analysis made it abundantly evident that PEG-stabilized TiO₂ nanoparticles have greater photodynamic activity than unstabilized NPs. On human skin cancer cells and human cervical cells (HeLa), their anticancer activity was evaluated in vitro (HT144). The findings promote the further development of nanomaterials based on the mixing of polymers with titanium dioxide. By examining the activity of modified TiO₂ NPs, the authors furthered their investigation. The photoactivation of doped-TiO₂ NPs in the visible/near-infrared range was made possible by cobalt and nitrogen doping on TiO₂ nanocrystals. Contrarily, their photochemical characteristics improved, but their anti-tumor effectiveness decreased. The authors link it to 'downregulated' ROS generation or reduced conjugate absorption by cancer cells' [52]. In a different investigation, Zeni et al. [53] administered nitrogen-doped TiO₂ NPs in vitro to fibroblasts and the B16-F10 murine melanoma cell

line (NIH 3T3). Triethylamine was used as a nitrogen precursor in a modified hydrogen peroxide sol-gel technique to create the nitrogen-doped TiO₂ NPs. Additionally, both TiO₂ and N-TiO₂ samples were found to be composed entirely of anatase crystals with no traces of rutile, according to X-ray diffraction (XRD) studies. In comparison to the neat ones, the nitrogen-doped TiO₂ NPs showed increased visible absorbance. Under UV irradiation therapy, the usage of modified titanium (IV) oxide at a dosage of 0.5 mg/mL led to the death of up to 93 percent of melanoma cells and increased expression of the pro-apoptotic BAX gene. Comparing the two findings may show that, depending on the kind of cancer, the susceptibility of cancer cells to modified NPs may differ greatly [53].

Other Medical Applications of TiO₂ Nanoparticles

The use of titanium dioxide in pharmaceuticals is comparable to the design of chemotherapy carts, drug delivery systems, or packaging. Pharmacy, namely pharmaceutical chemistry and technology, as well as other fields have used titanium

dioxide NP medical, including dental and surgical procedures.

SUMMARY

Many studies in manufacturing and medicine have recently focused on large packages of titanium dioxide, with topics spanning from water hygiene to dye-sensitized solar cells and photomechanical therapies. These nanoparticles are useful due to their superior photochemical properties and outstanding biocompatibility. TiO₂ waste also has easily available components and is reasonably priced. The price of making these chemicals and photosensitized homes is frequently inversely correlated with the number of brilliant websites present on the floor. After exposure to radiation, they can unfold from nanoparticles and emit reactive oxygen species, leading to molecular disintegration in neighbouring tissues. As a result, a lot of study has been done on the photodynamic treatment packing of TiO₂ nano- and microparticles.

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A House for Mr. Biswas by Naipaul: A Critical Estimate of Human Isolation and Disintegration

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ABSTRACT

This paper examines Mohun Biswas' issues with identity loss, alienation, and fragmentation from a post-colonialist perspective. Mohun is the main character in V.S. Naipaul's book *A House for Mr. Biswas*. Post-colonialism is the subject of the investigation, with particular emphasis on Gayatri Chakravorty Spivak, Homi K. Bhabha, and Leela Gandhi. The goal of the study is to determine how Naipaul addresses post-colonial problems like displacement, identity crisis, and a desire for a sense of belonging in a foreign land. The research design for the investigation was textual analysis. The key conclusion is that Mr. Biswas lives in an alienated atmosphere within his own neighbourhood despite really residing with the people he depicts in the book. Some of the important terms employed in postcolonial literature in this study to explore the character's attitudes toward the detached lifestyle include dislocation, identity crisis, and diaspora.

Keywords: resistance, diaspora, identity crises, and displacement

Masood (2019) asserts that racism, including slavery, exile, alienation, and dislocation, is frequently discussed in postcolonial literature. The primary focus of this study is on how specific postcolonial concerns of displacement and identity loss are dealt with in V.S. Naipaul's book *A House for Mr. Biswas*. Salman Rushdie was cited by Boehmer (1995) as the original member of the old diaspora and V.S. Naipaul as the representative of the new diaspora. It has been considered that Naipaul's works provide the most accurate representation of the difficulties faced by frequent travellers. Dark works by Naipaul about estrangement as well as his careful travel and life writing are well-known (Barnouw, 2003;2006, Dooley;Ray, 2005). Naipaul was born and raised in Trinidad's multicultural society despite his ancestry, where he felt like an outsider among outsiders (Chakroberty, 2005).

Although Naipaul lived in London for 27 years, he still felt unwelcome there and wrote about his own experiences in his books. In England and the West Indies, he felt like an Indian and a West Indian, respectively (Ray, 2005). *A House for Mr. Biswas*, Naipaul's third novel, is about a Trinidadian Hindu whose primary desire is to buy his own home. It was published in 1961. Naipaul's quest to establish his own community free from the alienating consequences of colonialism is the primary subject of the book (Garebian, 1984; Kumar, 2002). It tells the story of the author's father, which includes some biographical information.

The story of *A House for Mr. Biswas* (AHMB) revolves around Mohun Biswas, an Indo-Hindu Trinidadian who is married into the governing Tulsi family and finally embarks on the goal of reclaiming his own home (Hayward, 2002). Naipaul makes an effort to describe the traumatic and emotional experiences of an immigrant through the protagonist (Kukreti, 2007;Ray, 2005). The book chronicles Naipaul's struggles with writing. The inclusion of the indefinite article "A" in the title *A House for Mr. Biswas* "indicates the depth of his longing to belong somewhere, to feel at home, and to get rid of alienation" (Kukreti, 2007, para.1). Researchers want to understand why his fictional characters are fixated on the concept of leaving the oppressive, depressing Caribbean, why they feel that they have lost their identity, and why it is accepted that they are essentially the slaves of Western cultural imperialism. The basis for the paper is the researchers' attempt to emphasise the loss of identity and other post-colonial traits in the fiction.

Numerous analyses of Naipaul's *A House for Mr. Biswas* provide insight on the author's purpose for producing this novel as well as the book's character, storyline, and theme. A critical analysis of Naipaul's characters by Chinnam (2014) revealed that the protagonist Biswas was going through the socialisation and articulation processes. A critic who is inextricably linked to Naipaul wrote about Biswas's battle to own a home and the usage of the house as the main theme in 1996. This idea was sparked by his personal experience visiting pilgrims' sites in a foreign country while he was dealing with Naipaul. The work, according to Kukreti (2007), was inspired by a true story. Thieme, 1996). Another critic who embarked on an intellectual odyssey was Dooliy (2006). When he encounters an Indian point of view, he starts a new research into the house and home trope. He visited all of Naipaul's residences throughout the process, particularly the two that he had called home as a young man. Mr. Biswas lives in a comedic position since he is unfamiliar with the world he is accustomed

to. (Garebian, 1984; Hayward, 2002; Kumar, 2002). A House for Mr. Biswas depicts the struggle of the settlers through the prism of creolization, the process of settling an area by gaining control over the indigenous people there, to better understand Biswas's depiction. Naipaul emphasises the linguistic and cultural blending that contributes to Trinidadian identity creation, according to Khan (1998). "Naipaul shows a real fighter in all his littleness and still maintain a feeling of man's inner dignity," claims Tas (2011). (p.117). Levy (1995) analyses Naipaul's language in this book and finds that his narrative style is straightforward. As a result, literary reviewers like Khan and Tas complimented the novel's methods for using simple language rather than complex ones.

The reviews of A House for Mr. Biswas by various critics suggest that they are aware of the problems with settlement and unsettlement that the book's central characters deal with. Critics haven't paid attention to the challenges presented by identity loss and fragmentation or how they affect the lives of the major characters. The purpose of this article is to close the research gap as a result. It tries to investigate the root reasons and consequences of Mr. Biswas's identity loss, fragmentation, alienation, and exile.

The basic source, V. S. Naipaul's A House for Mr. Biswas, was analysed discursively and qualitatively in this essay utilising a theoretical framework based on postcolonial theories by Leela Gandhi, Gayatri Chakravorty Spivak, and Homi K. Bhabha. Additionally, the research gap was found by looking through secondary sources including journal articles and internet text commentary. The main point of the paper's delimitation is the characters' struggle to find their identities in a strange world.

(Raja, 2019) People from former colonised nations write and tell stories in postcolonial literature. It discusses problems with former slaves' political and cultural independence as well as the challenges and effects of decolonization. The essential components of postcolonial literature include hybridity, detachment, imitation, third-space, and vacillation (Bhabha, 1994). Postcolonial literature is frequently characterised by the colonisers' rebellion against colonisation. All postcolonial writing is resistance writing, according to Bhabha (1994, 1998). (Gandhi) When the coloniser encounters the colonised, both civilizations are impacted (Bhabha, 1994). The coloniser wants to deter them by teaching the colonised a specific pattern of suppression. Spivak (1988) equated the exploitation of subalterns to that of colonisers in the post-colonial discourse. The above-mentioned post-colonial theories are the main research techniques employed in Naipaul's A House for Mr. Biswas to analyse how Mr. Biswas feels his sense of dislocation and anonymity.

The famous novel A House for Mr. Biswas by V. S. Naipaul, in which he tackles concerns of identity crisis, dislocation, and disregard for a person that result in alienation and fragmentation, is the main topic of the research. The main character's state of despondency is depicted by the author right away. Mr. Biswas is battling to keep his individuality and grow into his true self in a strange environment. It is impossible for migrants to accept the invitation to identity because they have "a doubling, dissembling image of being in at least two places at once," according to Bhabha (1994). A researcher notes that Mohun Biswas is portrayed as a person who is losing his identity in the book's first chapter. Even though he was an astrologer, Pundit Sitaram predicted after examining Mohun Biswas's birth information and consulting his astrological almanack, "The boy will be a lecher and a spendthrift." possibly a liar as well (p. 16). Mr. Biswas's six fingers, in the opinion of Pundit Sitaram, portend poor fortune for his family. Mohun's identity dilemma consequently starts there. Because of the dominant worldview, the elites are prejudiced against non-elites (Gandhi, 1998;1988, Spivak) Pundit Sitaram stands in for the ruling class that allows Mr. Biswas to be marginalised. Mohun feels isolated in his home because the family priest read Mohun's horoscope and concluded that he is foreboding. These criticisms make him feel unwelcome in his Indian community. His search for a home is an effort to develop his social role and identity.

Mr. Biswas is aware that the identity dilemma is brought on by the ambivalent state. Ambivalence is defined as "a simultaneous attraction toward and repulsion from an object, person, or activity" by Young (1995, p. 161), or a persistent swing between desiring one thing and desiring the other. The struggle and complexity of a man's relationship with his upbringing, as well as his incapacity to escape it, are depicted by Naipaul. Being aware of his loneliness and situation, Mr. Biswas tells his kid, "I am just anybody." Nothing at all (AHMB, page 279). Unlike his father and siblings, who inherited the labourer social identity, Mr. Biswas is unable to claim this. Estrangement is viewed as an indication of personal dissatisfaction with certain fundamental elements of contemporary civilization (Lystad, 1972;Silva, 2017). Mr. Biswas first tends to his uncle's business before landing a position as a sign painter. While working as a sign painter, he meets Shama, the Tulsi daughter, and subsequently marries her. His life after his marriage is a representation of the third space. The alienated

individuals struggle to recognise themselves in the third space (Bhabha, 1994;2021 Oversveen) Because of his marriage, Mr. Biswas feels that while duty increases, life does not allow for romance.

Due to the Tulsis' failure to give Mr. Biswas a dowry or money, he is compelled to relocate into the Hanuman House. Bhabha (1994) claimed that "home" is not a physical place but rather a manner of existence that serves as "a symbol of survival." Mr. Biswas, however, does not understand the metaphor. The unpleasant family context adds to his mental complexity. It is a typical joint family that functions similarly to "the British Empire in the West Indies," according to Mr. Biswas (p. 112). Hanuman House offers Mr. Biswas shelter in exchange for giving up his identity. The following is yet another metaphor for Hanuman House: The House became massive, impregnable, and vacant when the bottom floor's small Tulsi Store doors were shut. The walls of concrete appeared to be as thick as they actually were. The flat roof's railing was topped with a concrete figure of the Monkey God Hanuman. (p. 186)

According to this description, the house's concrete wall was too small and thick for a Mr. Biswas on an alien world.

Mr. Biswas experiences ambivalence regarding his health every day. Ambivalence, according to Bhagwati (194), is a complex state characterised by the bond between the coloniser and the colonised. Men are required to work in the Tulsi home whether or not they are husbands, according to Mr. Biswas. In Hanuman House, "he was regarded with indifference rather than hostility," he understands that people do not welcome him (AHMB, p. 187). This knowledge enhances his ambiguous personality. However, he "kept his tongue and tried to gain favour" (p. 188). He firmly believes that he is capable of achieving freedom and independence. He keeps trying to take back who he is.

One of the Tulsi sons-in-law, Govind, advises Mr. Biswas to stop painting signs and work as a driver for the Tulsi estate instead. I disapprove, Mr. Biswas replies. halt the painting of signs? And my uniqueness? No, boy. Paddle a canoe of your own, is my maxim (p. 107). It appears that Mr. Biswas' identify is depicted in the sign painting. Any activity connected to the Tulsis is rejected by him. Additionally, he does not want to be recognised by the unimportant son-in-law of the Tulsi family. This demonstrates his attempt to forge his own personality out of an uncertain one.

Mr. Biswas seems confused in the hybrid state. Homi K. Bhabha underlines how hybridity has a postcolonial quality. Bhabha (1994) claims that the term "hybridity" frequently refers to the emergence of unique transcultural forms inside the colonial contact zone. Mr. Biswas works hard to seize his chance in Hanuman House. He makes an effort to be more like the so-called protestant Hindu people group from India, the Aryans. The Tulsis' wrath is a result of his support for the beliefs of idol worship, child marriage, and the abolishment of the caste system. Mr. Biswas struggles in his identity crisis like a colonised person since he lacks a legitimate employment, a source of income, or a place of his own. This is shown in the text:

The future he dreaded was about to come to pass. He was sliding into the nothingness and was experiencing the kind of dread that is only felt in dreams as he lay there at night hearing the snores, creaks, and occasionally baby cries from neighbouring rooms. That morning's sense of relief gradually subsided. Food and smoke had no flavour. He was always drained and agitated. His fractured life is the root of his dark universe (AHMB, page 227).

He experiences life without solace and comfort. Mr. Biswas is unhappy because no one knows him, loves him, or cares about him, according to Levi (1995). Instead, everyone laughs at his situation. Mr. Biswas notices a bitter stillness in the evenings when he is confined to his room.

Mr. Biswas is a subordinate who behaves absurdly quite frequently. According to Spivak (1988), man's ludicrous behaviour is motivated by his sense of inferiority, a lack of roots, and an identity crisis. Mr. Biswas performs a few foolish activities to bring attention to himself and highlight his distinction, such as exacting revenge on Bhandat by spitting in his rum or calling the Tulsis other names. For instance, "the old hen," "the old queen," and "the old cow" were intended for Mrs. Tulsi, while "the two Gods" were meant for Seth. The narrator claims that because of his great suffering, "he could not be trusted" (AHMB, page 102). Before their daughter is even born, Seth and Hari decide to name her Savi without asking Mr. Biswas. To express his protest, Mr. Biswas scribbled the following on the birth certificate. Lakshmi. The phone was signed by Father Mohun Biswas. (p. 163) It was earlier than that. This demonstrates Mr. Biswas's persistent efforts to carve out a unique identity for himself in the postcolonial world.

The creolization process is carried out on Mr. Biswas. Creolization is the term most frequently used to describe "post-colonial nations whose current ethnically or racially mixed inhabitants are a consequence of European colonisation" (Ashcroft et al., 2000, p. 51). Mr. Biswas and Sharma start living independently in a different chapter titled "The Chase." He is acutely conscious of his unimportance and unwelcomeness despite this Mr. Biswas said, "Chase was a halt, a preparation" (AHMB, page 147). Mr. Biswas's wish to acquire his own home is a reflection of the issue of identity crisis among displaced people. Spivak (1988) believed that the seized attempt to define their voice, character, and overall location. The Hanuman House at Chase, according to Mr. Biswas, "was the world, more genuine than the Chase, and less exposed." As stated on AHMB, page 188, "Beyond its gates, everything was foreign and unimportant."

Mr. Biswas expects Chase to reveal his identity to him. Wherever he shifts, he yet feels alienated and torn apart. Despite aware that he is destitute, he still makes an effort to define who he is. The perception of economic inequality exacerbates the feeling of alienation (Oversveen, 2021; Silva, 2017). Mr. Biswas is still striving to reclaim his identity as an immigrant from East India living in Trinidad. Mr. Biswas suffers as a result of his imitation of the English invaders. The crucial concept "mimicry," which is connected to post-colonialism, is used in the novel. According to Bhabha (1994), mimicry is the inaccurate replication of language, culture, habits, and thoughts. Mr. Biswas is being taught the Ramayana and traditional lessons by Pundit Jairum. He doesn't read them, though. As an alternative, he reads philosophical books like Bell's Standard Elocutionist. Reading literature and philosophical texts reveals to Mr. Biswas that the members of his community lack a significant past. The romance depicted in Bell's Standard Elocutionist, in Mr. Biswas' opinion, is unattainable in our nation. These words express the following idea: He read the writings of Hall Caine and Marie Corelli. They led him into the realms of inebriation.

His disappointment increases his sense of inferiority. When Seth first meets the Tulsis, he inquires about Mr. Biswas's father but is met with the response, "I am the nephew of Ajodha Pagotes," which sidesteps the inquiry (p. 85). He acknowledges this because, in addition to the fact that he cannot be entirely free from sorrow, his Trinidadian identity and inheritance are at danger. Mr. Biswas believes that without Sharma, his children, and even the Tulsis, life is nothing. Garebian (1984) considered Mr. Biswas to be a grotesque character because of his dislocation. Mr. Biswas continues to search for his character and visit Hanuman House frequently out of confusion. Mr. Biswas periodically exhibits colonial behaviour in order to preserve his identity. One's own self-respect is violated in the pursuit of enormous accomplishment. According to Bhabha (1994), "Colonial mimicry is the yearning for a transformed, recognised other, as a subject of a difference that is almost the same, but not quite" (p. 86). Mr. Biswas acknowledges that freedom and opportunity are found in England. He disapproves of the widespread practise of casting judgement on others. He believes that "a man's caste should be established entirely by his conduct," according to AHMB, page 111. He believes himself to be a modern Englishman while in reality he is an immigrant from India who is of Brahmin descent and whose father left him a job as a worker.

Mr. Biswas' dejection and unhappiness are the results of this incoherence, which is solely the outcome of his mimicry. Mimicry could be seen as an attempt to change one's identity rather than depicting the servitude of colonised people (Bhabha, 1994). Mr. Biswas possesses strengths for which a higher design is looking. Even in this constrictive culture, Mr. Biswas gave up reading Samuel Smiles despite the persistent notion that he had a higher calling, according to the narrator. That author made him quite depressed. He turned to religion and philosophy (AHMB, page 174). Mr. Biswas has a persistent feeling that he is a man from another planet and is quite remote from the one where he lives. Despite the fact that the books he reads are unfamiliar to his world, they give him comfort and support. He finds comfort in the literature because he feels unsafe in the actual world. He doesn't know where to start. Consequently, living a life of imitation puts him in a setting where no one pays attention to him. This only makes him feel worse about himself. Readers are aware of the inconsistency between Mr. Biswas's aim and the interaction, as well as between his dream and reality. Despite this, he plans to mimic the English to escape colonisation.

During his stay in the Green Vale, Mr. Biswas feels a sense of freedom and significance, yet his acts there are characterised by physical and emotional insecurity. The marginalised, non-elites in the post-colonial situation deal with identity insecurity (Gaandhi, 1998). Here is where his house-building design starts to take shape. Instead of wanting a big house for himself, he prefers to be recognised as the father of his kids, especially Anand. According to Mr. Biswas, Anand "belonged entirely to Tulsis" (AHMB, page 216). He begins constructing his home in Green Vale, but it differs slightly from his ideal home. Bhabha (1994) defined imitation as "repeating rather than re-presenting" (p. 85). Mr. Biswas enters the home's cosy chambers in the hopes that he may change his mind. But there's also a feeling of displacement and alienation here. He feels alienated in the society of the so-called elites. Over time, he and Mrs. Tulsi are developing a closer bond. But

the tragedy is that joy is just temporary. The Trinidad Sentinel being run by the new authorities and Mrs. Tulsi choosing to reside in Shorthills are blows to Mr. Biswas. Despite this, the location of Mr. Biswas's home is not ideal. He has to walk a mile to the store every day because he has no transportation. His children also want to go back to Port of Spain.

Mr. Biswas is still carrying out his duties as a husband and father in Port of Spain. He constantly experiences dual awareness. Tyson (2006) asserts that those who have been colonised have a dual consciousness that includes both that of the coloniser and the indigenous group. The mansion serves as a prison for Mr. Biswas because it is so far from the city. Mr. Biswas said, "Could not just leave the house in this place." He required release from it (AHMB, page 432). Mr. Biswas informs Sharma that he is about to leave the residence. He wants to locate a home of his own. Mr. Biswas's hunt for the house is a metaphor for his struggle with identity, respect for oneself, and dignity. Over time, Mr. Biswas has grown to trust this feeling. Creolization is a recent idea developed by those who are tired of the dominant culture (Ashcroft et al., 2000; 2021 Oversveen)

Sharma, the wife of Mr. Biswas, wants to leave the house despite having previously insisted on moving in with the Tulsi family. Sharma declares, "I don't want anything bigger." This is perfect for me. something lovely and compact (page 580). In the end, Mr. Biswas is able to borrow money from Ajodha and buy a home in Port of Spain. He says the following about the residence: The sun came through the open window on the ground floor and hit the kitchen wall. The timber and frosted glass were extremely warm to the touch. As it moved through the home, the Sun cast dazzling ribbons of light up the exposed stairway (p. 572). The sun's presence in the lovely residence represents Mr. Biswas' happiness and joy in his new place. This is a subliminal representation of Naipaul's satisfaction with the realisation of his goal. Even though Mr. Biswas feels content to have a home of his own, he eventually finds a number of problems in the property. In addition to offering shelter from the elements, Naipaul suggests that Mr. Biswas and other dislocated people see home ownership as a sign of establishing order in Trinidad's diverse and fragmented society.

According to reports, Mr. Biswas is a resolute individual who chooses to fight rather than run from the difficult atmosphere. One of the most common topics in postcolonial literature is the diaspora. The dispersion from a single site or centre, from which all of the dispersed gain their identities, is a component of diaspora, according to Ingleby (1999). The Prologue highlights Mr. Biswas' comprehension of a house's symbolic value: It would have been a terrible situation to not have it at this time, to be attacked by the Tulsis, to have to confine Shama and the other children to a single room, to have lived without even attempting to claim a piece of the earth for oneself, and, worst of all, to have died and lived as if one had never been born—without being required or rewarded. AHMB, p. 14)

Naipaul uses the legend Mr. Biswas to illustrate what is happening and the manner of life in Trinidad's Indian diaspora community.

In this sense, the novelist is able to successfully universalize the problem of personal alienation. The protagonist stands in for the author, who is suffering from the excruciating state of dislocation. The tale occasionally gets darker when Biswas' conflict with the Tulsis gets increasingly convoluted.

But in the end, Mr. Biswas is able to acquire a home for himself. Mr. Biswas' name, which Naipaul appears to have chosen with care, is that of the protagonist. He tries to visualise the difficulties a Hindu would face in a foreign environment. Since Mr. Biswas is depicted as an unfortunate guy attempting to find out his identity in a hostile society, his first name, Mohun, means "beloved." The novel tells the story of Indians trying to establish their identity and place in a strange land. Unfamiliar language, religion, and cultural traditions create the identity crisis.

As a result, *A House for Mr. Biswas*, a work of fiction by Naipaul, captures the compassion of travellers struggling for survival in a state devoid of any sign of their personality. The house acts as the life of Mr. Biswas's fundamental, integrating, and unifying metaphor. Compassionately described, the house stands in for Mr. Biswas's desire for independence from reliance. The book makes evident the troubled social and ethnic past of Trinidad's disadvantaged East Indian migrants. Mr. Biswas's inner self and his objective view of the outside world are balanced throughout the story. Mr. Biswas's chaotic existence is a reflection of Naipaul's conflicted temperament. Similar to Mr. Biswas, Naipaul had experienced alienation and fragmentation throughout his turbulent life in Trinidad. In quest of his own identity, Mr. Biswas transitions from a rural to a city and from a nuclear family to a joint family. He is unable to identify his own beginnings in the alienated world, though. The book explores the challenging existence of Trinidad's dislocated Indians and how they come to be colonised by either locals or outsiders. The research's main finding is this. Despite being a member of the Trinidadian

community, he continues to retain his incognito. He is compelled to leave the place of his ancestors since he lacks a house, property, or community in Trinidad, despite the fact that he has a home there. Like his forefathers, Mr. Biswas is forced to leave his home and traverse a strange world in quest of identity and protection. Naipaul describes Biswas' effort to find his own identity in the novel. The story incorporates both an individual's expression and the Indian diaspora's collective work.

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Synthesis, Spectroscopic Characterization, Antibiotic Study of Hg (II) Complexes with Gram Positive Bacteria (GPB) and Gram Negative Bacteria (GNB)

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ABSTRACT

A new schiff base metal complexes were prepared by the condensation of 3-amino pyridine with 3,4-dimethoxy benzaldehyde in the molar ratio of 1:1 in ethanol solvent. The obtained ligand & metal complexes were characterized by FTIR, Elemental analysis, EAS, Mass spectroscopy, SEM, EDX, antibiotic study on gram positive and gram negative bacteria. SEM image showed that the size of [Hg(L)₂]Cl₂ & [Hg(L)₂]Br₂ were analyzed in the magnification range in between [1-20 μm] & 100 nm, the synthesized complexes show different shapes like fibrous, agglomeration, chalk, wooden log, asymmetrical type, dry grassy type, drum sticky type, helical spiral curly type and bushy type shape. The synthesized complex [Hg(L)₂]Cl₂ easily entered in the cell wall of the bacteria and give maximum coverage of protection due to the bushy, helical, curly, dry grassy nature than [Hg(L)₂]Br₂ having wooden log, sticky, bowl, granular shape nature. The synthesized complexes are electrolytic in nature and the ligand co-ordinates through N-atom of the imine group and N-atom of pyridine ring in a bidentate manner with proposed tetrahedral shape. The antibiotic study explained the MIC value of the synthesized complexes by Tweedy chelation, Overtone's complex and Anil's Conceptual Model of Inhibition. The MIC value followed by order.

[Hg (L)₂]Cl₂ > [Hg (L)₂]Br₂ > Antibiotic (except ceftriaxone) > Ligand

Keywords : Morphology, Bidentate, Gram Negative Bacteria, Gram Positive Bacteria, Antibiotics (Norfloxacin, Amikacin, Ceftriaxone, Cefuroxime), FTIR, NMR, Mass spectroscopy, SEM, EDX, UV, Schiff Base Ligands, Metal Complexes.

INTRODUCTION

Schiff base produced by condensation reaction of aromatic amine and aromatic aldehyde. Schiff base ligand is a versatile ligand furnishing imine N and other donor sites responsible for a wide range of biological and chemical application.¹⁻⁷ Transition metal ion enhances the biological activity of different ligands and in some case the activity has been solely attributed to metal ions only.⁸ Metal complexes can play key role in variety of applications in conversion of solar energy, polymeric light-emitting diode, photo refraction, chemical sensors, electro chromic as well as electrocatalysis.⁹

Mercury(II) compounds are used in polymers, cosmetics, papers, dyes, fluorescent lamps and also in batteries to some extent. Divalent mercury ion possess ten electrons filled in its 5d energy level thus it has a strong potential to form complex quickly and show different coordination number by some metal ion.¹⁰

An attempt has been made in this paper to study the synthesis of Hg metal complex, spectroscopic characterization, antimicrobial and antibiotic activities of Hg(II) complexes with gram positive bacteria and gram negative bacteria.

Experimental Section

3-amino pyridine (Rolex-Mumbai), 3,4-dimethoxy benzaldehyde (Rolex-Mumbai), Mercuric chloride (BDH), (Mumbai). Mercuric Bromide (Loba-Kolkata), laboratory reagent and remaining all chemicals were used as procured without any purification. Standard procedure has been adopted for the present experimental work.¹¹⁻¹⁴

Synthesis of Schiff Base Ligand

0.05 mol of 3,4-dimethoxy benzaldehyde was dissolved in minimum amount of ethanol and the solution was added to ethanolic solution of 3-amino pyridine (0.05 mol). The reaction mixture was refluxed with constant stirring for 4-5 hr. On cooling ligand prepared was in liquid state. The colour of the ligand is of wine colour. The ligand was established as C₁₄H₁₄N₂O₂ and named as [N-(3,4-di-methoxybenzylidene)-3-amino pyridine]. The prepared ligand was characterized by the elemental analyzer using GMBTT Germany (Unicube) at I.I.T (I.S.M) Dhanbad. The mechanistic pathway preparation of the ligand has been depicted in Fig.1.

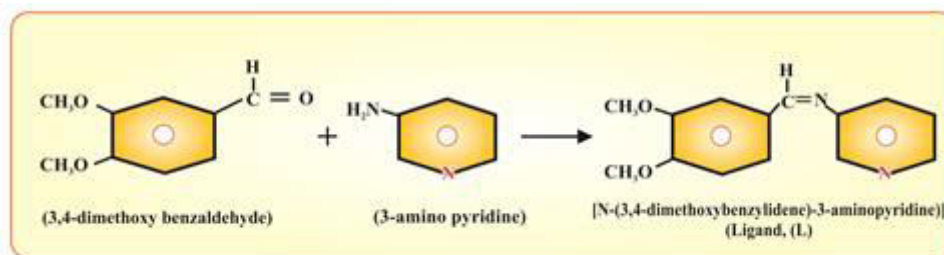


Fig. : 1 Mechanistic Pathway for Preparation of Ligand, (L)

SYNTHESIS OF METAL COMPLEXES

Preparation of Hg (II) Complex: [Hg (L)₂]Cl₂, [Hg(L)₂]Br₂:-

For the preparation of Hg(II) complex, the ligand, (L) (0.10 mol) is dissolved in ethanol and ethanolic solution of HgCl₂ (0.05 mol) & HgBr₂ (0.05 mol) respectively. The different solutions were refluxed with constant stirring for 4-5 hours. On cooling coloured solid were precipitated. The product was filtered, washed with cold ethanol. It was re-crystallized and dried in the desiccator using anhydrous CaCl₂. The prepared complexes were characterized by the Elemental Analyzer, using GMBTT Germany (Unicube).Table 1

Table No. 1: Physical & Analytical Data of Hg(II) Metal Complexes.

Sl. No	Compound	Molecular formula	Mol. Wt	Colour	% yield	Elemental Analysis found (calculated %)						Molar Conductivity
						Meta l	C	H	N	O	X	
1.	L	C ₁₄ H ₁₄ N ₂ O ₂	242	White	65	-	69.40 (69.42)	5.69 (5.78)	10.98 (11.57)	12.97 (13.22)	-	-
2.	[Hg(L) ₂]Cl ₂	[Hg(C ₁₄ H ₁₄ N ₂ O ₂) ₂]Cl ₂	755.49	Chalky white	63	26.44 (26.55)	44.40 (44.97)	3.67 (3.70)	7.39 (7.41)	8.44 (8.47)	9.35 (9.38)	112
3.	[Hg(L) ₂]Br ₂	[Hg(C ₁₄ H ₁₄ N ₂ O ₂) ₂]Br ₂	844.39	Faint white	59	23.69 (23.79)	39.74 (39.79)	3.28 (3.31)	6.61 (6.63)	7.54 (7.57)	18.86 (18.92)	114

Experimental: Micro-analytical methods on GMBTT Germany (Unicube), Elemental Analyzer were used to determine the % composition of C,H,N of ligand and complexes. FTIR spectral data of the ligand and complexes were recorded using KBr-pellets in the range of 400-4000 cm⁻¹ on Perkin Elmer Spectrum-2 at I.I.T (I.S.M) Dhanbad. The UV-visible spectral data of the schiff base ligand and metal complexes of schiff base ligand were accomplished by DMSO by CARRY-5000, Aligent at I.I.T (I.S.M), Dhanbad, Gouy balance gave the magnetic measurements of the complex using Hg[Co(NCS)₄] as standard. The conductivity measurements were carried out in DMSO using Electronic Digital Conductivity Meter, 0.01M KCl solution is used for calibration. NMR spectrum was analysed on Bruker Ascend™ 400 spectrometer at C.D.R.I, Lucknow. HRMS spectroscopy was recorded in USA Xevo spectrophotometer. Morphological studies(SEM) and percentage elemental composition(EDX) of the synthesized complexes were analyzed on Gemini-Supra™ 55 at I.I.T(I.S.M), Dhanbad. In vitro microbial studies were done at Bio Chem Lab, Sahibganj. The complexes were synthesized at P.G. Dept. Chemistry, Lab, Sahibganj College, Sahibganj.

BIOLOGICAL ACTIVITY

Biological Activities related to ligand as well as their complexes and Antibiotic were conducted against pathogenic and non-pathogenic bacteria such as [E-coli, Bacillus Subtilis] utilizing nutrient agar medium via disc diffusion method.¹⁴ Also the test solution is prepared in DMSO, after that soaked in filter paper with diameter 5 mm and thickness of 1 mm disc are placed on already inoculated seeded plates and subjected to incubation for 24 hrs at a temperature of 37° Celsius. The diameter of the zone of inhibition around each one of the disks was evaluated for 24 hours. The synthesized complexes showing considerable biological activity

against the bacteria as shown in (Table 5). The anti-microbial results showing that the activity of schiff-base ligands were pronounced in the case co-ordinated to Hg(II) ion.

RESULT & DISCUSSIONS

FTIR Spectra & Mode of Binding

FTIR spectra of schiff base ligand signifies a very strong absorption band at 1677 cm^{-1} which is due to $\nu(\text{C}=\text{N})$ of imine.¹⁵⁻²⁴ For the spectrum of analyzed complexes, this absorption band has been shifted to lower region by $55\text{-}78\text{ cm}^{-1}$, indicating the co-ordination of the schiff base ligand through Nitrogen atom present in the 3rd position to pyridine ring i.e. (imine nitrogen).¹⁵⁻²¹

The another characteristic FTIR spectrum shows an intense band at 1586 cm^{-1} which is a characteristic of ν - pyridine ring. The observed band gets shifted to lower region by ($12\text{-}71\text{ cm}^{-1}$), indicates co-ordination of ligand through N- atom of the pyridine ring.

In addition to the above, the FTIR spectra of metal complexes show absorption band at $537\text{-}525\text{ cm}^{-1}$ are attributed due to $\nu(\text{M-N})$ stretching.²⁸⁻²⁹ These bands are absent in the spectrum of the schiff base ligand. (Table-2) (Fig.2-4)

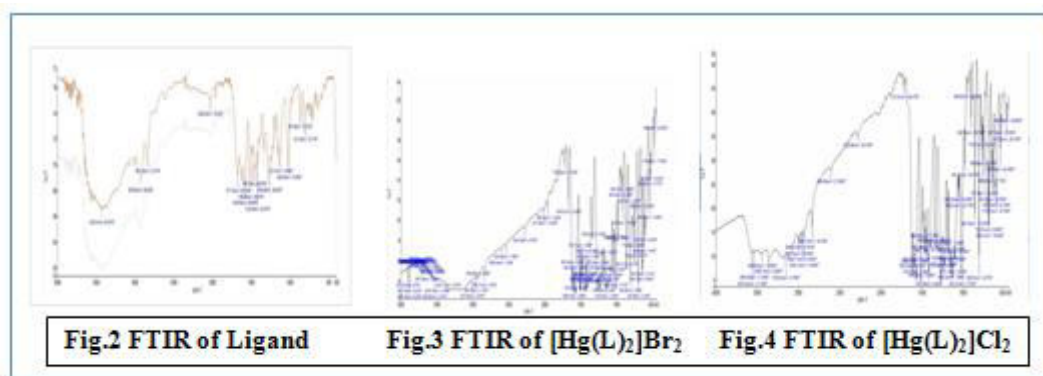
Table-1 illustrate the physical and analytical data of schiff base ligand, (L), & the metal complexes. The data shown that the ligand(L) form 2:1 [L:M] complex with Hg(II). The processed complexes were $[\text{Hg}(\text{L})_2]\text{Cl}_2$, $[\text{Hg}(\text{L})_2]\text{Br}_2$, where L=Schiff base ligand. The ligand binds with a metal in a bidentate manner. The C,H,N,O elemental analysis of schiff base ligand and its complexes were found satisfactorily with the predicted values. (Table-1)

FTIR Spectra & Mode of Binding

Table: 2 FTIR (cm^{-1}) Spectral Data of Ligand & Hg(II) Metal Complexes

Sl. No.	Compound	$\nu(\text{C}=\text{N})$	$\nu(\text{Pyridine})$	$\nu(\text{C-H})$	$\nu(\text{OCH}_3)$	$\nu(\text{M-N})$
1.	Ligand (L)	1677(s)	1586(s)	2929(b)	1269(s)	-
2.	$[\text{Hg}(\text{L})_2]\text{Cl}_2$	1622(s)	1515(s)	2835(b)	1246(s)	537 (s)
3.	$[\text{Hg}(\text{L})_2]\text{Br}_2$	1599(s)	1574(s)	2887(b)	1238(w)	525(s)

Where, s=sharp, w = weak, b= broad



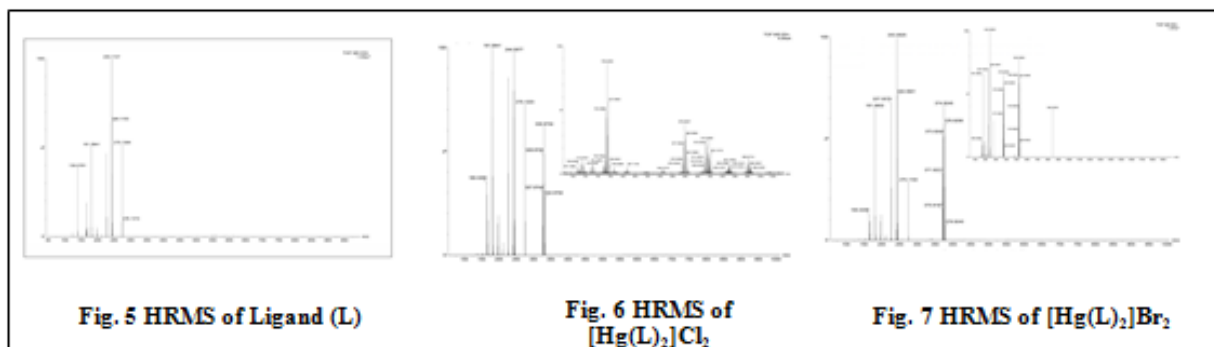
High Resolution Mass Spectrum (HRMS) of Ligand and Hg (II) Complex:

The mass spectrum of ligand and its metal complexes shows a molecular ion peak at m/z 243.11 which corresponds to formula weight 242 (Fig. 5).

In addition other peaks of the ligand were observed at m/z 276.13, 244.11, 181.08 and 139.07 with significant intensity and they correspond its fragment ion peaks.

The molecular ion peaks for metal complexes $[\text{M}+\text{H}]^+$ appear at m/z for $[\text{Hg}(\text{L})_2]\text{Cl}_2$ is 756.09 and confirms their formula weight (755.49) and the other fragment peaks with m/z ratio are 753, 755, 680, 674, 643 etc. (Fig.6)

The metal ion for $[\text{M}+\text{H}]^+$ appear at m/z for $[\text{Hg}(\text{L})_2]\text{Br}_2$ is 845.39 and confirm the formula weight (844.39) and other fragment peaks are 853, 856, 906, etc. (Fig.7)



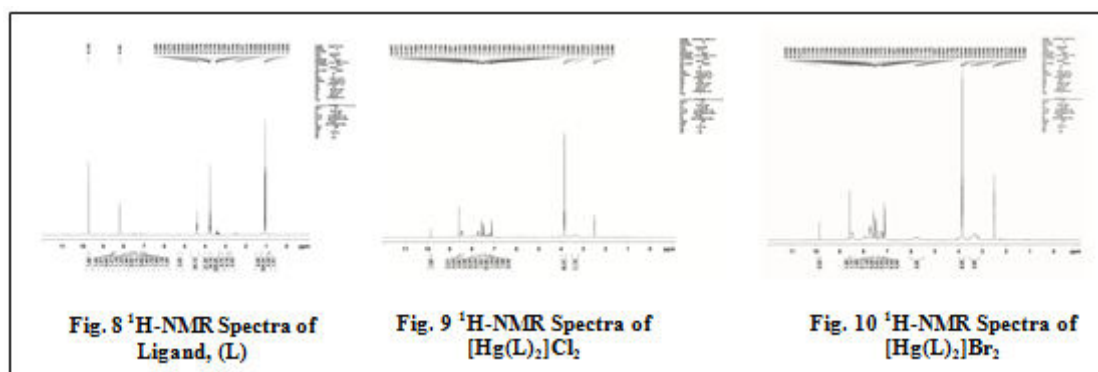
¹H-NMR of Ligand & Metal Complexes

The ¹H-NMR spectral data of the ligand and its metal complexes were recorded in DMSO-d₆. The ¹H-NMR spectrum of the ligand and metal complexes were compared. It was observed that the signals of the protons of different functionalities of the ligand have been shifted toward the downfield region indicating the co-ordination of the ligand to metal ion through N-atom of imine group & pyridine molecule. The ¹H-NMR spectra of the ligand (L) shows a band at $\delta = 9.832$ ppm attributed to the azomethine proton (-N=CH-) ^(15-21,30-34). The band appeared at 8.197 ppm assigned to pyridine ring proton. ^(15-21,30-34) Furthermore, the band observed at 3.863 ppm ascribed to methoxy proton (-OCH₃) of the ligand. ^(15-21,30-34) **Fig. 8-10, Table-3**

The ¹H-NMR spectrum of the Hg(II) metal complexes showed signals of azomethine proton (-N=CH-) in the range of $\delta = (9.847-9.849)$ ppm ^(15-21,30-34). Furthermore, the signals observed in the range of (8.469-8.577) ppm are attributed to pyridine ring proton ^(15-21,30-34) and the signals also appear in the range of (3.341-3.463) ppm assigned to proton of methoxy group. ^(15-21,30-34)

Table: 3 ¹H-NMR Data in ppm for Ligand, (L) and Hg (II) Metal Complexes

Sl. No.	Compound	Imine Proton	Pyridine Ring Proton	Methoxy Group Proton
1	Ligand, (L)	9.732	8.197	3.863
2	[Hg(L) ₂]Cl ₂	9.847	8.577	3.341
3	[Hg(L) ₂]Br ₂	9.849	8.469	3.463



Electronic Absorption Spectra

The electronic absorption spectrum of ligand, (L) exhibits $n \rightarrow \pi^*$, intra ligand charge transfer band at 398 nm (Table-4), which is due to the involvement of azomethine group (-CH=N) of the ligand moiety. ^(35,36,37) Figure 11 indicates the proposed structure of ligand (L).

The electronic spectrum of the [Hg(L)₂]Cl₂ and [Hg(L)₂]Br₂ complex shows an absorption band at 318 nm & 311 nm respectively, attributed to the L \rightarrow M (charge transfer transition). The Hg(II) complex is found to be diamagnetic nature as expected for d¹⁰ system. Different researchers predicted the tetrahedral shape for Hg(II) complexes by different schiff base ligands. ⁽³⁸⁾ Based on above discussion, experimental evidence, tetrahedral structure may be proposed for Hg(II) metal complexes. **Fig.12, Table-4**

Table: 4 Electronic Absorption Spectrum [EAS] & Magnetic Moment Data of Hg (II) Metal Complexes

Sl. No.	Compound	Peaks (nm/cm ⁻¹)	Assignment	Magnetic Moment (B.M)	Geometry
1.	Ligand (L)	398/25126	$n \rightarrow \pi^*$	–	–
2.	[Hg(L) ₂]Cl ₂	318/31447	C.T	–	Tetrahedral
3.	[Hg(L) ₂]Br ₂	311/32154	C.T	–	Tetrahedral

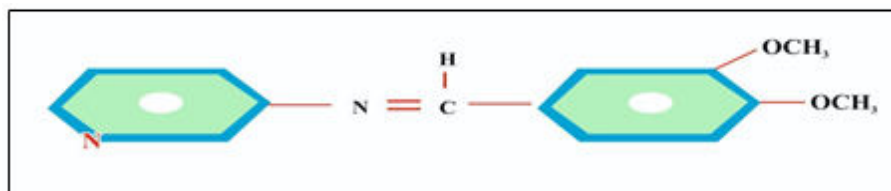
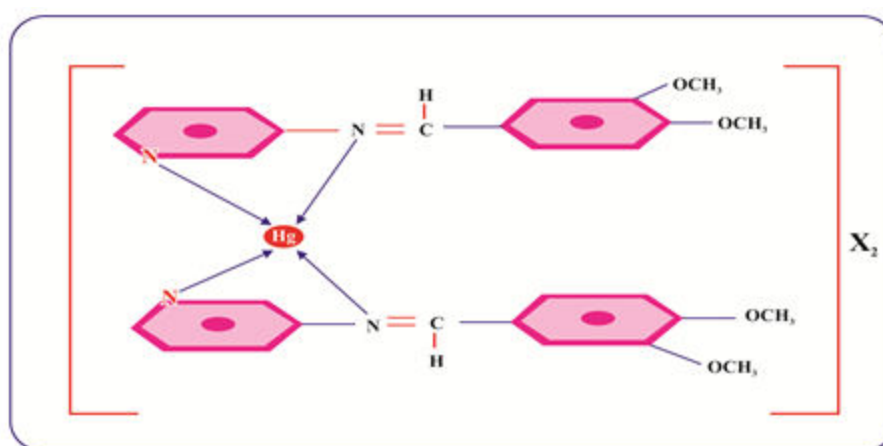


Fig. 11:- Proposed Structure of Ligand [L], [N-(3,4-dimethoxybenzylidene)-3-aminopyridine]



Where, X=Cl, Br

Fig. 12 Proposed Structure of Hg (II) Complexes

Molar Conductance

The molar conductance values of [Hg(L)₂]Cl₂ and [Hg(L)₂]Br₂ are 112 and 114 mho cm² mol⁻¹ which suggest the electrolytic nature of the complexes.³⁹⁻⁴⁰ (Table-1)

Antibiotic Study on GPB & GNB:

The In-vitro antimicrobial screening effects of the investigated compounds were tested against various bacterial species like Lactobacillus, E-coli, Norfloxacin, Amikacin, Cefuroxime, Ceftriaxone and are used as positive standard for antimicrobial studies. The presence of clear zones noted that the compounds were active. Hg(II) complex showed (18-21 mm) Inhibition Circle Diameter (ICDT) zone of inhibition against E-coli, Bacillus subtilis Lactobacillus. (Table-5)

All other complexes show moderate activity against the tested pathogens. From the above observation, the highest inhibition of microbial growth is due to the incordinated imine group (heteroatom), the variation of the effectiveness of different compounds against the different organism depends upon the impermeability of the cells of the microbes or difference in the ribosome of the microbial cells. The order of activity of the synthesized are as follows.

[Hg(L)₂]Cl₂ > [Hg(L)₂]Br₂ > Antibiotic (except ceftriaxone) > Ligand.

The enhanced activity of the complex can be explained on the basis of Overtone's Concept⁴¹, Tweedy's Chelation Theory⁴², Anil Concept of Inhibition⁴³.

The effect of nitrogen (imine group) in the synthesized ligand co-ordinated to metal ions forming chelates is responsible for the enhancement in biological activity of the synthesized complexes. The chelation reduces the polarity of the central metal atom because of partial sharing of its positive charge with the ligand which favours the permeation of the complex through the lipid layer of cell membrane.⁴⁴ The increased anti microbial activity of the synthesized complex may be due to their solubility, fitness of the particle, shape, size of the metal ion

and the presence of bulkier organic moieties. Other factors like solubility, conductivity, dipole moment, cell permeability, mechanism (influenced by presence of metal & ligand), bond length between the metal and ligand.⁴⁵

Anil's Conceptual Model

The order of inhibition (OI) of the synthesized complexes may depend upon size, higher electron affinity, higher electronegativity & lesser ionic radius of chlorine atom than bromine atom. However, the inhibition circle diameter of $[\text{Hg}(\text{L})_2]\text{Cl}_2$ is greater than $[\text{Hg}(\text{L})_2]\text{Br}_2$ (Table-5) so complex 2 will easily enter in the cell wall of gram positive and gram negative bacteria. The above conclusion may be due to the diff. morphological structure of $[\text{Hg}(\text{L})_2]\text{Cl}_2$ & $[\text{Hg}(\text{L})_2]\text{Br}_2$ complexes (Fig. 13-24). The cell wall of GNB is mainly composed of lipopolysaccharides which prevents the accumulation of compounds in the cell membrane. For the reason, GPB are more sensitive than GNB due to the cell membrane and their composition. GNB have three other components outside the peptidoglycon (lipopolysaccharides, phospholipids, periplasmic space) for defence but GPB lack these protective coats outside the peptidoglycon layer which then make them more vulnerable to foreign attack.⁴⁶

The minimum inhibition concentration (MIC) value of GPB is maximum than GNB $[\text{Hg}(\text{L})_2]\text{Cl}_2$ posses the dry grassy type, asymmetrical shape, drum stick type, helical spiral curly type, bushy type shape. So the complex may easily enter in the cell wall of bacteria and give maximum coverage of protection than GNB due to less fighting tendency of metal complexes in chalk type, granular shape, bowl type shape of $[\text{Hg}(\text{L})_2]\text{Br}_2$. (Fig.- 15-26)

Table 5: Inhibition Circle Diameter in Millimetre for the Ligand & Hg(II) complex

Compound	Escherichia coli(G ⁻)	Bacillus Subtilis(G ⁺)
Ligand	Resist (6)	Resist
$[\text{Hg}(\text{L})_2]\text{Cl}_2$	21 mm	23 mm
$[\text{Hg}(\text{L})_2]\text{Br}_2$	20 mm	22 mm
Norfloxacin	19 mm	21 mm
Amikacin	18 mm	20 mm
Ceftriaxone	Resist	Resist
Cefuroxime	20 mm	21 mm

EDX Analysis: The results of energy dispersive X-ray analysis (EDX) reveals the purity of the complex which indicates that there is no elemental contamination present in the complex. The EDX result of complex where as the percentage (%) content of element of $[\text{Hg}(\text{L})_2]\text{Cl}_2$ complex is C(37.71), O(9.46), N(7.76), Cl(11.63), Hg(33.44) and for $[\text{Hg}(\text{L})_2]\text{Br}_2$ (34.8), O (8.98), N(8.11) Br(2.32), Hg(24.9) respectively. Composition of C, N the percentage (%) in EDX agree well with CHN analysis which confirm that complexation has occurred effecting in 2:1 (L:M) ratio which supports the elemental composition.⁴⁷ The variation of elemental composition for $[\text{Hg}(\text{L})_2]\text{Cl}_2$ is 0.37 to 7 and for $[\text{Hg}(\text{L})_2]\text{Br}_2$ is 1.2 to 4.9 which may be due to the bombardment of the electron of different site of the synthesized complexes.(Fig. 13-14)

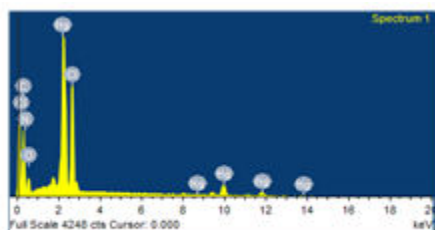


Fig. 13 EDX Image of

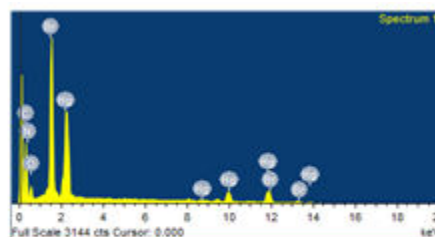


Fig. 14 EDX Image of

SEM Analysis

Morphology of synthesized complexes were characterized by SEM analysis, SEM image of Hg(II) complex are shown in (Fig 15-26). SEM picture of the metal complexes indicate that the particles are agglomerated with controlled morphological structure and the presence of small grains in non uniform size. After agglomeration, SEM image of compounds shows irregular grassy shape with elongated morphology and increased particle shape. The diff. SEM photorgaphs of $[\text{Hg}(\text{L})_2]\text{Cl}_2$ shows fibrous type, dry grass type, Aloe vera leaf plant shape, bush type, asymmetrical shape, helical spiral curly type, drum stick type shape. (Fig. 15-20) The different SEM Photograph of $[\text{Hg}(\text{L})_2]\text{Br}_2$ shows different shapes like wooden log type, irregular rocky shape, granular shape,

bowl nest type, upper onion stem type, chalk shape.(Fig. 15-26). FTIR, HRMS, NMR, EAS, SEM, EDX and In vitro Antimicrobial study revealed that ligand behaves as bidentate co-ordinating through imine group of N-atom and pyridine nitrogen having tetrahedral geometry with sp^3 hybridization with proposed structure⁴⁸⁻⁵³ in figure-12.

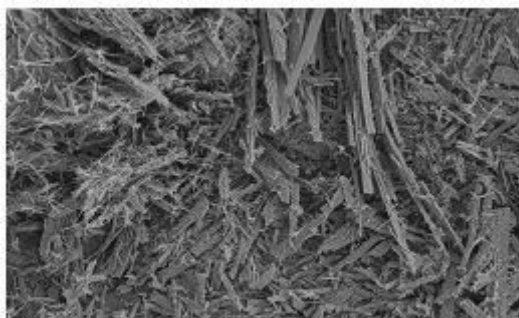


Fig.15

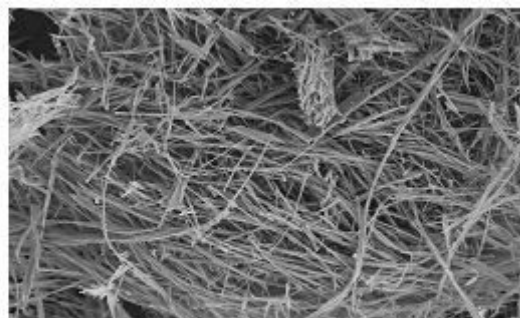


Fig.16

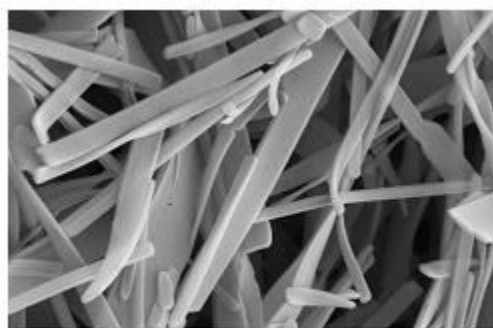


Fig.17

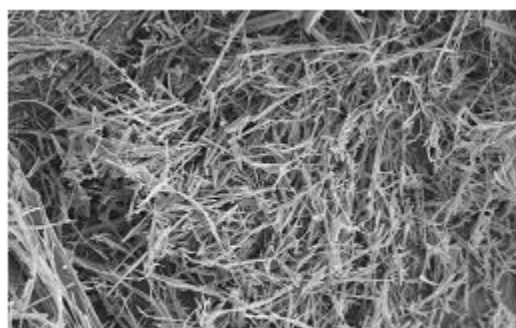


Fig.18

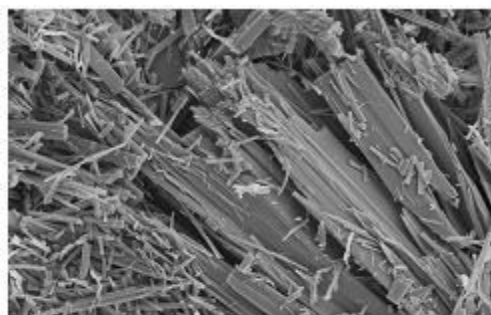


Fig.19

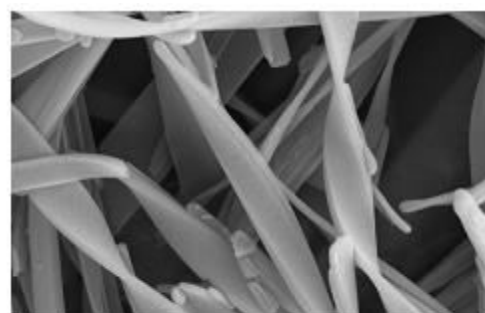


Fig.20

SEM Image of $[Hg(L)_2]Cl_2$

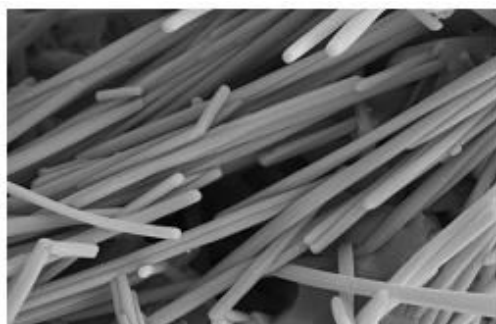


Fig.21

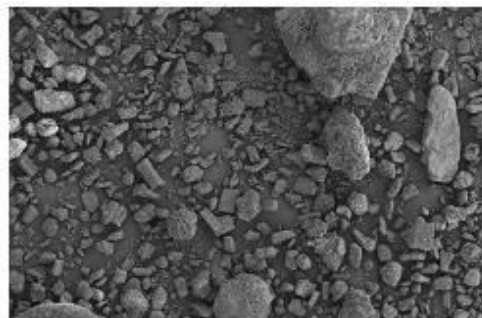


Fig.22

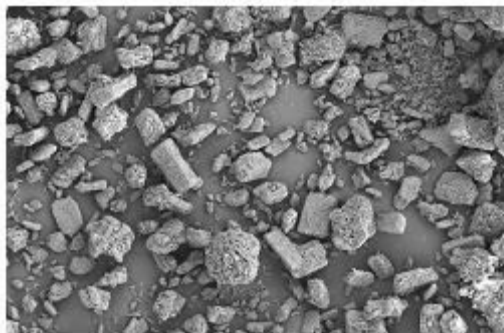


Fig.23

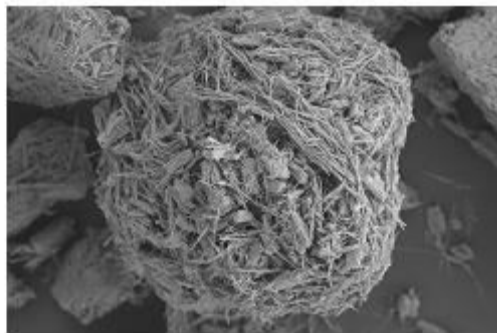


Fig.24

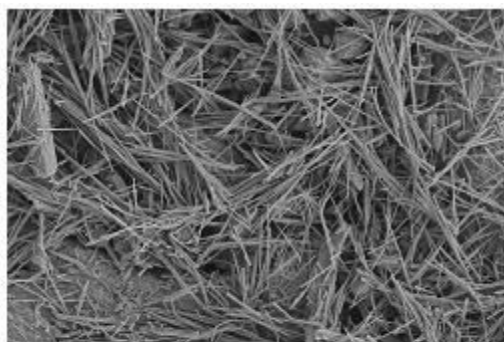


Fig.25

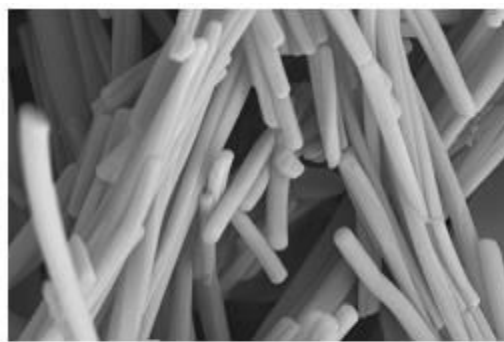


Fig.26

SEM Image of $[\text{Hg}(\text{L})_2]\text{Br}_2$

CONCLUSION

Metal complexes of Hg(II) & Ligand(L) have been characterized structurally by different spectroscopic techniques. The analytical data reveals that the ligand metal stoichiometry in complex is 2:1. All complexes are electrolytic in nature in DMSO. The ligand(L) binds in a bidentate manner which is governed by different spectral data. Ligand(L) co-ordinates through N-atom of the imine group and N-atom of pyridine ring. The proposed geometry of the synthesized complexes were tetrahedral. SEM analysis of synthesized complexes revealed the different morphology like-fibrous, rock shaped, nest shaped, stick shaped, stubble grassy shaped, upper onion stem shaped, chalk type asymmetrical shaped, bushy type shaped, cylindrical and wooden log type shaped. The % content of element in Hg(II) complexes agreed with the EDX with a little variation due to bombardment of electron on different areas.

Antibiotic Microbial study confirmed the order $[\text{Hg}(\text{L})_2]\text{Cl}_2 > [\text{Hg}(\text{L})_2]\text{Br}_2 > \text{Antibiotic (except ceftriaxone)} > \text{L}$. The above order may be due to fibrous, bushy agglomeration of the complexes.

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A Study on Present Scenario of Education Development and Educational Development Probabilities in Future of Paschim Medinipur, West Bengal, India

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ABSTRACT

Both a cognitive and sociological concept, education is. One of the most important components of human resource development is it. India has not yet attained the necessary level of education since gaining independence. The calibre of education determines the calibre of human capital. A nation's growth and progress are fuelled by education. The quality of human capital is improved by education. Education helps the populace comprehend a wide range of issues pertaining to the social, economic, technological, and cultural facets of a country's overall development. Many developing nations have recently experienced rapid economic growth and social development as a result of providing their citizens with high-quality education, using various strategies to increase student enrolment, and enhancing learning outcomes by building high-quality infrastructural facilities in schools. Our goal of teaching all children in the country, including male and female, urban and rural, and the underprivileged, has not yet been achieved, despite the governments' adoption of numerous measures to attain and overall educational development reaching every corner of the country. In this study, we examine Paschim Medinipur district, West Bengal, India's educational system and its growth.

Keywords: Education, Paschim Medinipur, Educational development, Human development, Growth.

1. INTRODUCTION

Education is important in everyone's life because it promotes learning, knowledge, and skill, all of which affect the mind and personality and foster positive views. One of the most important factors in the growth of a person or a community, especially in tribal areas where new programmes for development have been implemented, is education. India is home to the world's biggest tribal population, which may be economically disadvantaged. With a population of 1.21 billion, India is one of the most populous democratic nations, where people come from a variety of castes, religions, and cultural backgrounds. India has 10.42 crore tribal people, or around 8.6% of the country's overall population, according to the 2011 census. These tribal people are regarded as the most deplorable, oppressed, and backward segment of Indian civilization. However, the Government of India has adopted a number of measures and initiatives through various developmental schemes or programmes to advance both the socioeconomic situation and the educational level (Shyamal., 2021). The current government has taken the initiative "sab kasath sab kavikash," which refers to development for the people, to the people where caste, religion, and community never exist, to develop them through education. Upgrading the educational situation among tribal communities has become the biggest challenge in the modern world. One of the most valuable resources for developing the potential of tribal people and transforming them into skilled, resourceful humans is education. At several points during a person's migration, education and skill development are crucial. Migration is mostly influenced by the different returns on talents in the country of origin and the country of destination. Internal student movement may have a positive impact on household results, including those related to children's education, according to micro-level studies in the subject.

1.1. Primary Education in West Bengal

India's educational scene has seen significant upheaval since independence. This transformation, which affected the scope and standard of both the demand and supply sides of public elementary education in India, was implemented at different levels and in different ways. The educational surveys from the 1990s showed that India had atrociously low levels of educational accomplishment. The government was putting a lot of emphasis on universalizing education and paying particular attention to the enrollment in basic schools. The Indian government received financial assistance from many national and international organisations for the advancement of education. Additionally, the passage of the Rights to Schooling Act (2009) marks a significant shift in the system by making education mandatory for all individuals in the relevant age bracket (6-14). The age-old traditional system of prioritising merit and dividing children according to merit, position, and social background takes a significant hit as a result.

The field of primary education has witnessed significant investment during the past ten years. However, there is also a confounding issue of many aspects in the advancement of education due to the current deficiency of money. India's education system has suddenly and significantly advanced in giving nearly universal access to

primary education. However, access has not kept up with the improvement in educational quality. If not closed in a timely manner, this growing gap between access and quality may undo the progress already made (Dev, 2020).

The typical quality indicators, which are both real (such as infrastructure, student-teacher ratios, and student-classroom ratios) and intangible (such as teaching-learning materials) have a great deal of diversity within states (relevance of curriculum, interpretation of curriculum, quality of teacher, etc.). The educational environments of West Bengal, District Paschim Medinipur, and the town of Midnapur are described in more detail in the parts that follow.

Table: 1. Literacy rate and gap in rural and urban in Paschim Medinipur and West Bengal

	1951			2021		
	Urban	Rural	Gap	Urban	Rural	Gap
Paschim Medinipur	33.4	21.5	13.2	94.8	86.7	10.2
West Bengal	46.3	19.12	27.1	92.6	81.4	16.8

1.2. Theoretical Background of Education

There is little uncertainty that proper education assumes a significant part in cultural development. The students can do their work effectively. It has the potential to widen the social divide. It is worth emphasising that some countries are discriminatory in their differentiation between male and female and continue to hinder women from obtaining full social equality, which is a burden on their lives.

Furthermore, schooling provides two sorts of task employment in the community, namely manifest (or principal) professional occupations and latent tasks (or secondary).

Children's early education begins in pre-school and kindergarten and is based primarily on conventions, traditions, and cultures passed down through families. Western society, for example, is becoming increasingly varied (District Census Handbook Paschim Medinipur, , 2020). As a result, pupils acquire various cultural norms, and educational systems communicate their people's essential values through tasks such as supporting principles and values and obeying authority and the law.

Through the system's recognition of the critical role of instructors and those in charge of managing learning affairs, the school environment promotes quality education for students. They enable pupils to develop the skills required to meet the challenges of life in the industry and society. The previous education gives pupils with social security and helps them find suitable employment. Universities and higher education institutions are regarded as critical educational channels for qualifying professionals in numerous sectors and bringing students closer to financial sufficiency in order to attain societal peace. Another key latent function of formal education is the ability to collaborate in small groups with others. The expertise may not be learned and transferred to the workplace within the family in the home environment. 3 \s. Students can obtain experience tackling many political, social, and economic concerns through college education. They can also adopt a policy of communication and tolerance for opposing viewpoints.

1.3. Education for Everyone (EFA)

The Education for All development was created in 1990 during a world culmination met by UNESCO, UNDP, UNFPA, UNICEF, and the World Bank. Delegates from 155 nations, between administrative associations, and non-legislative associations met in Thailand that year and vowed to lessen ignorance before the decade's over definitely. As per the World Statement on Education for All, "every individual kid, juvenile, and grown-up will have the option to profit from educational open doors intended to meet their fundamental advancing requirements." after a decade, with numerous countries still quite far from achieving this goal, the world local area reconvened in Dakar, Senegal, and reaffirmed their obligation to accomplishing Education for All by 2015.

The worldwide local area recognized the worldwide Education for All (EFA) plan in 2000 at the World Education Gathering as alluding to six regions: youth care and education, essential education, youth and grown-up advancing necessities, proficiency, orientation equity, and educational quality. Three quantifiable targets were laid out for 2015: dividing the quantity of unskilled people, widespread essential education, and orientation balance, the last two of which have been reaffirmed in the Thousand years Development Objectives (MDGs).

As the primary office, UNESCO is liable for planning global endeavours to accomplish Education for All. State run administrations, development associations, metro society, non-legislative associations, and the media are attempting to accomplish these targets. India's significant fundamental education drive is the Sarva Shiksha

Abhiyan (SSA). The SSA is one of the world's biggest projects of its sort, with more than 194 million kids to be taught in around 1.1 million homes. The Indian government is concentrating on the program to accomplish the EFA objectives.

1.4. The Importance of Education

Today, every country in the globe is endeavouring to further develop in each way possible. Each country, whether created or creating, wishes to deductively get to the next level. Education is a basic method for a human being's capability to arise in a positive manner bearing so a man can live in the public eye with nobility and shape his propensities and tastes and character of people living in the public eye through the spread of information and data Fundamental Education is, and has forever been, the way to freedom from bondage, dread, and need.

Education is a useful asset for battling destitution. Resilience and understanding are encouraged by education and cultivates a majority rules system and soundness. It saves lives and offers individuals the chance to better themselves their very life Consider deserted youngsters or deactivated kid officers who have had next to zero education. Residing in the city, without a task or a protected spot to remain Consider wiped out children who are biting the dust on the grounds that their moms who can't peruse the solution on the medication bottle, or a rancher who has lost his tribal land. Since he can't comprehend legitimate desk work Quality education furnishes individuals with the abilities they need. They need the data, abilities, and confidence to upgrade their pay and widen their chances work. Thus, education gives people a voice and lifts a nation's creation and seriousness, as well as being helpful to social and political growth (N.K., 2021).

1.5. Problems and difficulties

In the context of Indian Higher Education, the most significant dimensions of the learning environment are integration, inclusivity, openness, and flexibility. Traditional divisions between formal, non-formal, and informal learning, as well as remote education and face-to-face instruction, become more obsolete in such an environment. We need to give more emphasis on scientific and technological developments.

We should encourage universities to become centres of higher learning and research, thereby contributing to the development of a highly trained global workforce.

1.6. In the Twentieth Century, Education in Developing Countries

Since the turn of the 100 years, the world has seen the development of new innovation for educating and learning by means of the Web and the computerized upset, which has brought about a subjective change in educational techniques to accomplish the Unified Countries Manageable Development Gathering's objective of education for all by 2030. There have been numerous opportunities for these ambitious initiatives to succeed through the development of curricula, teacher training, educational leaders, innovative teaching methods, and so on.

However, there are still certain barriers to reaching these goals, particularly in the areas of free education and female education, as well as learning quality. In developing countries, the achievement gap has widened dramatically. Although education is necessary for a better living, graduates frequently discover that their knowledge does not meet the demands of the labour market.

Schools and universities should provide a variety of study programmes in many disciplines to allow students to develop information, skills, and professional experiences that will allow them to compete for and secure relevant positions that will allow them to raise their level of living. Despite the numerous problems that education systems will encounter during the Covid-19, there are certain chances for poor nations to improve their educational planning capacities and contribute to sustainable development (Ghosh, 2020).

Demographic shifts are critical to the advancement of education. For example, in developing nations, the population is fast increasing in comparison to the similar population in Europe, posing a serious challenge to extending primary education to all children and delivering quality education. Demographic shifts (particularly in developing nations, where the majority of people live in rural and urban regions) place pressure on education institutions to provide chances for adult re-skilling and up-skilling. Rapid urbanisation places additional strain on urban schools and suggest that the population serviced by rural schools may be dispersed, needing alternative provision modalities.

In contrast, there are currently 214 million international migrants²⁰. This figure is expected to rise dramatically in the future, resulting in major "brain outflow" in certain nations and "brain gain" in others. According to the

indication, education should equip students to live and work overseas. This system must evolve to meet the growing desire for greater transparency and more effective methods of recognising qualifications.

Rural education is critical to increasing agricultural productivity and overall food security. Education is also an important factor in reducing not only economic poverty but also capacity poverty. Poverty and hunger, on the other hand, are significant hurdles to significant uptake of educational possibilities.

As a result, educational policies, initiatives, and programmes must take a pro-poor stance and remove poverty-related impediments to realising the right to education. Education and health are also linked. People who are more educated have better health outcomes, and healthier students perform better in school.

Recognizing the importance of quality education is one of the foundational pillars of growth. It has an impact on raising living standards and raising cultural awareness of the significance of birth control. Education reform plans aim to improve students' capacities to be productive members of society, ultimately eradicating poverty and illiteracy. Some developing countries have recently made attempts to improve the standard of living for low-income households. These countries are marked by a young population that, if highly educated, can work in a variety of professions related to sustainable development. They necessitate the establishment of a good learning environment, the provision of free education, and the establishment of links to work. However, these countries' economies suffer from a lack of resources and significant investments, particularly in the industrial and agricultural sectors. These countries rely on the utilisation of their natural resources and tourism services. These funds are insufficient to fund comprehensive development plans, particularly those aimed at boosting education in their cultures (Gould, 2020).

Some countries updated their entrance policies and primary school education. These encouraging indicators may lead to the achievement of learning objectives, particularly for young people in terms of reading and writing, which will have an impact on societal behaviour. It is worth emphasising that the dropout rate of children from completing their studies is attributable to economic factors, as low-income families resort to employing their children at a young age to supplement their income.

As a result, improving quality educational opportunities in the early grades to acquire life skills protects children. Finally, education reform in developing nations offers a genuine investment in the education of millions of children in the acquisition of writing, reading, numeracy, and critical thinking skills, thereby reducing the spread of ignorance, poverty, and disease. To ensure the success of the reform initiatives, low-income families should be assisted and encouraged to enrol their children in school while lowering education costs and providing financial and professional support to teachers.

The following 21 criteria are critical to the effectiveness of reforms and improving educational quality:

- Create a clear educational strategy for all levels. Infrastructure development and maintenance, modernization of educational administration systems, curriculum and academic content development, academic and administrative cadre training, attention to students' general health, and meal provision
- Providing the required funds, improving evaluation methodologies and efficiency
- There is no question that accomplishing the above elements will require worldwide endeavors, especially from givers, to help agricultural nations in strengthening their endeavors to guarantee kids signed up for schools and the capacity to keep learning to accomplish the rule of education for all. Some governments have been able to increase school construction rates, hire new instructors, and provide printed materials and textbooks through modest aid programmes (Hallock JA, 2020).

1.7. Study Area

Paschim Medinipur, located in the southern region of West Bengal, was created on January 1, 2002, and it was carved out of the former Medinipur district, which was at the time the largest district in India. Bankura locale in the north and Purba Medinipur area in the south-east enclose Paschim Medinipur. Balasore and Mayurbhanj locale in Orissa line the area toward the south, and Sing murmur and East Region in Jharkhand line it toward the west. Paschim Medinipur, which situated in the south-western locale of West Bengal, is viewed as one of the states's in reverse areas and is to a great extent populated by native individuals. Because of its underdevelopment, alongside different areas in the western part of W.B., this second-biggest region in the Province of W.B. has forever been the subject of consideration. The district's eleven western blocks have experienced a rapid growth of Maoist violence over the last two or three years, which has highlighted the challenges of underdevelopment. The district is divided into two separate parts: the western half, with its dry, desert topography and predominance of tribal people; and the eastern section, with its alluvial soil cover and

predominant non-tribal population. The district's twenty-nine blocks offer a singular opportunity to comprehend the problems related to the various facets of human growth, such as livelihood, income, health, and education.

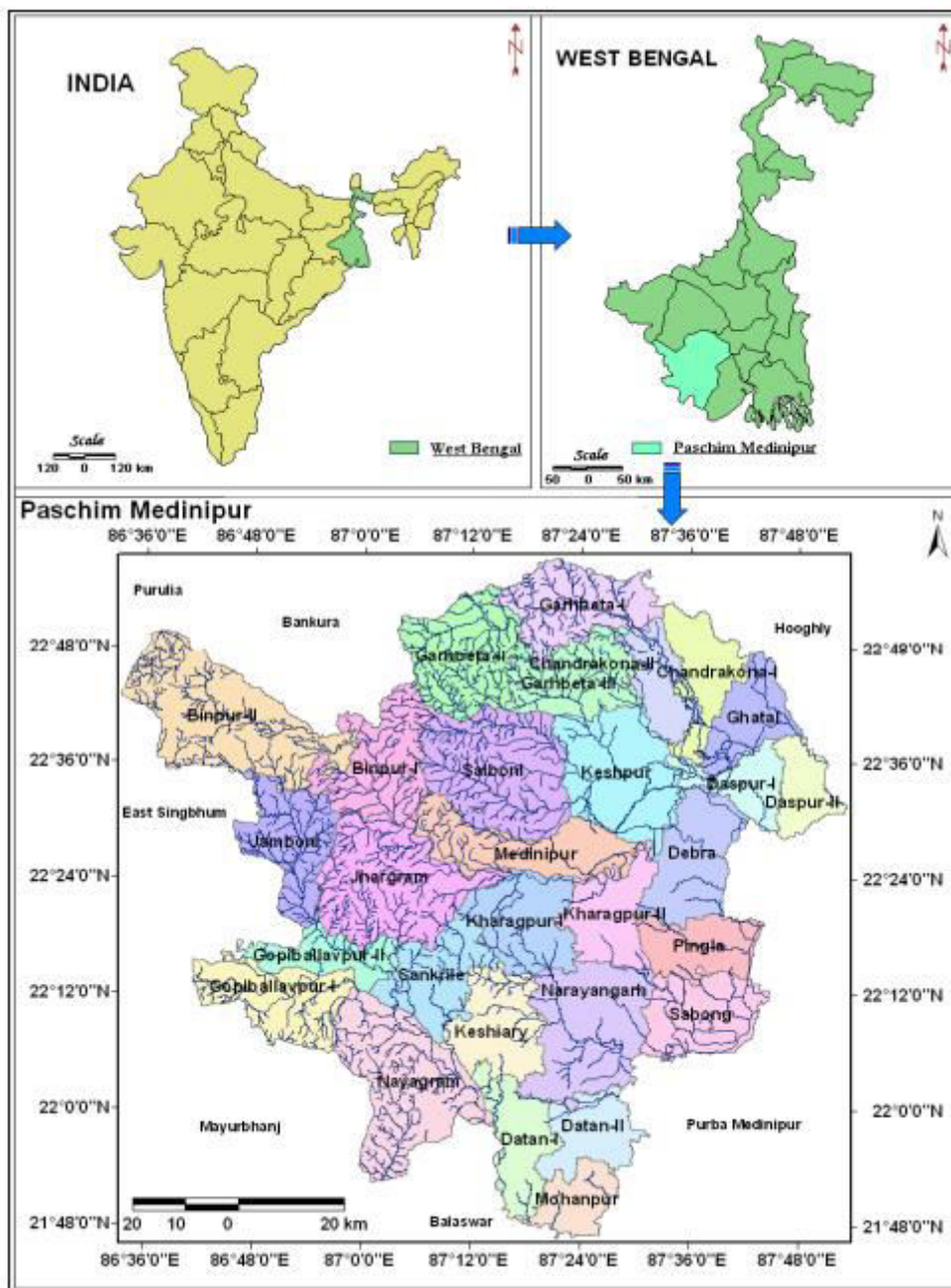


Figure: 1. Location map of Paschim Medinipur district, West Bengal, India

2. REVIEW OF LITERATURE

Patterns in Growth of Advanced education in India, Uma Pujar, 2014. The development of human assets that can take care of the social, financial, and logical development of the country is made conceivable by the advanced education area, which is pivotal for both short-and long haul monetary advancement. Right now in its segment change, India's populace is as yet developing; however the quantity of youngsters joining the work market is developing. To support the country, teaching this energetic and huge population is significant. By shaping various methodologies and panels, the public authority has given the advanced education area the fundamental lift. During its 11th Long term Plan, the Indian Government needed to raise the Gross Enrolment Proportion (GER) to 21%. (2007-12) to achieve this, the quantity of understudies signed up for colleges and schools should be altogether expanded by 2011-12. In her study work "A Review of Gender Disparity in Education Sector in India," ChakrabortyAnanya (2012) On the one hand, universal education is necessary, but on the other, it presents a challenge to the overall development of third-world society. For a nation like India, the gender gap in education has continued to be a major problem. Only 54.16% of Indian women, who make up 50% of the workforce, are literate. This represents a gender disparity in literacy. Based on data gathered from

secondary sources, the current study makes an effort to assess the differences in the Indian education sector as well as their impact status. Sopher's Gap Index uses data on male and female literacy by state, age, educational attainment, social class, and place of residence to calculate the disparity. Finally, it has been found that female education significantly affects gender and human development by using the Spearman's Rank Correlation Coefficient technique. The study comes to the conclusion that empowering women is essential to development because it creates a brighter future for their children.

Based on a school survey and pupils' academic performance, M. Aslam and G. Kingdon (2007) conducted a study on school education (2002–2003) in Lahore. The study's primary goals were to: a) investigate the relationships between student accomplishment scores and information about the subject teachers who taught them; and b) investigate the effect of the teaching and learning process. Kernel density, OLS Regression, and pupil fixed effects were the methods employed in this study. The dependent variables in this study were students' math and language accomplishment scores, whereas the independent factors were student characteristics, teacher characteristics, family characteristics, and school characteristics. The study's key conclusions are: 1) A significant portion of effective teachers believed they could affect students' academic performance and attempted to meddle in the classroom. The student learning is significantly benefited by certain unmeasured teaching procedure variables, such as lesson planning, allowing student participation by conducting question and answer sessions in the classrooms, as well as questioning them on previous lessons. It is also discovered that teachers in government schools are more effective at imparting lessons to the students with their cognitivity (Association, 2020).

2.1. Objectives of the study

The study's primary goals are:

- To investigate how curriculum structure affects management, long-term learning, and quality improvement in educational institutions.
- Examining the academic learning stability in education and the student's understanding of their knowledge practise in contemporary Paschim Medinipur.

3. RESEARCH METHODOLOGY

The district chosen for the study by the current author is Paschim Medinipur, which is also known as Jangalmahal or the Red Corridor and has been excluded by Mousiest for the past three decades. Additionally, the district has the largest density of tribal people in West Bengal. However, the Paschim Medinipur district was established on January 1, 2002, following the division of Midnapore. Paschim Medinipur was specifically chosen for the study, and secondary data is employed to achieve the aforementioned aims (James, 2020).

Information has been gathered to create an educational development index. Using resources:

- i. Indian government's ministry of human resources development.
- ii. Some statistics on education.
- iii. Colleges' Office of the Registrar

3.1. Hypothesis

H1: In Paschim Medinipur's educational system, there is a statistically significant relationship between long-term learning and quality improvement.

H2: The Paschim Medinipur educational system's Long Term Learning and Quality Improvement have no statistically significant relationship.

4. Data Analysis and Result

The specialists utilized the UNDP's Human Development Record (HDI) (UNDP 2006) system to ascertain each file by normalizing the picked attributes. Crude information has been changed into values that are unbound by units and standardized corresponding to restricting qualities, guaranteeing that all values fall between the scope of 0 and 1. Each aspect record is determined utilizing the accompanying nonexclusive equation:

Allow X_{id} to address the size or worth of the i th pointer in the area's d th block $I - 1, 2, \dots, m$; $d=1, 2, \dots, n$, for instance). The accompanying equation is utilized to accomplish normalization and standardization:

$$Y_{id} = \frac{X_{id} - \text{Min}_d X_{id}}{\text{Max}_d X_{id} - \text{Min}_d X_{id}} \quad [\uparrow] \quad (1)$$

The dropout rate, for instance, should decrease as the district with human development improves. If, however, x_i is adversely connected with human development, then (eq. 1) can be written as

$$Y_{id} \frac{\text{Min}_d X_{id} - X_{id}}{\text{Max}_d X_{id} - \text{Min}_d X_{id}} [\downarrow] \quad (2)$$

This makes it simple to retrieve the normalised scores for each parameter using the statistics and functions in any spreadsheet application.

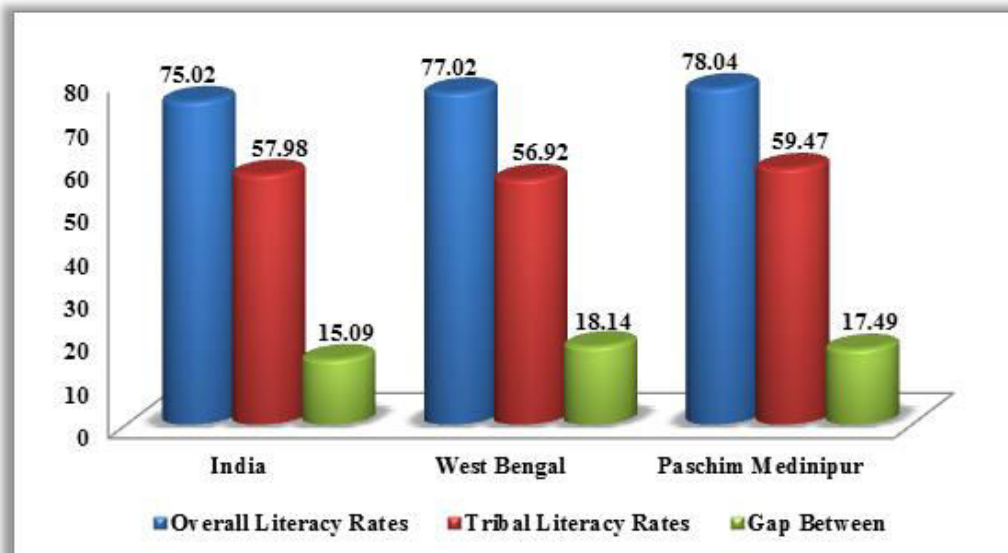


Figure: 2. Overall literacy rates, tribal literacy rates, and the gap between them are displayed graphically.

The graphical depiction shows the district's total literacy rate as well as the literacy rate for Scheduled Tribes. When compared to the tribal literacy rate of Paschim Medinipur district and the overall or all social group literacy rate of the national average, there is a huge gap between the overall literacy rates and tribal literacy rates, which is as much as 17.49% higher from the tribal literacy rates of Paschim Medinipur district. The literacy percentage of Paschim Medinipur's tribal population is 59.47%, compared to the nation's total literacy rate of 75.02%. This 15.55% discrepancy indicates that the government is seriously concerned about Paschim Medinipur's educational situation. It also demonstrates the precarious state of education because there is a 17.55% discrepancy between the tribal literacy rate of Paschim Medinipur district (59.47%) and the overall literacy rate of West Bengal (77.02%). As a result, it is evident from the comparative analysis that the tribal education in the Paschim Medinipur district is insufficient, and the tribal population in West Bengal is far behind other socioeconomic groups or the national average for literacy rates (Malta, 2020).

4.1. Descriptive Statistics

Descriptive statistics are used to describe a variable's central tendency (the "centre" or expected value) and dispersion (the distribution of the variable's responses). Be aware that SPSS will still provide statistics even if the central tendency and dispersion measures are incorrect.

Table: 2. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Long term Learning	100	1.18	3.58	1.692	.462	-.8284	.170	-1.326	.340
Quality Improvement	100	1.38	3.78	1.881	1.049	-.2392	.170	-1.192	.340
Valid N (listwise)	100								

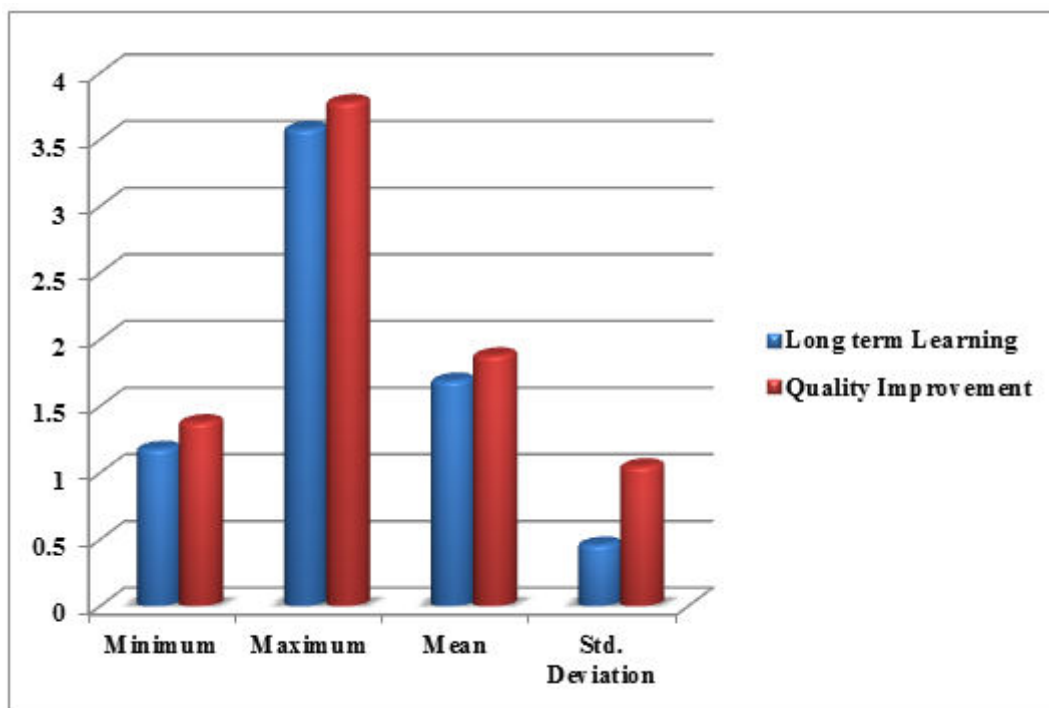


Figure 3. Graphical representation of descriptive statistics

Table 2 shows that the differences in long-term learning and quality improvement are statistically significant for our analysis. Long-term learning does not have a higher mean value than quality improvement.

4.2. Correlations Analysis

Correlation is a statistical technique that shows how closely two variables are related to one another or how much of a relationship there is between them. For instance, if we have information on the weight and height of taller and shorter persons, as well as the correlation between them, we may be able to infer how these two factors are related. Furthermore, by examining the relationship between these two variables, we can get the conclusion that weight and height are positively associated. Correlation is calculated using the correlation coefficient. The correlation coefficient can be calculated easily in SPSS. Before using SPSS to calculate the correlation, we should have a basic understanding of correlation.

Table 3. Pearson correlation matrix

Correlations			
		Long term Learning	Quality Improvement
Long term Learning	Pearson Correlation	1	.089
	Sig. (2-tailed)		.227
	N	100	100
Quality Improvement	Pearson Correlation	.089	1
	Sig. (2-tailed)	.227	
	N	100	100

It is evident from Table 3 that there is a sluggish association ($r=.089$) between long-term learning and quality improvement. As a result, we might conclude that there is a statistically significant link between long-term learning and an increase in the calibre of Paschim Medinipur's educational system, or that alternative hypothesis H1 is accepted and H2 is rejected.

5. CONCLUSION

Education is a system that shapes and strengthens an individual's body, intellect, and personality. It is the organisation of the brain, heart, and mind, allowing a person to build an optimal personality while recognising

the best in him or herself. Higher education in India has advanced dramatically in recent decades, yet it is not equally accessible to all. Education is the key to the development of many people or community or state. Though the tribal development is taking place in India since post independent phase to the current time, the tribal educational condition in Paschim Medinipur district as well as in West Bengal has been quite slow that means the pace of development also progressed with the same condition. Because education gives to a glance of development where has the links to an understanding of the socio-economic and demographic structure of the society or community. Education is a significant social control and change specialist. India has forcefully sought after the six EFA objectives in the space of youth care and education, essential education, orientation, youth and teenagers, grown-up education, and educational quality (Wilson, 2020). The SSA is the Public authority of India's lead program for accomplishing Education for All (EFA) inside a time period. The 86th amendment to the Indian Constitution laid out education for kids matured 6 to 14 years to be a central right. We are focused on guaranteeing that all kids, paying little heed to orientation or social class, approach an education that permits them to foster the abilities, information, values, and perspectives expected to become capable and dynamic residents of India. At last, EFA and the Central Right to Education for All Kids, as reported by the 86th Protected Revision in 2002, might be acknowledged over the long haul through more comprehensive education execution. Accordingly, the nation ought to increase its determination to meet the EFA focuses by 2015.

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Study of the Effect of Different Operating Parameters on Adsorption at Different Ratios by Proposed Composites of Multiwalled Carbon Nanotubes

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ABSTRACT

In these studies, carbon element carbon nanotubes were created using a chemical vapour deposition method with ethylene as a carbon source and Nano crystalline iron as a catalyst. The article mentions composites of the Nano crystalline iron and MW carbon nanotubes processes. Composites of MW carbon nanotubes were created in an 800°C high-temperature furnace. The adsorbent sample was then prepared at room temperature in a normal atmosphere. Oxidation has been used to modify the surface of carbon nanotube composites. A 10 gramme sample was oxidised in an HNO₃ solution at 30°C for 24 hours with continuous agitation. After that, deionized water with a pH of neutral is used to wash Composites carbon. To filter the composite, a fine polycarbonate membrane is used. Adsorption tests were performed in a carafe flask with a dye arrangement of 300mL with beginning dye fixation. The dye's initial concentration shifted from 5, 15, and 25 mg/lit. The trials are only for MW carbon nanotubes and carbon nanotube composites with adsorption capacity. The flask with the dye arrangement has been fixed and set in a temperature-controlled vibrating water container (designed specifically for this experiment) and unsettled at a constant speed of 200 rpm. The tests were carried out at three different temperatures to observe the effect of temperature, namely 15°, 25°, and 35°C. The pH levels of the dye arrangement were balanced at 7.5 before blending in with the adsorbent. The pH levels of the dye arrangement were balanced at 7.5 before blending with the adsorbent. When the ideal temperature was reached, 30 mg of adsorbent was added to the carafe. At the predetermined minute, 1 ml of watery sample was removed from the arrangement, and the fluid was separated from the adsorbent by centrifugation at 6000 rpm for 8 minutes. Spectrophotometry was used to resolve the convergence of BR46 in its arrangement.

Index Terms — Multi-Walled Carbon nanotube, Methyl blue dyes, Orange-red dyes, Thermodynamic parameters, Carbon nanotube adsorption

I. INTRODUCTION

The sidewalls of nanotubes can be functionalized to change their sidewall properties to get the desired results for the application at hand. For creating functional composites, for instance, chemical sidewall modification may enhance the adhesion properties of nanotubes in a host polymer matrix. Chemical and biological sensors can be produced by functionalizing the ends of nanotubes. To clean and oxidize the raw material, the produced multiwall carbon nanotubes were subjected to boiling concentrated HNO₃ under a reflux condenser for around 50 hours at 120 °C. Deionizer water was used to rinse the oxidized multiwall carbon nanotubes until the pH of the filtrate was stabilized (20). The production of amide and ester bonds by the oxidative introduction of carboxyl groups makes these sites suitable for future alterations because they allow for the covalent coupling of molecules.. Carbon nanotubes are referred for the structure and diameters .

While nanotubes of other compositions exist the research focuses on the strategy of the technology of carbon Nano tubes. Therefore, the "carbon" qualifiers are also known and published by the names like SWNT, MWNT and CNT Etc. The length of the carbon nanotubes and the molecules are for the production matter which are much bigger in size as compared to the others. Carbon nanotubes can exhibit remarkable electrical conductivity, while others are semiconductors. They also have exceptional tensile strength¹ and thermal conductivity because of their nanostructure and the strength of the bonds between the molecules of the carbon atoms. In addition, they can be chemically bonded. These properties are to be much value of great years with the advent of technology, such as electronics, optics, composite materials (replacing or complementing carbon fibers), nanotechnology, and other applications of materials science.

Rolling up a hexagonal carbon atoms and molecules in the surrounding around the long single-wall carbon nanotubes shows that all of these tubes not only have the structure of the nontrivial rotational symmetry about this axis. In addition, most are chiral, meaning the tube and its image of mirror cannot be Superimposed. This construction also allows

$$\ln[q_e - q_t] = \ln q_e - K_1 t \quad (i)$$

Single-wall carbon nanotubes to be labeled by a pair of integers.

$$\frac{t}{q_t} = \frac{1}{K_2 q_e^2} + \frac{1}{q_e} t \quad (ii)$$

II. PURIFICATION OF MULTIWALL CARBON NANOTUBES

To eliminate amorphous carbon, one gram of the multiwall carbon nanotubes generated was heated at 350 °C for 30 min. Half a gram of multiwall carbon nanotubes was thermally treated before being mixed with 20 ml of a 70% sodium hypochlorite solution in a flask. In an ultrasonic cleaning bath the solution was then shaken (3.2). Metal catalysts were eliminated by heating the sample for 20 minutes at 85 °C in a water bath. When the multiwall carbon nanotubes had cooled, deionized water was used to wash them until the pH of the solution reached 7. After drying the solution at 200 °C and centrifugal filtration, pure multiwall carbon nanotubes were obtained.

Surface modification of the grown multiwall carbon nanotubes has been done through the oxidation method. In the oxidation process, we oxidized 10g of multiwall carbon nanotubes in an aqueous solution of HNO₃ (200 ml) at 25 °C for 24 h with continuous agitation. After that, the modified multiwall carbon nanotubes were washed with deionized water at neutral pH and filtered using a polycarbonate membrane (Whatman, 0.2 μm pore). Finally, the multiwall carbon nanotubes were dried for 12 hours at 80 °C.

III. DYE CONCENTRATION

The absorption percentage of the carbon nanotube depends on the initial dye concentration. It varies with the temperature of the reaction. We have selected 5, 15, and 25 mg/liter dye concentrations for this research. The goal of these various dye concentrations is to investigate the absorption properties in different dimensions.

At pH 7.0 and 20 °C, illustrates the impact of starting dye concentration on the quantity of BR46 adsorbed by carbon nanotube and modified carbon nanotube. As demonstrated, for carbon nanotube and modified carbon nanotube respectively, the adsorption rises with increasing starting BR46 concentration, from the selected 5 mg/liter, 15 mg/liter and 25 mg/liter. The mechanism and rate-controlling phase in the whole adsorption process will be examined.

For this, we followed Pseudo-first-order, pseudo-second-order, and intraparticle diffusion models were used to explore the adsorption process in order to look at the mechanism and rate-controlling phase in the overall adsorption process. The following equations provide the pseudo first-order kinetic model and the pseudo second-order kinetic model. The slope and intercept of the linear plots produced by the graphical representation of t/q_t vs t were used to derive the values of k_2 and q_e .

The correlation coefficients for the pseudo second-order kinetic model are higher than those for the pseudo first-order kinetic model, as can be seen from the results presented. The calculated values of q_e from the pseudo second-order kinetic model are very close to the experimental values for both adsorbents (Wojciech Konicki and Iwona Peech, 2019). The absorption percentage of the carbon nanotube depends on the initial dye concentration. It varies with the different temperatures.

IV. EXPERIMENTAL ANALYSIS

Composites of the Nano crystalline iron and MW carbon nanotubes process has been mentioned in article [17]. The preparing of Composites of MW carbon nanotubes was conducted in a high temperature furnace at 800 °C. After that the adsorbent sample has been prepared at normal room temperature under normal atmosphere. Modification in Surface of Composites of carbon nanotubes has been performed through oxidation. For 24 hours of continuous agitation of 10 gram sample has been taken for oxidation in solution of HNO₃ at 30 °C. Before blending in with the adsorbent, different pH levels of the dye arrangement were balanced at 7.5. At the point when the ideal temperature was reached, around 30 mg of adsorbent was included into the carafe.

At foreordained minutes, 1 ml of watery example was taken from the arrangement, and the fluid was isolated from the adsorbent by centrifugation at 6000 rpm for 8 min. The convergence of BR46 in

arrangement was resolved Spectrophotometer. The adsorbed dye quantity at time t can be measured by A_t (mg/g) and explain by the following expression:

Where

$$A_t = \frac{(C_i - C_f)V}{m} \quad \text{(iii)}$$

adsorption at different temperatures and pH. The upcoming changes have been observed.

Experimental Conditions 1000.0 mg /L of dye solution; mass of adsorbent of 05.0 mg; the temperature was fixed at 15° Time of contact between the dye and adsorbate was fixed in

6.0 h

A_t = Adsorbed dye at time t.

C_i = Dye concentration at initial level

C_f = Dye concentration at final (after time t) level

V = Volume of the sample

M = mass of the adsorbent

v. EFFECT OF PH ON DYE ABSORPTION

One important parameter that affects dye adsorption is the pH of the aqueous solution. The Influence of pH illustrates the results of the decolonization experiment at different dye solution pH values. As seen in the figure, a pH of 3 was determined to offer a very low percentage of decolonization when compared to other pHs. Under neutral (pH 7.0) and mildly alkaline circumstances, the decolonization was effective (pH 8.0). Additionally, it was discovered that the isolated organism was capable of degrading the dye solution at different pH levels (pH 4.5- 11.5). This suggests that the isolated bacterium can be used to treat textile wastewater, which often has pH levels that vary widely, in an efficient manner. Furthermore, the literature reported a tendency for *Pseudomonas luteola* to degrade Congo red (Hsueh and Chen 2007).

Therefore, it was determined how beginning pH affected the adsorption of BR46 onto multi-wall carbon nanotube and modified multi-wall carbon nanotube at 20 °C and an initial dye concentration of 5, 15, and 25 mg/lit. When the dye solution's initial pH was raised from 4.0 to 11.5, the adsorption capacity for multi-wall carbon nanotube from 5 mg/lit to 15 mg/lit and from 15 mg/lit to 25 mg/lit with pH 4.5, 7.5, and 11.5 at constant temperature condition.

vi. RESULT

Composites combine two or more materials with different properties in a way that takes advantage of each individual property of the components. In contrast, hybrid materials are material combinations, which take advantage of interfacial charge and heat transfer processes to create new synergistic functions and properties. The composition of nanocomposites materials is being used at present. Which additionally take advantage of interfacial processes that greatly improved their properties and even created new properties This research involved the synthesis of carbon nanotubes followed by its

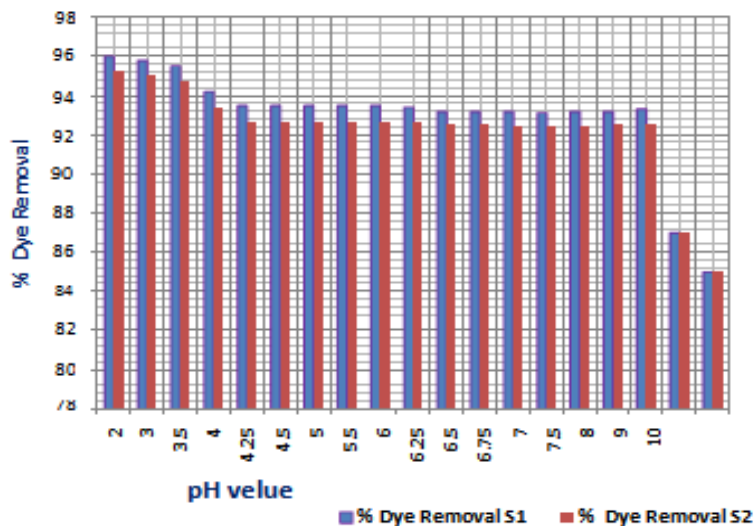


Figure 1: Effect of pH on the adsorption dye on 15⁰C

Experimental Conditions 1000.0 mg /L of dye solution; mass of adsorbent of 30.0 mg; the temperature was fixed at 30°. Time of contact between the dye and adsorbate was fixed in 6.0 h

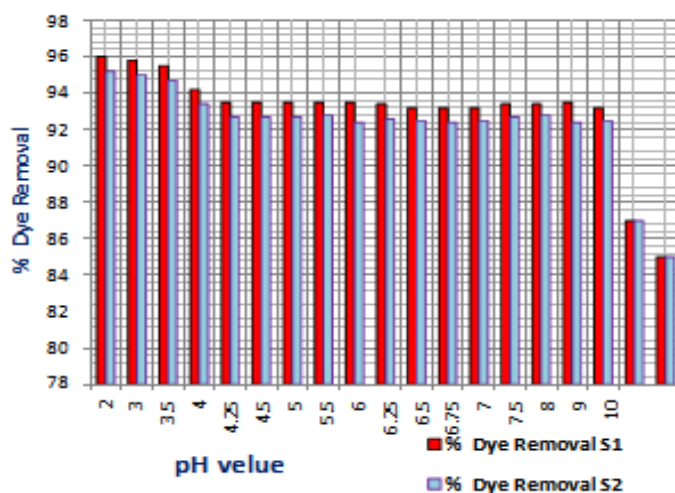


Figure 2: Effect of pH on the adsorption dye on 30⁰C.

Experimental Conditions 1000.0 mg /L of dye solution; mass of adsorbent of 30.0 mg; the temperature was fixed at 45°. Time of contact between the dye and adsorbate was fixed in 6.0 h

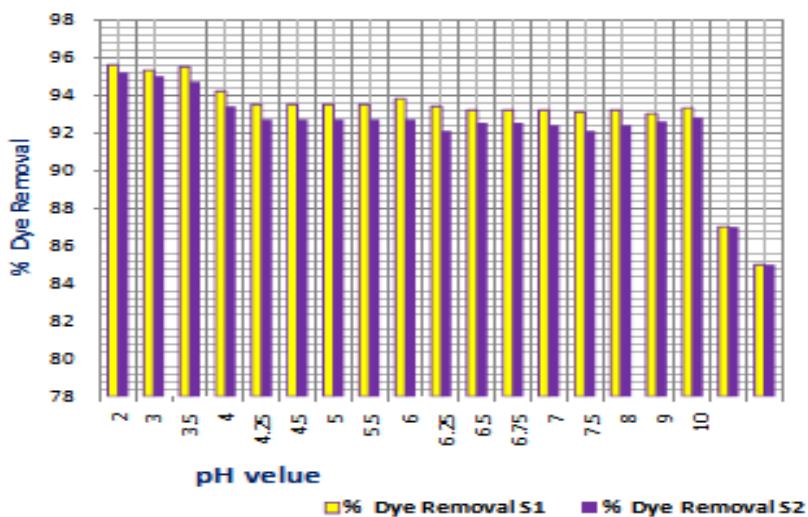


Figure 3: Effect of pH on the adsorption dye on 45⁰C

concentration parameters 5 mg/lit, 15 mg/lit, and 25 mg/lit on pH 7.5 valuations and thermal parameters i.e., 15°, 25° and 35°C. In the first stage of analysis at 15°, it is about 7.31, 15.8 and 19.9 mg/g absorption, at 25° it is about 9.8, 17.3 and 24.8 mg/g absorption and at 35° it is 10.3, 19.9 and 25.1 mg/g absorption for MWCNT similarly for composite MWCNT on the first stage of analysis at 15° it is about 21.12, 24.8 and 26.9 mg/g absorption, at 25° it is about 22.7, 28.6 and 31.62 mg/g absorption and at 35° it is 20.2, 31.6 and 40.62 mg/g absorption result for the test. Based on our study were effective adsorbents for absorbing reactive BR46 textile dye from aqueous solutions. They were made from multi-walled carbon nanotubes. When suspended in water, the BR46 dye interacted with the MWCNT adsorbents at the solid/liquid interface.

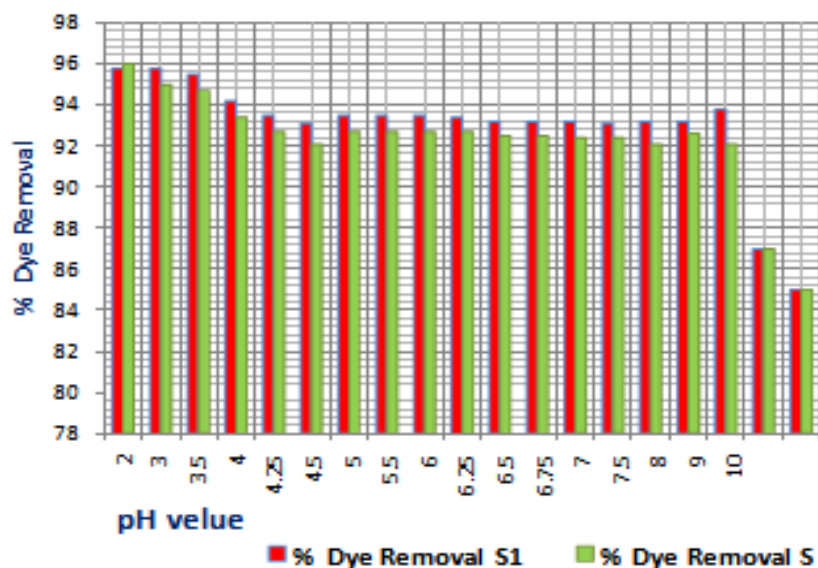


Figure 4: Effect of pH on the adsorption dye on 60°C

CONCLUSIONS

Adsorption experiments were conducted in a carafe flask containing a 300 mL dye arrangement with the first dye fixing. The starting dye concentrations were reduced to 5, 15, and 25 mg/lit. The trials only use composites of multiwall carbon nanotubes with abortion potential. Flagon flasks were fixed and placed in a temperature-controlled vibrating water container (used only for this experiment). At a constant speed of 200 rpm, the water container has been unsettled. The tests were carried out at three different temperatures, namely 15°, 25°, and 35° C, in order to observe the effects of temperature. Our third goal has been accomplished. As the experimental setup initially we are taking some results on initial concentrations dye concentration one is for MWCNT and the next is for composite MWCNT. As we mention we are taking

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Ascorbic Acid Electro Oxidation: Nitrogen Doped Carbon Generation and Improved Electrochemical Performance

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ABSTRACT

Carbon materials are frequently employed in electrochemical sensors because of its high conductivity, stable substance properties, and wide likely window. Only a few of the many different kinds of carbon particles with cutting-edge designs that have been successfully generated thus far include fullerene, carbon nanotubes, grapheme, carbon nanofilms, carbon nanoparticles, and light carbon materials. This work shows that nitrogen-doped carbon, which is obtained by carbonising polyaniline at a constant temperature of 800 °C in a latent environment, has a wide range of properties that distinguish it from other forms of carbon. This nitrogen-doped carbon, which was made from polyaniline base, is a remarkable description of the amazing electro catalyst shown by the oxidation of ascorbic corrosive in a nonpartisan arrangement.

Keywords: Materials, Doped, Celsius, Carbon, Oxidation.

1. INTRODUCTION

Carbon-based materials have a wide range of uses because of their superior physical and synthetic properties. They have been used, for instance, as catalysts. Despite the investigation of several nanostructure carbons, the need for catalysis and energy change/limit applications has outpaced their applicability. The possibility of doping carbon with N heteroatoms has been suggested by research on the display of nanostructure carbon. N-doped carbons, also known as "decent carbons," can be similar to carbons in terms of wet ability, ability to give off electrons, conductivity, and reactivity, even if only a tiny portion (less than 0.5 percent) of N particles are condensed. This is due to the higher nitrogen grouping of N-doped carbons compared to undoped carbon. In doped nitrogen iotas, solitary pair electrons have the ability to generate extra negative charges. [1] Better synthetic and physical properties as well as reliable correspondences with unexpected species, such acidic mixes, cationic particles, and metal nanoparticles. Both electrochemistry and catalysis, which both deal with a range of difficult situations, benefit greatly from these characteristics. The behaviour of N-doped carbon materials is affected by the accessibility of reactants to the material's active areas as well as by the N atoms themselves. In this method, NMCs with accessible mesopores (2–50 nm) are favoured over those with micro porous carbons because the mass vehicle and charge/molecule move more swiftly in them. Due to their enormous, transparent surface area and adjustable mesopores, NMCs are consequently attracting a lot of interest. Furthermore, the augmentation is very attractive for the terminal, energy unit, and stimulus components when NMCs with rich N do pants are combined with a mesoporous structure.

The manufacturing method is a crucial element in deciding whether robust N presentation and mesopore development are accomplished. Treating carbon compounds with N-containing smelling salts or precursors thereafter is one method for creating N-doped carbons. In situ pyrolysis of mixtures containing nitrogen is another technique. A variety of N-containing precursors, including melamine, N-heterocyclic, and others, are also workable possibilities since the final option may create thick N do pants that are equally dispersed throughout the carbon skeleton. On the other hand, a structure containing mesopores is often made using the templating framework.[2] They unlike the challenging and costly instrument using the careful templating approach is easier even at the adaptive creation level. This eliminates the necessity for initial design creation because the regular organisations can be destroyed during pyrolysis. However, pyrolysis at high temperatures can speed up the separation of molecules containing nitrogen.

As a result, the mesoporous structure implodes when the design is removed, and nitrogen addiction decreases. By immediately carbonising N-containing ionic liquids, citrates, or dry sucrose while annihilating sulphur or microscopic porous particles, NMCs with broad or scattered mesopores can be created. Li-ion batteries and energy sources Although some NMCs were purposefully designed for synergist decline responses, examples of metal-regular constructions (MOF) and covalent regular frameworks (COF) that can be directly pyrolyzed include ZIF-8, zinc-dicarboxylic destructive containing MOF (NZnMOF), hydrogen-supported regular framework (HOF), and others. Making NMCs in distinct mesopores with homogeneous or rich N do pants is interesting, despite the challenges that currently exist. It is now clear that NMC research is still in its early stages. Research has been conducted on the appearance of N-doped grapheme and carbon nanotubes in oxygen decrease processes.[3]

2. RESEARCH METHODOLOGY

Polyaniline Production

The synthetic oxidative polymerization of aniline resulted in the production of polyaniline (PANI). Separate 50 ml capacity carafes were used to break down 2.59 mg of aniline hydrochloride and 5.71 g of ammonium persulfate in a single mill combination operation. The two solutions were left at room temperature for one hour, and then blended in a beaker to aid in polymerization. After being let to stand for 24 hours, the PANI precipitate was washed with 0.2 M hydrochloric acid and acetone. Any undisclosed monomers were dissolved in 0.2 M HCl, and any low-molecular-weight oligomers were dissolved in acetone. The manufacturing of fine powders was made easier by avoiding PANI agglomerates during drying. Prior to carbonization, the green polyaniline powder was vacuum-dried at 65°C.

Generation of NDC

PANI was intentionally carbonised at 800 °C for various lengths of time in a dead air. On a circular heater, 1.5 g of PANI in a silica boat was typically applied.[4] The constant development of excellent argon gas maintained the environmental conditions. NDC-1, NDC-2, NDC-3, and NDC-4, for instance, NDCs acquired over time spans of 60, 90, and 120 minutes, were allocated to the intensity treated PANI.

Electrode Production

Carbon paste electrodes were created from these NDCs to characterise them. This was achieved by constantly using 20 L of paraffin oil to harden 6 mg of the various NDC powder throughout the study. This ratio was used to make the carbon glue cathodes. The finished glue, which was used to fill the pit terminals, had an outside width of 3 mm and an interior diameter of 1.6 mm. An electrical contact was made using a metal bar. Before starting the electrochemical reactions, the cathode's outer layer was first made smooth and then thoroughly cleaned with deionized water.[5]

Characterization

The carbonised surface-level morphology of the PANI was the main subject of the SEM [VEGA3 TESCAN]. The gathering and recording of Raman spectra were made possible by the employment of a significant standard. The dispersive Renishaw Laser Raman spectrophotometer's maximum power thickness for the helium-neon excitation laser was 2.0 watts (633 nm). The Fourier change infrared (FTIR) vibration range was evaluated using an FTIR spectrometer of the Nexus 670 type (make: Thermo Electron Corporation, USA). The wavelength range for the 400–4000 cm⁻¹ FTIR spectra acquisition was employed. The spectra of these newly synthesised materials were obtained by first combining them with superior potassium bromide (KBr), then forming the mixture into pellets, and last inserting the pellets into the IR route while carrying out the measurements in transmission mode. German-language publications referred to the results of the elemental composition (CHN) research as Elementa diverse EL III. The thermo gravimetric analysis (TGA), which was used to ascertain the warm steadiness, was finished using the SDT Q600 V8.3 Build 101 model.[6]

Electrochemical Measurements

Electrochemical operations were made utilising the auto lab type PGSTAT-30 potentiated in a traditional three-cathode configuration. The reference and counter anodes, respectively, were the platinum and Ag/AgCl cathodes. The cathode in operation was a carbon cement containing nitrogen. The cyclic voltammeter experiment revealed that at 251 °C, 0.01M potassium ferrocyanide and 0.10M potassium ferrocyanide were present (room temperature). Using THALES 4.13 programs and the Ivium Technologies Compact stat electrochemical analyser with a solution comprising 0.01M + 0.1M potassium ferricyanide, an impedance estimate was performed in the comparative electrochemical cell. The arrangements were made using sterile water from Millipore with a resistivity of 18.2 M cm, an applied rotational voltage of 5 mV, and repeat ranges of 0.01 Hz to 100 khayal.

3. DATA ANALYSIS

Elemental Analysis

The findings of the basic analysis of PANI and pyrolyzed PANI are shown in Table 1. The numerous carbon and nitrogen measurements that came from the treatment at 800 degrees Celsius for the predetermined period of time are the main subject of this investigation. Instances NDC-2 and NDC-3 demonstrate an increase in carbon content to a value of 70% after being heated, as was anticipated. The longer the method was utilised, however, the less carbon there will be in the material since it is more likely that the carbon structure will break down. Observing how the nitrogen content shifts from a value of 11 percent to a value of 6.7 percent is another method for providing evidence to back up this assertion. The C/N ratio, which in an intriguing turn of events grows to a

modest value of 10.7, may be used to estimate the rate of decomposition. A cross-linked PANI Chain with a C/N ratio of 6.0, consisting of 71 percent carbon and 12 percent nitrogen, forms when PANI is carbonised. These interconnected structures resemble phenazines.[7]

The phantom inquiry, which will be discussed later in this section, serves as evidence for this. Anyhow, delayed heat treatment causes the breakdown of the phenazine-like carbon structure, which consequently functions with a reduction in the amount of carbon and nitrogen present. Figure 1 also depicts the observed decrease in the nitrogen and carbon concentrations as well as the typical cycles. The quantities of oxygen, chlorine, and sulphur in the examples may remain constant throughout time; but, when the examples warm up, these quantities will fall. This potential will be determined by the extent of the study.

Figure. 1: A schematic representation of the structural modifications that occur in polyaniline when it is heated to 800 degrees Celsius in an oxygen-free environment.

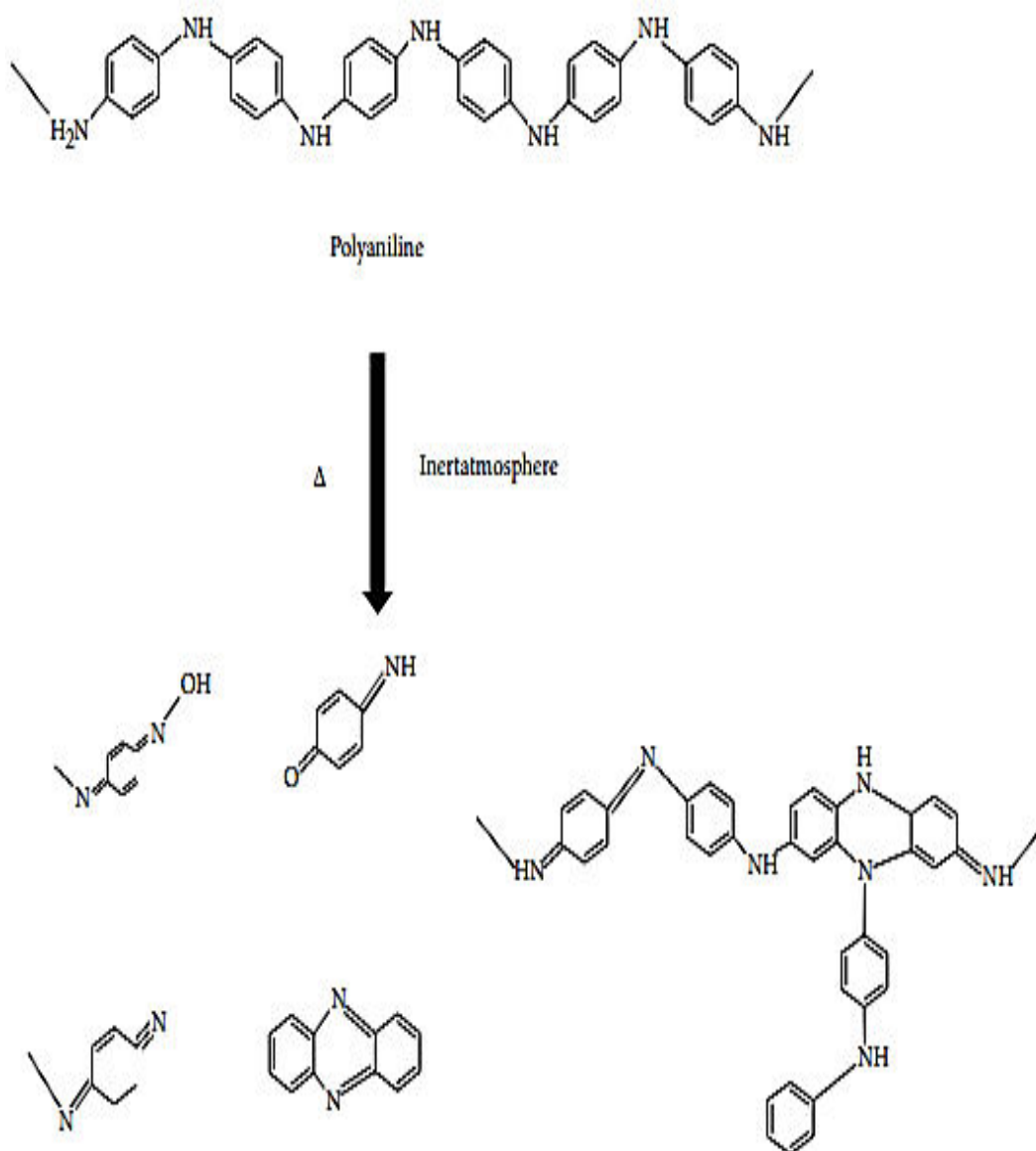
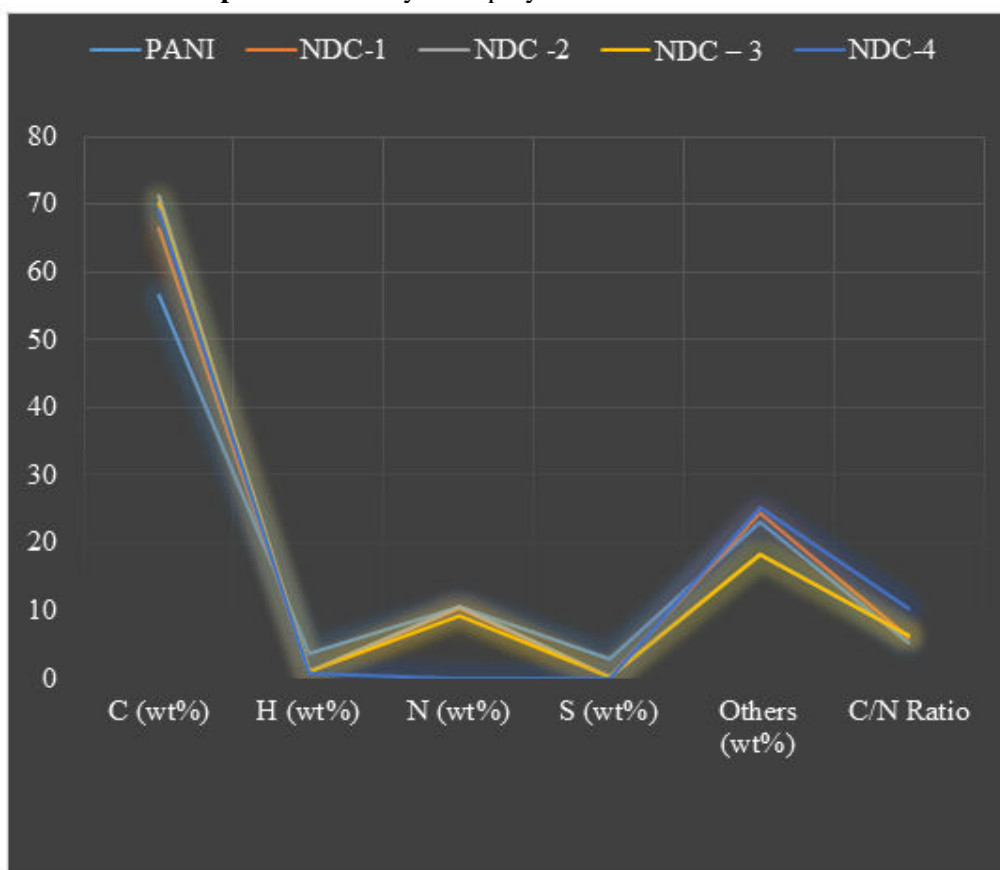


Table 1: CHN analysis of polyaniline and NDC materials

Sample Description	C (wt %)	H (wt %)	N (wt %)	S (wt %)	Others (wt %)	C/N Ratio
PANI	56.4	3.6	10.15	3.0	23.0	5.2
NDC-1	66.4	0.9	20.2	0.2	24.3	5.9
NDC -2	11.2	0.9	10.6	0.2	18.2	6.4
NDC -3	70.2	0.9	9.2	0.2	18.3	6.4
NDC-4	59.2	0.9	0	0.2	25.3	10.5

Graph: 1CHN analysis of polyaniline and NDC materials



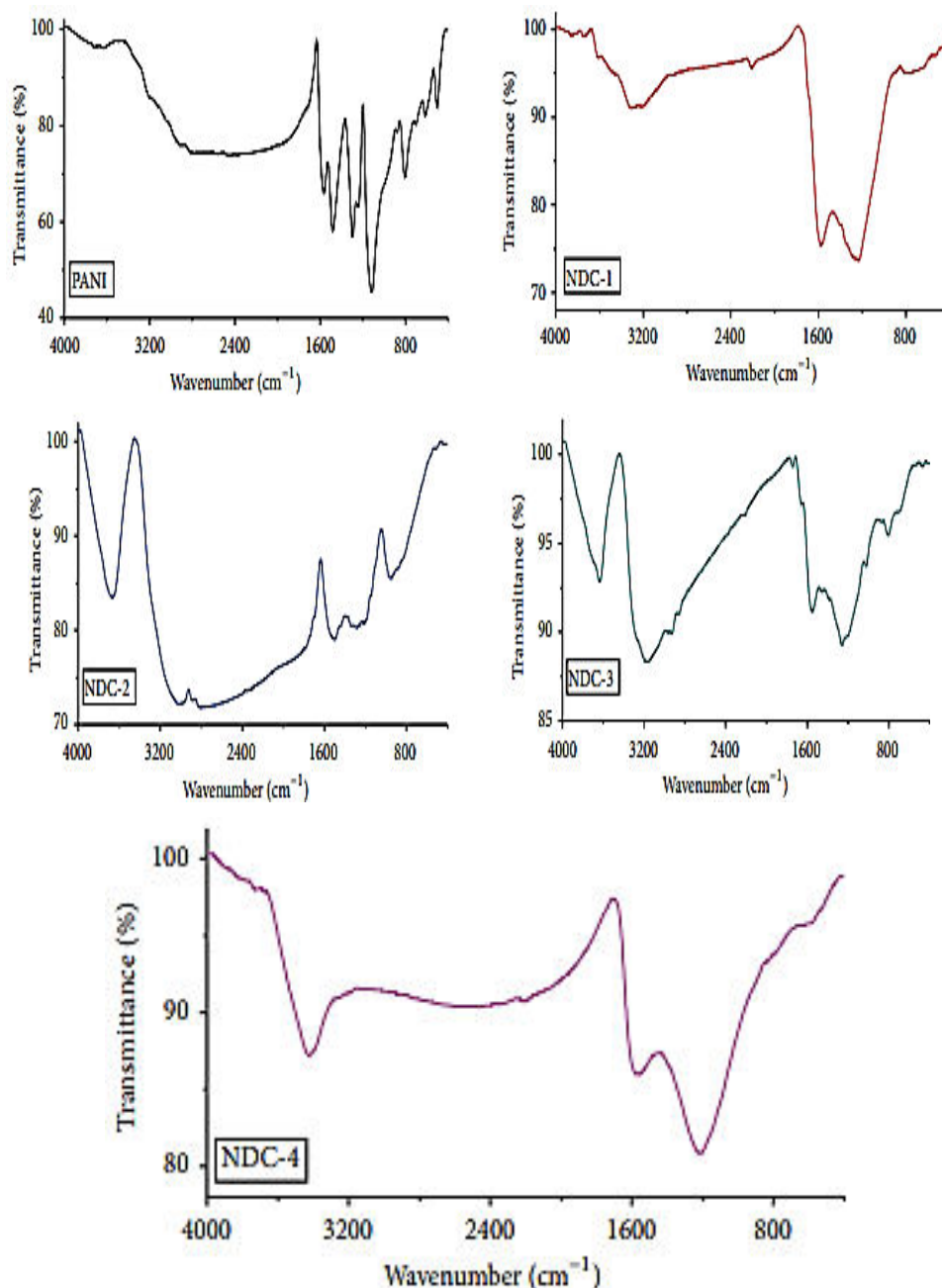
FITR Analysis

The 400–4000 cm^{-1} range shown in Figure 2 should show how the FTIR spectrum data for these various materials relate to one another. The 1482 cm^{-1} band is associated with the expansion of the vibration of the C = C sweet-scented ring, but the 1565 cm^{-1} band is equivalent to a benzenoid and Quindío ring. The band's signature sound may be heard on this repetition. The band at 1296 cm^{-1} is caused by the alternative odour amine's C-N vibrating winding, whereas the peak at 1115 cm^{-1} is caused by the sweet scent's in-plane C-H bending mode. Out-of-plane C-H truncations of the 1,4-disubstituted ring are present in the range of 804 cm^{-1} . Out-of-plane C-H, which affects vibration, is critical for the band at 503 cm^{-1} . In general, the spectrum between 2500 and 4000 cm^{-1} has a high hydrogen retention signature. This difference is explained by the creation of H-bonds between the -N-H and = N-H bundles of the neighbouring polymer.[8] Chains the 3627 cm^{-1} range is thought to be the best band for nitrogen particles in PANI. The majority of the zeniths do, however, vanish after carbonization, and a few new ones arise in their stead. This suggests that there have been considerable modifications. The plans make this clear (Figure 1). After 30 minutes of carbonization, the band at 3307 cm^{-1} begins to lose force due to the amine extension (N-H) vibration (NDC-1). This is due to the fact that PANI is made up of fewer hydrogen atoms connected to nitrogen molecules.

The two unmistakable peaks at 1232 cm^{-1} and 1573 cm^{-1} are moved and lengthened, presumably denoting the growth of the phenazine-type ring and probably taking into account the cross-association of the macromolecular rings. These progressions should be visible in the range. As the treatment is continued for a longer period of time, another band is discovered to emerge at a recurrence of 2996 cm^{-1} . This band is associated with the prolonged vibration of the C-H smell. The larger district that was found backs up NDC-2's proposal that the additional water in the case was reduced. A C=O bunch is evidently present in NDC-3's retention band, which is located at a distance of around 1743 cm^{-1} . Given the underlying modifications that occurred and the subsequent tracking by the development of an oxime-like moiety, this may be excuse.[9] The tops at 2209 cm^{-1} and 2212 cm^{-1} in NDC-1 and NDC-3 might be generally presented utilizing the N=C=O or nitride pack blended broadening vibrations. You can see those pinnacles utilizing both of those pieces. The pinnacle, which might be found in NDC-three at a reiteration of 806 cm^{-1} , is impacted by N-H out-of-airplane vibration and turning. The sp^2 and sp^3 C vibrations are connected with the band in NDC-four, which is at 1213 cm^{-1} . It is conceivable that NDC-2 incorporates oxime-like frameworks given that it seems to top around 949 cm^{-1} .

The C-N hiltler-kiltler broadening vibration, which was previously expected to be 1296 cm^{-1} (PANI), has now been corrected to 1288 cm^{-1} (NDC-2). The result of altering the amount of time that the nitrogen particle and carbon particle contact is 1260. (NDC-three). The sweet-smelling C=C vibrational loosening up with a sp^2 plan rather than an olefinic one using the carbonization approach is upheld by the tops at 1573, 1501, 1550, and 1568 cm^{-1} in NDC-1, NDC-2, NDC-three, and NDC4. The logo call zenith at 2459 cm^{-1} produces follow assortments of particular nitrogen-containing carbonaceous blends because of NDC4's communications with different securities. This pinnacle might be identified at a recurrence of 2459 cm^{-1} . These discoveries give convincing proof that nitrogen is effectively retained into carbonaceous materials as a heteroatom, as found in Figure 2.

Figure 2: FTIR spectra of PANI and heat-processed PANI, such as NDC-1, NDC-2, NDC-3, and NDC-4, after systematic exposure to time intervals of 30, 60, 90, and 120 minutes, respectively, in an inert atmosphere at 800 degrees Celsius. PANI was heated to a temperature of 800 degrees Celsius.



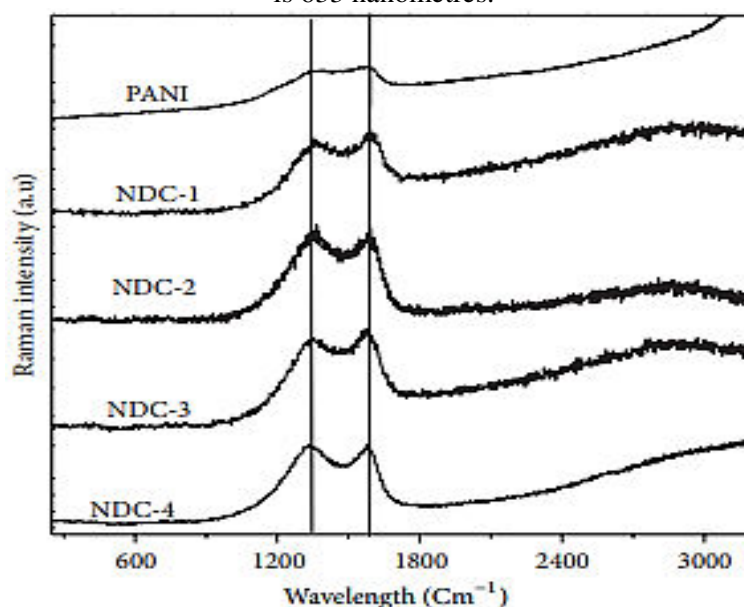
Raman Spectroscopy Analysis

Raman spectroscopy is a technique that is broadly used to concentrate on various carbon-based materials, particularly to recognize unmistakable kinds of securities created between carbon molecules. Figure 3 shows the Raman spectra of PANI and NDC materials considering this. In the range, two tops at 1582 and 1348 cm^{-1} ,

every one of which is related to the "assessed" graphite (G) and dissipate (D) band portions, show how the straightforward PANI locale changes into a model. This alteration ought to be promptly obvious by noticing the spectra. The two-stage PANI strategy didn't totally solidify the areas of the two parts due to NDC (PANI that has gone through hot treatment). The initial step is the absence of protonting corrosives. The formation of cross-related gadgets that look like phenazines all through the carbonization cycle occurs straightaway, and this is upheld by both FTIR and significant examination. At the point when PANI is given warm treatment, the previously mentioned bunches seem to changed degrees.[10]

The D and G groups then develop progressively over a certain amount of time. We find that the proportion of generally organised power (ID/IG) declines with respect to the number and size of graphitic tiny spaces. This implies that more carbon atoms (sp^3/sp^2) have a fourfold shape. A detailed analysis of the ID/IG, or overall included force proportion, reveals this. When one switches from one material to another, the pinnacle position and power somewhat change. This could be a result of the lattice's fundamental issue. Raman force was used to measure the ID/IG ratio of the orchestrated PANI, NDC-1, NDC-2, NDC3, and NDC-4, and the characteristics were assessed as 0.9, 0.92, 0.96, 0.98, and 0.99, respectively. This suggests that these mixtures' structures are similar. It is obvious when polyaniline undergoes graphitization during heat treatment, which eventually leads to a successful carbonization process, because the ID/IG proportion expands during heat treatment.

Figure 3: Spectra obtained with a laser Raman microscope of PANI and heat-treated PANI, such as NDC-1, NDC-2, NDC-3, and NDC-4, after being subjected to systematic time intervals of 30, 60, 90, and 120 minutes, correspondingly, in an inert atmosphere at a temperature of 800 degrees Celsius. The wavelength of excitation is 633 nanometres.



Surface Morphology Analysis

Scanning electron microscopy is used to examine the surface morphology of the carbonised PANI (SEM). As a consequence, Figure 4 shows both PANI and NDC's typical morphological traits. When observed at low magnification from a point opposed to the surface, there seem to be white dots all over the area. This clearly shows how rough the matrix's surface is, which is connected to how small the electrically conducting components are. The results of the scanning electron microscope examination (Figure 4) that demonstrate that the synthesised PANI keeps its original form even after the carbonization technique confirm the conclusions of these experiments.[11] Therefore, the morphology may still be observed to be intact even if the particle size in NDC-2 has somewhat reduced. More investigation has been done on the particle edges, and the results hint to some minor flaws there.

Thermal Stability Analysis

The materials' capacity to sustain a steady temperature is evaluated using TGA. Additionally, Figure 5 depicts the TGA bends for PANI and NDC. At temperatures below 100 degrees Celsius, a wide range of compounds lose a considerable percentage of mass, which may be caused by the release of trapped water particles or the existence of hydrogen chloride. Nonetheless, a minimum amount fiasco occurs assuming the temperature surpasses 200 degrees Celsius, demonstrating that NDC has predominant warm security than PANI base. This is welcomed on by how rapidly the little ties that make up the PANI establishment are corrupting. On account of

NDC, the polymer chains are oxidative annihilated somewhere in the range of 450 and 850 degrees Celsius, trailed by the retention of the nitrogen molecule. Thus, a significant amount of weight is lost. At the point when the intensity therapy is directed for a more drawn out timeframe, the NDC turns out to be steadier, and subsequently, the NDC-4 shows the most significant level of warm soundness.

These results add to the mounting evidence that the temperature-dependent weight loss of the carbonised material exists. It's memorable critical that over 800 degrees Celsius, these substances totally crumble (i.e., they have almost no mass leftover). This demonstrates that this cycle yields NDC absent any and all metal. Then again, most of the systems include delivering carbonaceous materials, and it is guessed that metal contaminations will be available.[12]

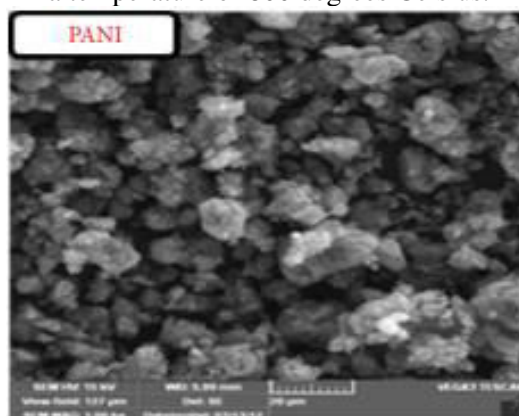
Cyclic Voltammetryresearch

Cyclic voltammeter was employed in conjunction with natural radix structures like potassium hexacyanoferrate [Fe (CN)6] 3-/4- to evaluate the electrochemical behaviour of NDC (carbonized polyaniline). When the display is analysed in terms of E_p values, $59/n$ mV at 25 °C—where n is the number of electrons involved in the redox process—is regarded as a satisfactory configuration. The display is defined as the comparison of the most notable cathodic and anodic alternatives in terms of (E_p values. $E_p = E(p,a) - E(p,c)$). The exterior circle radix framework [Fe (CN)6] 3-/4-is heavily dependent on a surface level variability of the carbon lattice since it is a carbon grid.[13]

Ru (NH₃)₆ hexesminerruthenium (III) The redox framework for action estimates is 3+/2+, another external circular redox framework. This method doesn't rely substantially on useful social networks or specific surface regions. In a solution containing 0.1 M potassium nitrate and 0.01 M potassium ferricyanide, Figure 6 shows the behaviour of polyaniline and a few NDC terminals. Additionally, the mobility of hexes miner ruthenium is shown (III). The continuing profiles of the cyclic voltammograms in these redox systems are all essentially identical (g), with the exception of PANI in Figures 6(a) and 6(f) and NDC-1 in Figures 6(b) and 6(c). It implies that the conditioned anodes' surfaces have almost equal conditions. The low conductivity of PANI is thought to be brought about by leucoemeraldine or pericardium designs, and it is intriguing to take note of that the cement cathode changed with PANI has a capacitive circuit. The cushion for NDC-1 basically shows how the material safeguards itself and rapidly makes sense of how PANI might be held back from being totally conductive carbonized after just 30 minutes of treatment. I can understand. The top to-expected partition for the mentioned cathodes for additional NDCs with a greater level of redox activity is displayed in Table 2 .[14]

All other NDCs have a direct redox conduct and more advanced top-to-top detachment (E_p values, with the exception of NDC-1. The top-to-top ratings of different NDCs range from 100 to 150 mV, and the maximum current ratio (I_a/I_c) between the cathode and the anode is very close to 1. It has been established that the presence of a nitrogen heteroatom builds a carbon structure's ability to coordinate power. This improvement is attributed to the delocalization of the particular groups of electrons that nitrogen retains inside the carbon material. The expanded electrochemical activity of the molecules may be used to track the origin of the single sets of electrons that the NDCs contain. The minor enlargement of the [Fe (CN)6] 3-/4-redox framework (E_p values (10-20 mV) is indicative of the non-uniform surfaces of the NDCs. This in homogeneity is measured in terms of surface fictionalization and micro structural highlights. [15]

Figure 4: SEM micrographs of PANI and heat-treated PANI, such as NDC-1, NDC-2, NDC-3, and NDC-4, subjected to systematic time intervals of 30, 60, 90, and 120 minutes, correspondingly, in an inert atmosphere at a temperature of 800 degrees Celsius.



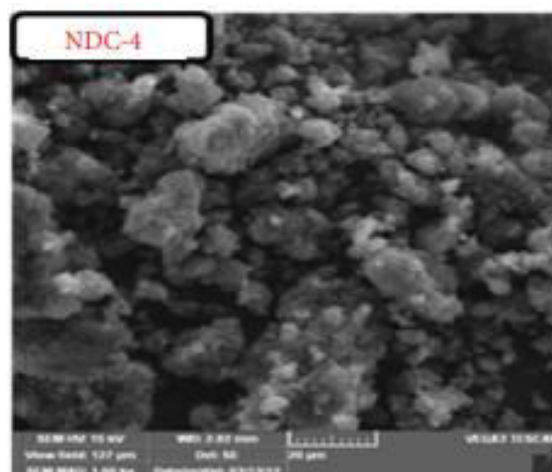
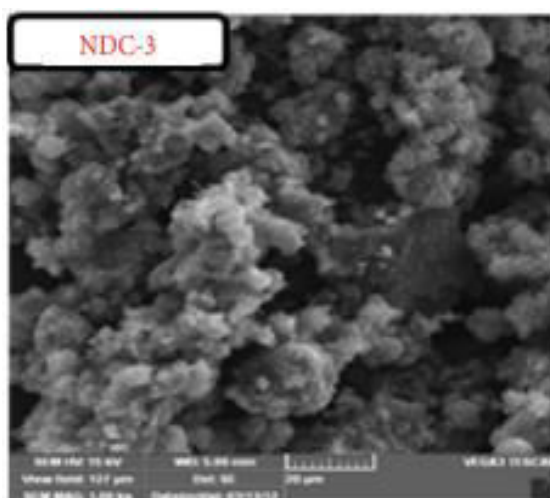
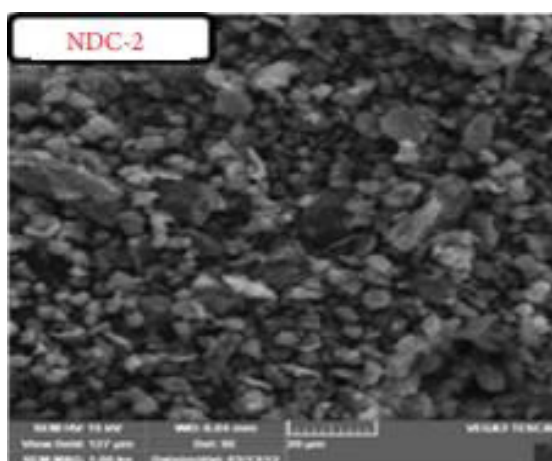
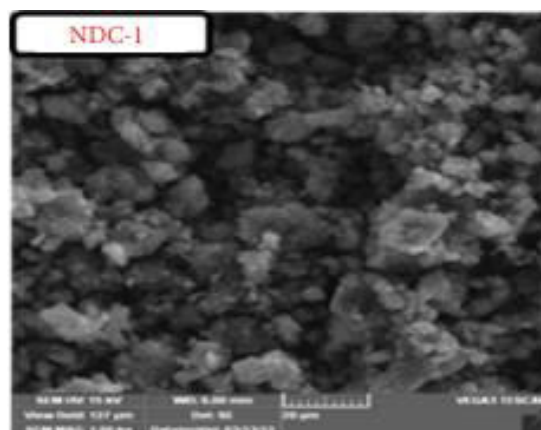
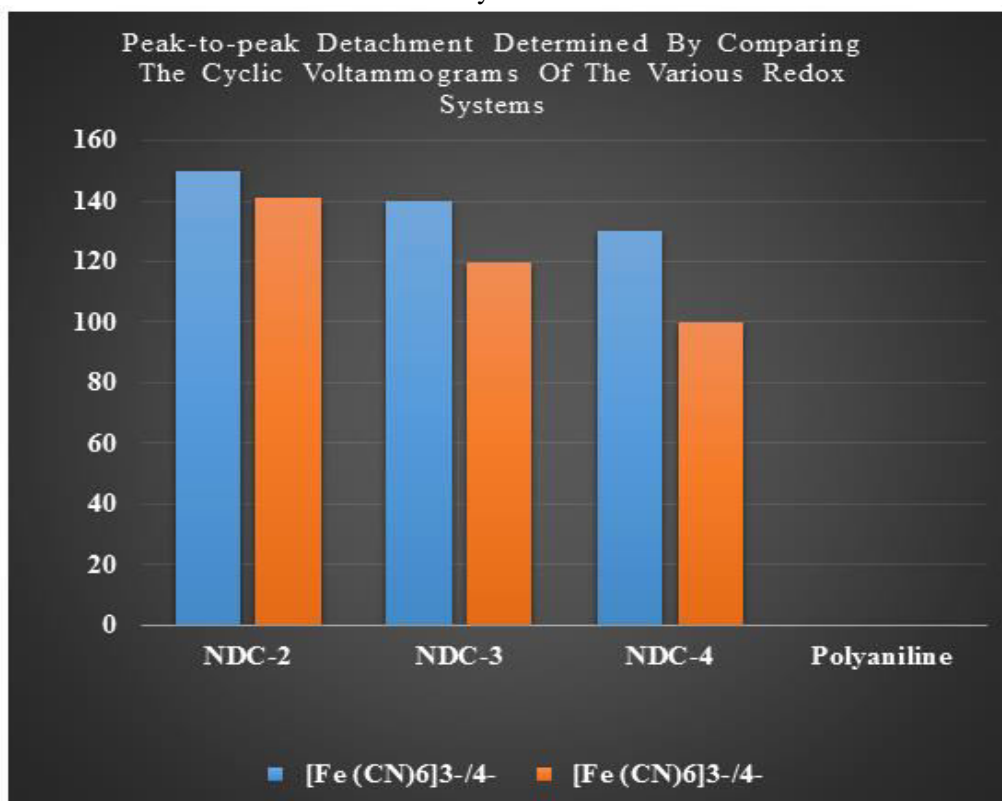


Table 2: Peak-to-peak detachment determined by comparing the cyclic voltammograms of the various redox systems

Electrode	[Fe (CN) ₆] ^{3-/4-}	ΔE _p , mV _{[Ru(NH₃)₆]^{3+/2+}}
NDC-1	—	—
NDC-2	150	141
NDC-3	140	120
NDC-4	130	100
Polyaniline	—	—

Graph: - 2 Peak-to-peak detachment determined by comparing the cyclic voltammograms of the various redox systems



The data in Table 2 show that the electro catalytic activity was produced by the redox reaction [Fe (CN)₆]^{3-/4-}/[Ru (NH₃)₆]^{3+/2+}. This is quite clear from the striking contrast between the high peak currents and large peak potentials of the electrodes (ipa, ipc). On the NDC-4 carbon glue cathode, the results show a substantially greater electro catalytic movement in favour of [Fe (CN)₆]^{3-/4-}/[Ru (NH₃)₆]. In contrast to the reactions at the other NDC carbon glue terminals, the 3+/2+ redox reaction is unique. The enhanced surface roughness and thus bigger effective surface area of the NDC-3 and NDC4 electrodes may be the cause of their higher peak current densities when compared to those of the other electrode.[16]

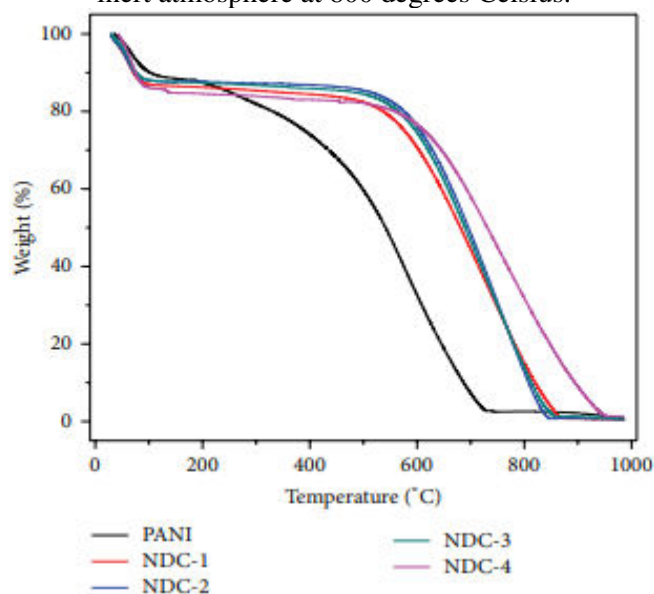
Electrochemical Impedance Spectroscopy (EIS) Research

The action of PANI and NDC is concentrated on by electrochemical impedance spectroscopy using effectively diffusible, adversely charged redox species. Figure 7 portrays diagrams of the cathodes' Nyquist complex plane impedance as per the data gave. The impedance range was significantly impacted by the planning strategy, the carbonization system, and the intensity therapy temperatures. The impedance scope of PANI exclusively uncovers scattering processes, as opposed to the next NDC materials' impedance spectra, which at first show charge development and a short time later recommend dispersal. Moreover, regardless of NDCs — from NDC-1 — show extremely indistinguishable impedance conduct. The Nyquist conduct of NDC-1 isn't ideal (sickle), but broken nitrogen doping and exceptionally remaining particles can both advantage from this. In the high recurrence band, the NDC shows a level crescent, while in the low recurrence range, it shows a straight line with a slant of around 45 degrees.[17]

This is common for permeable films covering metals in Halter-Kilter metal, film, and electrolyte systems and illustrates how permeable films behave in this setting. The discouraging half circle that was found in the high

recurrence zone may be the outcome of the exchange of charge (the two protons and electrons) at the junction between the carbon cathode and the electrolyte. It could be advantageous to employ the Warburg propagating component at low frequencies because to the semi-infinite dispersion of particles at the carbon-terminated / electrolyte interface. The immediate cause of this is the path taken by the particles at the connecting point. Using the identical circuit model used in this study, Figure 8 shows how the permeable terminal's impedance behaves at the open circuit voltage.

Figure 5: Thermo gravimetric analysis (TGA) of PANI and heat-treated PANI also including NDC-1, NDC-2, NDC-3, and NDC-4 subjected to systematic time intervals of 30, 60, 90, and 120 min, correspondingly, in an inert atmosphere at 800 degrees Celsius.

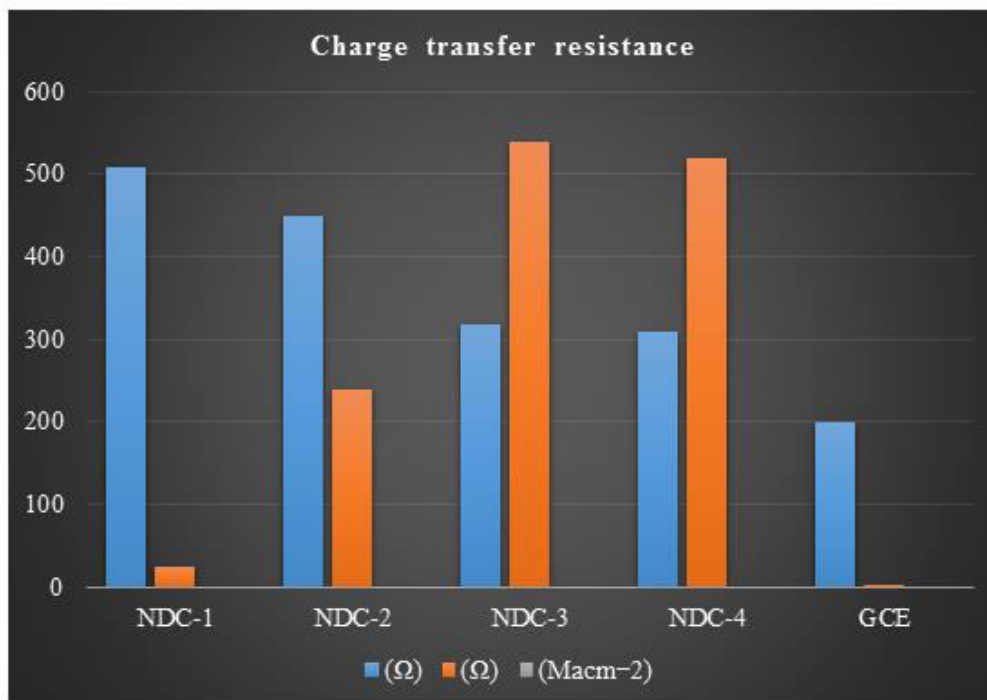


In this circuit, R_s denotes the opposite of the array, while R_1 and R_2 stand for the charge transfer barriers, or R_{ct} . Both Q_1 and Q_2 handle the twofold layer capacitance, which is shown in the image C_{dl} . The findings that were altered to fit the circuit values are also shown in Figure 8. The tantamount circuit models may be able to explain the electrochemical processes that take place when the voltage is in the open circuit at the junction between the carbon supports and the electrolytes, based on the fact that there is a good match. Table 3 displays the dynamic boundaries derived from the Nyquist plot. As per the EIS Nyquist outlines, the NDC cathode's sickle size really does truly draw more modest as it gets nearer to the standard smooth carbon end.[18] This peculiarity is brought about by the expansion of nitrogen particles, as shown by the size of the half circle changing significantly as the nitrogen fixation shifts.

The PANI terminal displays more signs of a highly resistive system; as a result, its impedance is not comparable to the pattern that was seen. The framework's porous porosity, which may be attributed to fractional carbonization, is the reason of NDC-1's broken crescent behaviour in the high recurrence range. This behaviour is seen in the NDC-1 pane. The ease with which the electrons may be charged can be shown by comparing the charge motion deterrent of various NDCs to that of conventional Sparkly Carbon at the terminal (GCE) of the NDC rod cathode/electrolyte connection point. Because the model surpasses the other terminals, the NDC-4 cathode created by current processing at 800 degrees Celsius for 120 minutes exhibits the lowest nitrogen content with the lowest R_{ct} (often an increase in exchange current i_0). Electrochemical elegance.

Table 3: Charge transfer resistance (R_{ct}), double layer capacitance (C_{dl}), and exchange current (i_0) for various NDC electrodes in 0.01 M $[[Fe(CN)_6]^{3-/4-}] + 0.1 M KNO_3$ solution at the open circuit potential. The kinetic parameters have been calculated using the Randles equivalent circuit shown in Figure 8.

Electrode	$R_{ct}(\Omega)$	$C_{dl}(\mu F)$	$i_0(Macm^{-2})$
Polyaniline	—	—	—
NDC-1	508	25	2.34×10^{-3}
NDC-2	450	240	2.64×10^{-3}
NDC-3	317	540	3.70×10^{-3}
NDC-4	310	520	3.83×10^{-3}
GCE	200	0.08	1.83×10^{-3}



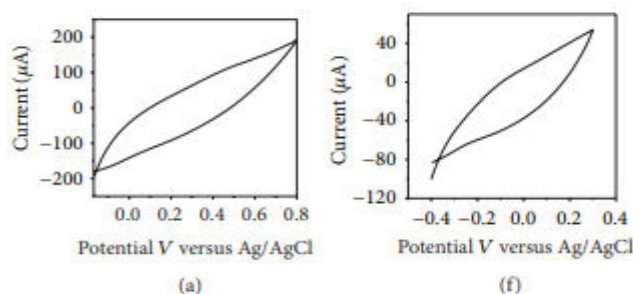
Electrochemical Oxidation of Ascorbic Acid

Throughout the course of our work, it has become clear that the NDC that was produced using the PANI base has outstanding electrochemical activity. The increase in conductivity may be brought about by nitrogen atoms being doped into the carbon network. This is so that you can see how the nitrogen molecule creates the action support by inducing the delocalization of the single sets of electrons in the carbon organisation. Because NDC4 best displays the reactant movement, it has been decided to employ it as the cathode material for the oxidation of ascorbic corrosive. Since ascorbic acid plays a significant role in natural systems, a lot of research is now focused on creating voltammeter techniques to measure its concentration. [19]

In any case, it is trying to evaluate ascorbic destructive by direct oxidation in an unprejudiced medium because of its huge over potential, unfortunate reproducibility, lacking selectivity, and awful responsiveness on average cathodes. Figure 9 shows the connection between the cyclic voltammograms of the debasement of 10 m ascorbic corrosive with volcanic carbon (without N-doping) or NDC pole terminals as the cathode. On a carbon cathode that has not been changed at all, ascorbic corrosive oxidation creates a 0.30 V oxidation wave, which is demonstrative of a sluggish cycle. In any case, the oxidation potential ($E_p = 0.22$ V) and pinnacle current thickness are fundamentally moved for a carbon cathode that has been doped with nitrogen. The probability of this reaction being reversible is more prominent. The two of them show solid ascorbic destructive electro oxidation electro catalytic development of the NDC cathode (i.e., massively redesigned top current, essentially twofold, and the negative change in the anodic applied ability of 0.22 V).

Both of these ideas ought to be made clear by the realistic underneath. An extensive drop in the ascorbic destructives over potential is one potential unique impact that could empower a critical expansion in the electron stream pace of ascorbic destructive oxidation. This critical ascent in the electron move rate might be because of the delocalization of a solitary gathering of electrons coupled to the heteroatom.[20]

Figure 6: Cyclic voltammograms of several NDC materials are shown in ((a)-(e)) for the PANI, NDC-1, NDC-2, NDC-3, and NDC-4 in a solution of 0.01 M potassium ferricyanide and 0.1 M potassium nitrate, and ((f)-(j)) for the PANI, NDC-1, NDC-2, NDC-3, and NDC-4 in a solution of 0.01 M hexa 20 mVs/s is the scan rate.



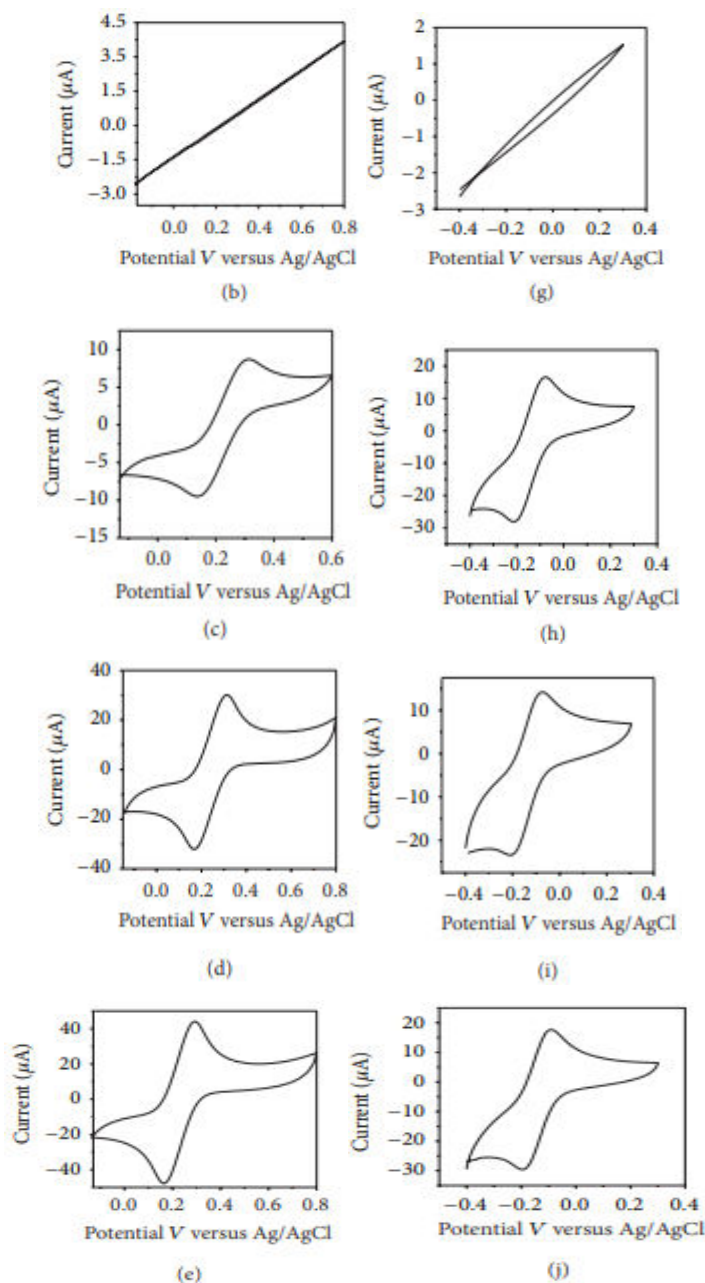
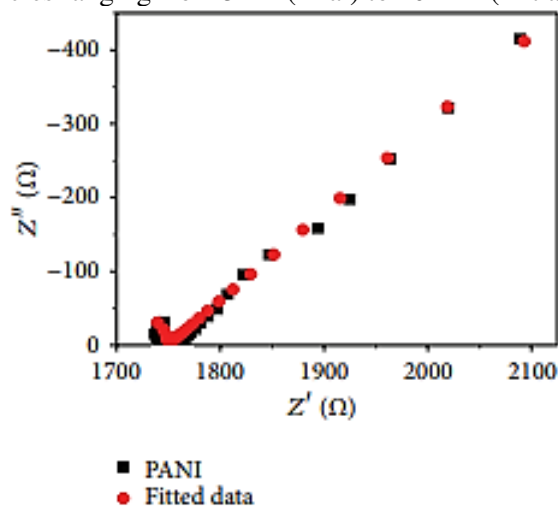
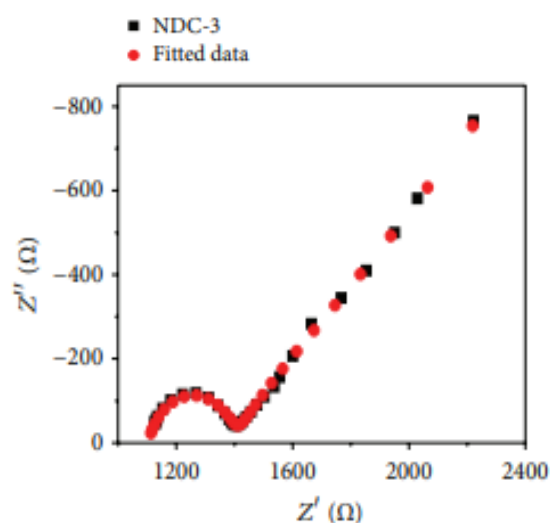
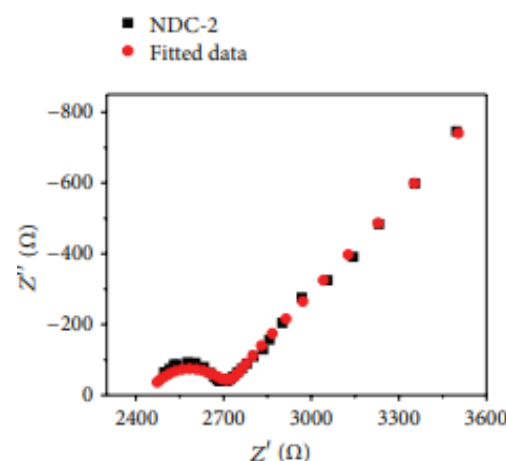
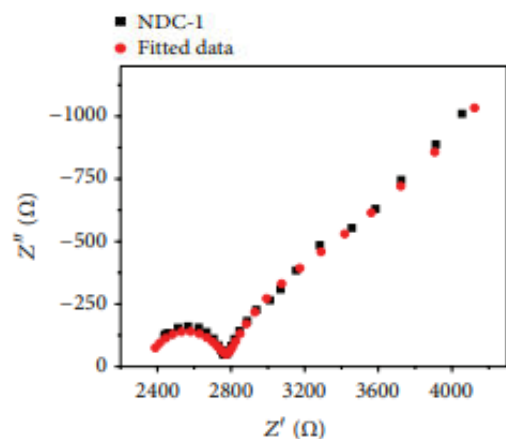
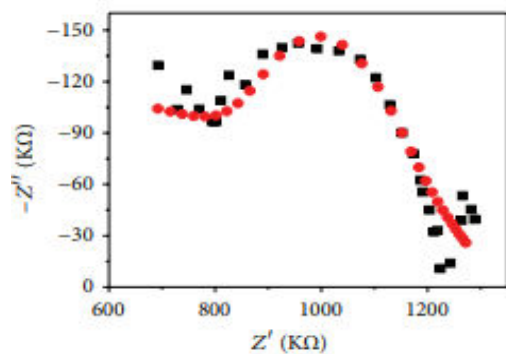
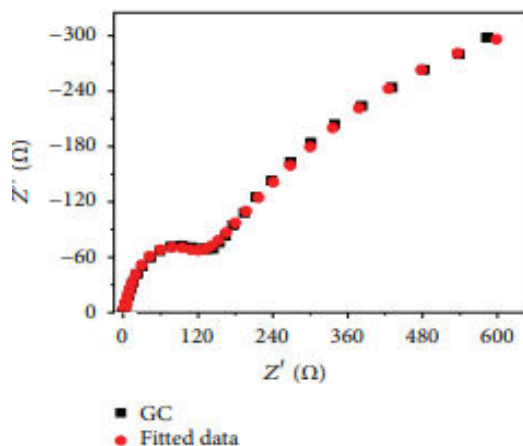


Figure 7: Measurements have been carried out at the formal potential of the $[[Fe(CN)_6]]$ for Polyaniline and several NDC materials using electrochemical impedance spectroscopy. 5-mM, +200 mV vs Ag/AgCl 3 M KCl, 3-/4- redox pair with frequencies ranging from 5 Hz (final) to 40 kHz (initial), and an amplitude of 5 mV.





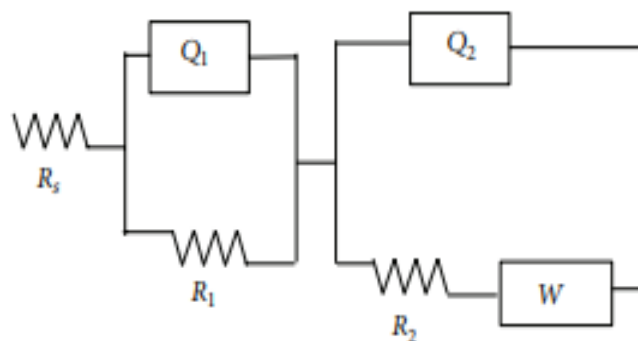
■ NDC-4
● Fitted data



4. CONCLUSIONS

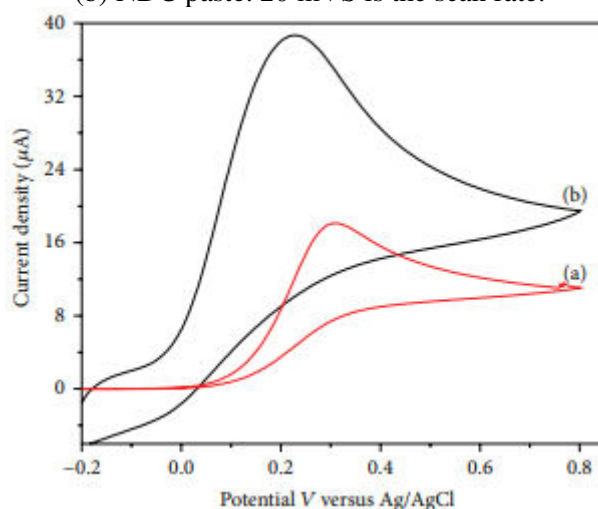
Materials with remarkable plasma catalytic properties for the oxidative polymerization have been created using nitrogen-doped polymeric carbon.

Figure 8: A schematic illustration of the equivalent circuit that was applied to the data in this research in the form of a schematic



The C/N proportion in this has been displayed to ascend over the span of treatment, per the discoveries of the basic examination. The surface morphology was found to have been held even after the PANI material was carbonized, per the consequences of a SEM examination. To totally progress PANI's sub-nuclear design to the corresponding nitrogen-upgraded carbon while as yet keeping an exceptional yield, certain boundaries should be met. The sub-atomic design and how it changes are shown by a confused carbon-like material with different types of linkages among carbon and nitrogen particles, for example, polyaniline and carbonized PANI. These protections are shown by the cross-associated parts that impersonate phenazines, quinoids, and different substances. As per the electrochemical portrayal, NDC has a generally higher electrochemical development than polyaniline or NDC that has just had a 30-minute intensity therapy. [21]

Figure 9: Cyclic voltammogram of 10 mM ascorbic acid using electrodes made of (a) Vulcan carbon paste and (b) NDC paste. 20 mV/s is the scan rate.



For a carbon material heated for one hour and 20 minutes, the usual redox reaction produced an E value of 100 mill volts (mV). The impedance shows as a half circle with a 45° straight line lead on a Nyquist plot (Warburg impedance). The normal charge growth of electro active species at the terminal electrolyte contact then joins the dispersion in this bearing. Therefore, carbonized PANI, otherwise called nitrogen-containing carbon, is an original synthetic with a few expected applications, for example, biosensors and electro catalysts for energy-related parts. At the point when nitrogen particles are available, particularly when the carbonized material contains nitrogen atoms, the singular arrangements of electrons in the material are animated to delocalize. Furthermore, ascorbic corrosive electro oxidation was utilized to show that the compound that was incorporated has reactant action. Accordingly, the nitrogen-consolidated carbon in the current prepares for best in class techniques to control substance and electrochemical reactivity, which have a few applications.[22]

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Cloud Accounting

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ABSTRACT

In this day and age, cloud accounting or online accounting has become almost widespread access among those businesses that would like to be speedy, skittish, resilient, economical, and sapient. Many business enterprises whether it is small or large have gets converted their business processes i.e., recording, measuring, classifying, summarizing, analyzing, interpreting, and communicating to the cloud pulpit. In simple words, “cloud accounting” or “cloud” denotes to the transfer of computing services or the process of executing business transactions through the internet. The current scenario business surroundings need quick analysis, fast interpretation, hasty access, prompt decision-making, rapid result, and high-speed conversion of raw financial data to finished financial data. Traditional accounting software or desktop accounting is installed in-house. All financial data and software are stored and processed on a local server. The traditional accounting system is back down due to less remote access, risk of security, local server, high cost for installation, more operating expenses, and unscalable.

Keywords: Cloud accounting, automation, accessibility, scalability, blockchain.

INTRODUCTION

The term “cloud” refers to “servers” that are accessed over the internet present at a remote location and the term “accounting” refers to the system of identifying, recording, measuring, classifying, summarizing, financial transactions and analysing, interpreting, and communicating the results to inter users as well as external users. It means recording, computing, analyzing, reporting, storing, managing, and accessing the data and programmes in the remote servers that are hosted on the internet instead of the computer hard drive. Cloud computing is the on-demand availability of computer system resources, especially data storage, cloud storage, and computing powers without direct active management by the user. In short, we store, manage and process data on remote servers.

There are mainly **three types of cloud**: **Public Cloud**: accesses to all users, **Private services**: accessible within organizational users, **Hybrid cloud**: public + private cloud features and **Community cloud**: services accessible by a group of organizations.

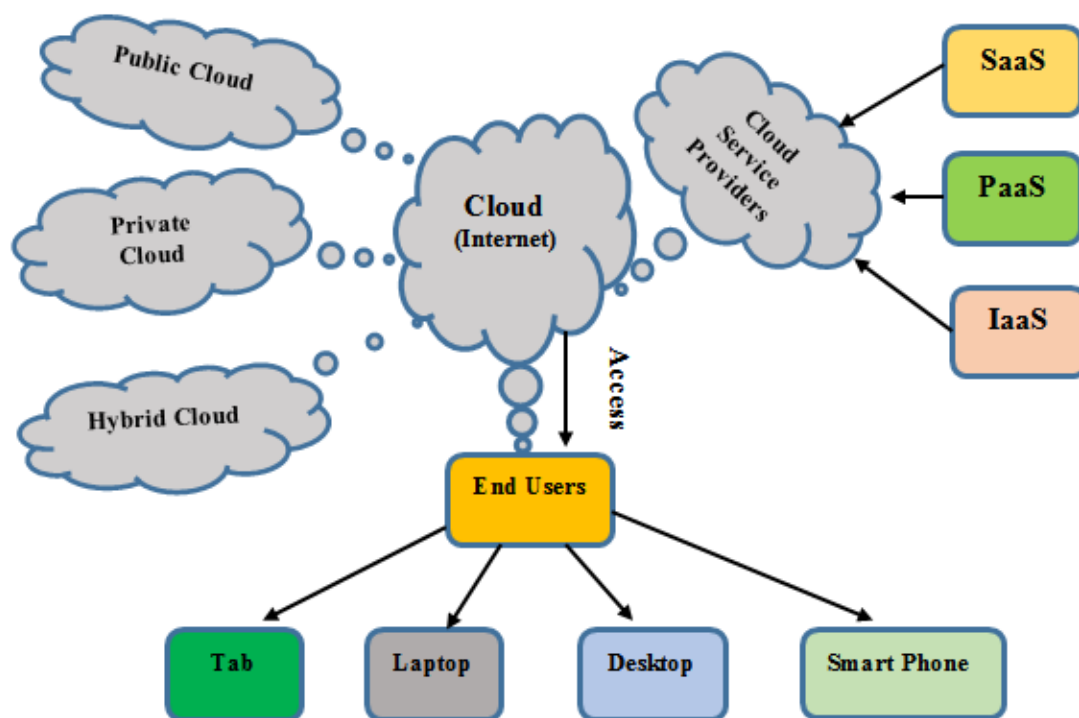
Similarly, there are some important **cloud services providers** which are engaged in providing services to the end users through cloud computing namely **SaaS, PaaS, and IaaS**.

Software as a Service (SaaS): SaaS provides software application services to the end users which are delivered over the internet. These applications are accessed by users through the internet and web browser. It is also known as an “On-demand Software Application”. SaaS is controlled, and managed from a central location and hosted through a remote server. There is no requirement for updating the hardware and software by the users because it is updated automatically. The important benefit of SaaS is security, it means no data are lost by fire, theft, or happening of any events, and data is saved in the cloud. Google Apps, Salesforce, etc., are the SaaS service providers.

Platform as a Service (PaaS): PaaS provides framework services to IT directors. It is also known as “Developer Service” because it gives privileges to developers for eliminating more intricacy and operational costs. The main benefit of PaaS is “auto-scale”, which means PaaS is assembled on virtualisation technology, so the data are easily scaled up or down as per the needs of the business and also gives the provision of upkeep of various languages and frameworks. The PaaS providers are Google App Engine, Microsoft Azure, Heroku, Magento Commerce Cloud, Force.com, etc.

Infrastructure as a Service (IaaS): The third service provider of cloud accounting is IaaS. It is a hardware infrastructure and networking architects managed over the internet, so it is also called “hardware as a service”. It removes the cost of acquiring, managing, and controlling the physical servers. The IaaS providers are Amazon Web Services, Microsoft Azure, DigitalOcean, Cisco Metacloud, etc.

Chart: 1 Process/Working of Cloud Computing or Accounting:



Cloud accounting goes through the cloud which consists of several servers, a virtual desktop, software platform, application, huge data storage, and backup. These facilities are provided by various cloud service providers namely SaaS, PaaS, and IaaS. End users can easily access it through a laptop or tab or desktop, or smartphone at any time and any place according to their requirements.

Traditional accounting is mainly based on online management software providers likely SAP, QuickBooks, Clear Books, Wave, Xero, Tally, ZOHA Books, Fresh Books, Profit Books, NetSuite, etc. This software is mainly built and runs according to the capacity or scope or conditions of the business. When a less number of employees are employed in the company, they incurred minimum costs for maintaining, storing, securing, processing, and backup the small data. But in case of increasing the manpower, they need the best server, the best accounting software, a huge storage device, a hi-tech system, huge infrastructure for maintaining, storing, securing, processing, and back-up the huge data that will incur huge expenses. But in cloud accounting, all services like storing and managing of data, backup, security, maintenance, etc., are provided at a minimum cost because the cost is charged according to per user in cloud accounting. They provide more than one server, the best accounting software, the best storage, security, and backup are automatically sifted to another server, etc. Therefore, it observes that data storage, management, and safety almost go to cloud service providers that is why the company fully focused on achievement of predetermined goals. The software applications can be accessed by users via the internet or other networks via cloud application service providers. With cloud-based accounting software, a company does not have to set up individual desktops with software because everyone in the company can access the cloud on their own devices. This also allows remote teams or branches to access the same data and the same version of the software. A major benefit of cloud-based accounting software is that data backup and disaster recovery is often a part of the account.

Cloud accounting deals with performing the basic accounting functions like identification of economic events, maintaining proper records of business transactions, calculation of profit or loss, depiction of financial position, providing effective control over the business, and making information available to various groups of users by applying software exist in the cloud and hosted on remote servers through the service providers SaaS, IaaS, and IaaS. Generally in the cloud accounting system, financial data are sent to the cloud server by the company where processed, store, manage, refine, evaluate, and ultimately returned to the clients or users according to their needs. Cloud accounting is also known as a “web-based accounting system”, or “online accounting software.”

Cloud accounting is a comparatively new business model in the changing accounting world. "Cloud computing is a system for facilitating pervasive, expedient, on-demand network access to a shared group of configurable computing resources i.e., networks, servers, storage, applications, and services. It can quickly provisioned and free with at worst management effort or service provider collaboration."

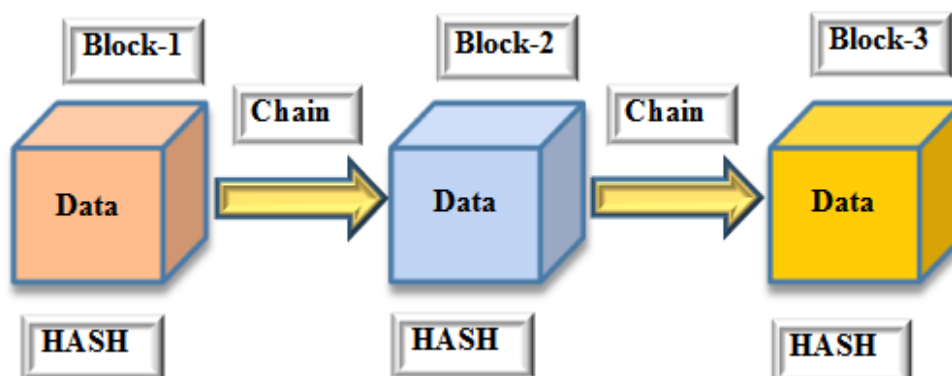
A cloud accounting system or web-based accounting has similar functions as desktop accounting software but all the functions or processes are working on the cloud server. All financial data are safely stored in the cloud server. There is no need to update the data. Cloud accounting is based on software, data, and infrastructure through the internet. Customers do not need to spend on servers, licenses, or in updating, maintenance, renewal, or in the processing of resources like networks, servers, storage, or applications; all this is the responsibility of the cloud administrator who shall only bill the purchaser what is used, in effect, in the period according.

Features of Cloud Accounting

Cloud accounting can assist in improved business performance that will help for recording, measuring, classifying, summarizing, and analyzing financial transactions through cloud service providers and it is also helpful for communicating the financial data to internal as well as external users via web services. There are some reasons to move from traditional accounting to cloud accounting or features of cloud accounting:

- a) **Economical:** There are no huge costs incurred for purchasing a powerful server, software, storage devices, hi-tech system, maintaining a backup, maintenance, etc. These all services are provided by cloud providers at the cheapest cost i.e., they charged per user.
- b) **Upgraded Technology:** The cloud service provider always upgraded the software and programming for fast and accurate computing. It also provides the latest and emerging technology to the end users for upgrading the accounting system. It boosts the efficiency and effectiveness of the management.
- c) **Strong Infrastructure:** IaaS provides a strong infrastructure to the company in the form of a physical server, CPU, RAM, storage, and Data Centre Networks for storing, processing, managing, and maintenance of financial data.
- d) **Safety:** In cloud accounting all financial data are stored on various servers. If anyone's server is destroyed due to any reason the data are not to be abolished and it transfer to another server. It means the backup of data is automatically sifted to another server.
- e) **Artificial Intelligence & Machine Learning:** 'Artificial Intelligence' means how to develop the artificial brain in a robot or artificial man like a human's brain enables and assists the machines to think, increase decision-making ability, digital analysis of financial data, to system maintenance, etc. AI performs any special task automatically with the help of input or raw financial data. 'Machine Learning' means how to explore and analyze financial data with the help of statistical tools and also assists to store and understand the data. It also reviews a large number of financial transactions and checks whether it correct or not. With the help of AI and ML, the company can easily evaluate the developing trends and performance ability which makes better financial forecasts. These techniques are used in cloud accounting in the field of management accounting, cost accounting, and financial management.
- f) **Blockchain:** Blockchain is a 'database' and 'database' is the collection of information that is electronically stored in the computer. Information and data are arranged in a tabular form which is convenient for searching and filtering it. In Blockchain all information is collected in a group and each group is known as 'Block'. Each 'Block' has limited storage capacity and when one Block is filled with information it is automatically added with another empty Block to form a long chain. That chain is known as 'Blockchain'. Blockchain concept was first to come into force when Bitcoins are launched.

Chart: 2 Blockchain Process



Each Block has “Cryptography HASH” of the preceding Block. This “Cryptography HASH” is generated after the recording of each transaction. If any changes are made in a single transaction it makes a new ‘HASH’ and resulted in all settings of data being changed. Therefore it can easily find out that any type of fraudulent entry has occurred. So, it is a secured option in cloud accounting. Each Block is automatically updated after 10 minutes. Thus, Blockchain is an important system that store, spread, and preserve accounting information.

OBJECTIVE OF THE STUDY

The core objective of this article is to assess the knowledge of accounting practitioners as well as accounting learners about cloud accounting. The specific objectives of this research are:

- To know about the concept and process of Cloud Accounting,
- To know about the functions of various cloud providers,
- To know about the impact of cloud accounting over traditional accounting,
- To ascertain the features of cloud accounting,
- To know about how Blockchain performs a task to preserve financial data, and
- To make a comparative study between cloud accounting and traditional accounting.

METHODOLOGY

The current study is based on primary as well as secondary data. An adequate review of literature has been done and information collected from various financial institutions, research papers, books, articles, the internet, and other published sources. However, some useful inputs were obtained based on the oral information from the user of cloud accounting software.

FINDING OF THE STUDY

Advantages of Cloud Accounting

Moving accounting from the traditional to the cloud has been a huge technological change in the field of financial accounting and managerial decisions, with many of disadvantages i.e., poor security, more costly, lack of upgradation, inadequate storage, ineffective management of data, etc., and consequently traditional accounting being partially aloof from the platform. There are some important advantages of cloud accounting:

Accessibility: Accessibility is an important benefit of cloud accounting under which financial data are accessed by end users at any time and any place through a cloud server. Data are not physically transferred like in traditional accounting. Data are easily accessed by users through laptops, desktops, tablets, and smartphones with help of a cloud server.

Automation: Accounting functions like recoding, classifying, summarizing, analyzing, and communicating are automatically done. All banking transactions are automated. It means all workload goes to the cloud service providers. So the company may concentrate on predetermined objectives. Cloud accounting also gives the facilities of bank reconciliation, tally to bank statements with cash book, invoices, or vouchers to ledgers to assist in the balanced and closing of the accounts. They also create automatically the various financial reports.

Minimization of Cost: Generally in traditional accounting huge expenditures are incurred for the installation of systems like hardware, software, server, internet, hi-tech computers, and other set-up according to the requirement. Also, more costs are incurred for storage, managing data, security, and maintenance. But in the

case of cloud accounting, all facilities are provided by the cloud service providers. There is no need to purchase a heavy server, hardware, latest software, and upgradation, only per user expenditures are incurred.

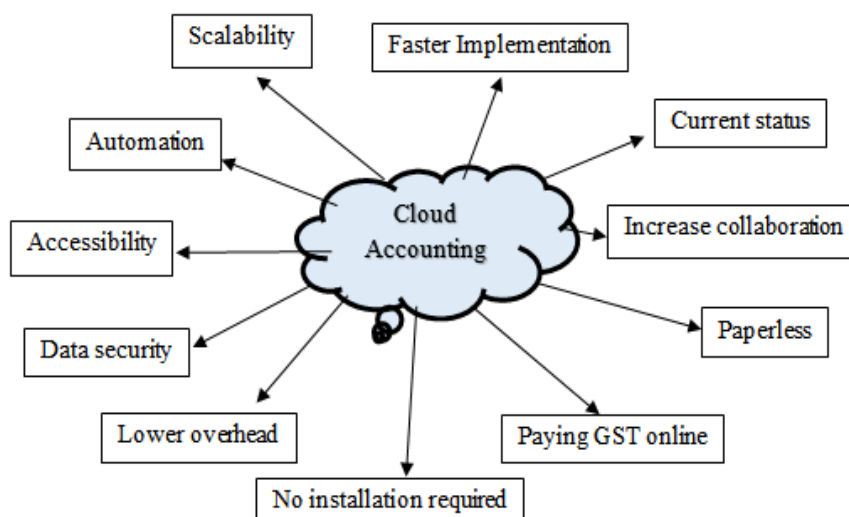
Data Safety: In the case of other accounting software data are not secured because it is generally stored on a hard disc and can easily be manipulated by others or easily hacked by unauthorized people. It is also not secured in case of transfer of data via the internet. But in the case of cloud accounting systems Blockchain is established who secured the financial data. Data cannot be lost because there are several servers and when the data are lost is on one server, it automatically transfers to another server. Also, data are not manipulated due to Blockchain and cannot be hacked.

Scalability: It is the popular benefit of cloud accounting. When the number of employees increases in the company, then there is no need to install extra hardware or storage devices to maintain increased data. Cloud accounting provides the benefit of scalability, it means if the number of employees increases, then it can easily be scaled up in the cloud storage device that manages and stores the extra data and take only per user cost. Cloud accounting systems can be applied in numerous locations or geographies must faster at a lesser cost. The company can take the privilege of any computing resources they might essential with the cloud system of accounting. This system is more flexible because there is no need for extra server space or any adjustments when the business expanded.

Enhanced Collaboration: All financial data are accessible and viewable by the authorized customers in the cloud system of accounting. This system removes the paper-based system to accomplish productivity goals through working together with customers and colleagues. So, it enhances the collaboration with the vendor to clients.

Fast Operation: In the cloud system of accounting, there are no servers to buy and install rather than no need for an information technology team for conducting because it runs through the cloud. Furthermore, the cloud accounting system has done thousands of applications and has developed effective, repeatable processes that permitted to rapidly acquire the benefits of the new technology. Due to performing on a single cloud through customers or users or groups of firms or companies—means frequent jobs such as cash payment or receipt, reconciliation, consolidation statement, inter-companies transactions, etc., are completed faster and very easily with securely.

Current Financial Status: All accounting processes are going through a cloud-based accounting system. The processes are started from identification of financial transactions to journal, ledger, trail balance, and lastly preparation of final account. They also prepare various subsidiary books such as cash books and bank reconciliation statements. Therefore, certain managerial tools are automatically used for the interpretation of financial statements i.e., ratio analysis, fund flow statement, cash flow statement, inventory management, budget, budgeting, budgetary control, human resource accounting, etc. That is why the company revealed its true and fair condition with the use of these tools. Anyone can observe the instant view of the current financial position of the company. Also, the management can takes precious decisions about cash position, budgeting, variance analysis, making strategies for future planning & prediction for accomplishing the ultimate goals of the company.



Accuracy & Free from Fraudulent : Since all the financial transactions and events related to business are recording, classifying, summarizing, analyzing, interpreting, and communicating through cloud system of accounting automatically at a set programme. There is no chance of occurring any mistake, misrepresentation and frauds regarding accounting data. So, finally all refined data reflect the true and fair financial statement.

Paying Goods and Service Tax online: In cloud computing system, it is very simple to calculate all taxes regarding a business' revenue through the access of a cloud platform and all the correct tax returns are sent digitally through a cloud.

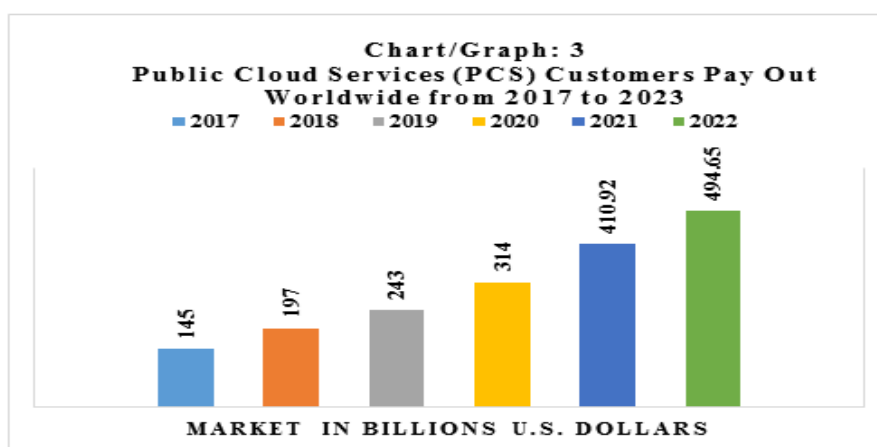
No charges for Installation: There is no need to purchase software to install the cloud accounting programme on a computer because all functions are going on online and accessed through the cloud. But in the case of other accounting software like tally that required a license for installation and access through a computer.

Paperless and Declutter: All financial transactions whether it is related to expenses, incomes, receipts, payments, invoices, vouchers, bills, debit notes, credits notes, etc., are manually recorded and processed in several books which consumed more effort, cost, and time and it may be onerous. But the cloud accounting system does not require any manual work on books or registers, all financial data are managed through the cloud. It means all financial data according to requirements can easily import or export from the cloud.

Table. 1 Public Cloud Services (PCS) customers pay out worldwide from 2017 to 2023

Year	Market in billions U.S. dollars
2017	145
2018	197
2019	243
2020	314
2021	410.92
2022	494.65

Source: Statista, 2022.

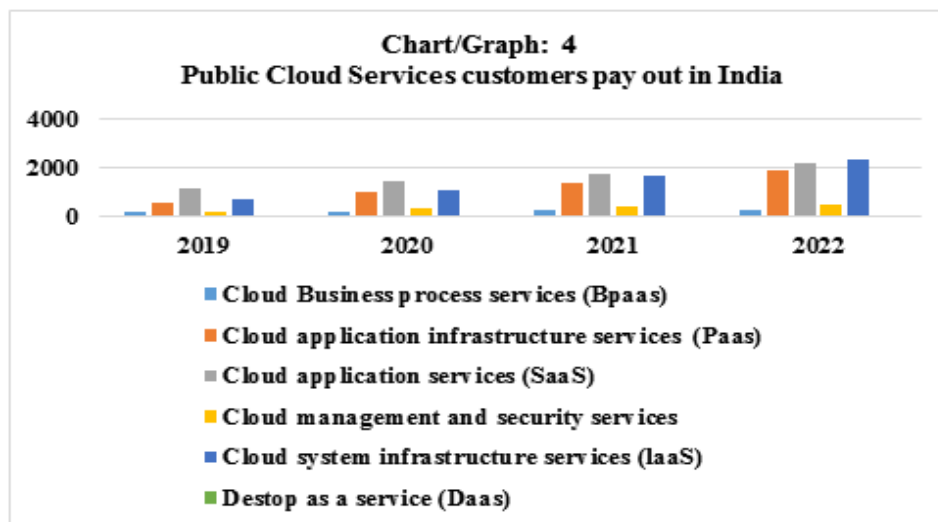


Public Cloud Services (PCS) Customers Pay Out worldwide market is continuously growing from 2017 to 2019. In 2017, public cloud service customers pay out was only 145 billion U.S. dollars but it gradually increased in 2022 was 494.65 billion U.S. dollars due to security, well management of financial data, well processing, advance advertisement services, effective programmes, and technical assistance provided by Public Cloud Services (PCS).

Table. 2 Public Cloud Services customers pay out in India 2019 to 2022

Public Cloud Services customers	Pay out in million U.S. dollars			
	2019	2020	2021	2022
Cloud Business process services (Bpaas)	186	242.4	272.4	294.7
Cloud application infrastructure services (Paas)	549	1,012.40	1,414	1,895.60
Cloud application services (SaaS)	1,133	1,472.60	1,786.90	2,169.20
Cloud management and security services	251	340.6	406.2	502.4
Cloud system infrastructure services (IaaS)	696	1,075.30	1,690.80	2,367.50
Desktop as a service (Daas)	30	47.8	71	83.30

Source: Statista, 2022.



All Public Cloud Services (Bpaas, Paas, SaaS, Cloud management & security services, IaaS, Daas) customers pay out in India are gradually increasing from 2019 to 2022. SaaS customers pay out in India is greater in comparison to other service providers.

CONCLUSION

Finally, I found that the Cloud system of accounting can accredit better business operations that will assist businesses to flourish. This accounting system contriving for the operation of recording, measuring, classifying, summarizing, and analyzing the financial transitions and it is also helpful for communicating the financial data to internal as well as external users. There is a big reason to convert traditional accounting to the cloud are inexpensive to concede and set off, more predictable costs, take advantage of the latest technology, best-in-class infrastructure, improve business continuity and unify business entity. Cloud accounting has to turn into the core high-tech change as enact continues to develop as Blockchain. Gradually and permanently increasing the demand and services for cloud accounting, various companies and industries are willing to acquire cloud-based accounting systems to minimize the time consumed in traditional work and also be more effective in cost saving. The other important reason for adopting cloud accounting is the security and scalability of the organization in case of hacking and illegitimate transfer of financial data. This day, cloud accounting system synergy with human resource management, inventory management, working capital management, personnel management, supply chain management, cash management, credit management, customer relation management, and also in report creation. This system is used to identifying, measuring, and record all financial transactions in the form of a journal, ledger, trail balance, financial statement, account receivable, account payable, budget, and investment. Likewise, it also retains traces of financial transactions, fund flow, cash flow, and provokes business dashboards offering many different tools and financial reports. All types of business organizations whether it is large or small extremely embrace cloud systems of accounting.

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Work-Life Balance: A Universal Aspiration in Current Day Storyline

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ABSTRACT

The global pandemic of COVID-19 has posed a genuine imminence to mankind. It's a menace faced by the whole world. This pandemic has forced us to witness a paradigm shift in our daily survival. It has left a deep sore in our lives, the heal to which is still left to achieve in different realms of society. Amongst exceptional challenges and unpredictable circumstances and uncountable tragedies, every individual is grappling under immense psychological constraints to maintain work-life balance for existence. A perennial thrive is constantly offered for developing new outlook in the post pandemic future, with a view in support of efforts to proactively build up the future of the world we look up to. The current paper highlights the conditions how a balance can be struck between work and family to lead a successful and happy life. We have observed how stress has crept in the lives of mankind which has grave effect on the mental and psychological arenas of life. Some holistic remedies will also be discussed in this paper which will help us achieve our desired life we always yearn for.

Keywords: Work-life balance, stress, pandemic, challenges.

INTRODUCTION

Work-life balance is the state of equilibrium where a person will rank or assign a rate in equal proportion to the demands of one's career and personal life. In essence, if one has a good work-life they will not let work ruin their lives and will devote specific amounts of time to their work and loved ones. Meeting deadlines at work even maintaining hobbies of an individual. Even a proper sleep should be attained; enough time should be devoted for a person's rest which will rejuvenate him/her for the next day's work. Another important factor is not worrying about work when one is at home, he/she always should be relaxed when at home because excess of anxiety may lead to problems. Every person in the world who has a career wants an ideal work-life balance but very few can achieve it. A sudden career change, heavy work duties, increased responsibilities at work; children may jeopardize a good balance. The time at work should be arranged accordingly, leave entitlements and those with care responsibilities and child care are some categories which are considered crucial for employee's work-life balance. Work-life balance can be improved by putting time, resources and effort into something that we are passionate about is often the best ways to boost our morale which also makes a meaningful impact in our community. Giving back in these ways is rewarding and can give us a sense of purpose that goes beyond the door of our office or home.



Fig-1. Source: 235,943 Work-Life Balance Stock Photos, Pictures & Royalty...- iStock.com

There are few steps to achieve a good work-life balance which are- the first one is we should make a list of what should be done and we should fix our priority. We should give special importance to exercise which makes us healthy and alert. We should not be distracted when we work but at the same time we should be focused for achieving the best in our work. We should know to delegate work so that responsibility can be divided in a proportionate way. And last but not the least, the time for relaxation is a basic necessity which all should get and they should enjoy their 'me-time' to gain maximum benefit from it.

OBJECTIVES

The main objectives of the study can be enumerated as follows:-

1. To examine the impact of work pressure in people around us.
2. To assess the importance of work-life balance in various spheres of life in current context.

METHODOLOGY

The paper is mainly descriptive in nature. The required information has been collected from secondary sources, various blogs and research papers and also reports prepared by various journals and authentic websites. Also reports from various national bureaus were also consulted. In this paper, an attempt is taken to analyze work-life balance in a person's life.

Few Ways to Improve Work-Life Balance

The importance of a good work-life balance can be determined by the fact that it yields a decrease in the employee health problems. An employee feels enhanced mindfulness and increases positivity during work is witnessed if positive /good work-life balance is there. And employee burn-out rate also decreases. To improve work-life balance, we should donate our time, expertise or finances to those in need. We can find a good mentor for ourselves who can provide us with proper advice and insight. We should have proper vacation and enjoyment because if we don't rejuvenate ourselves we cannot give 100% to our work. Rest both at physical and mental levels is extremely necessary. Exercise is equally significant in our daily lives to keep us fit and healthy as well as alert which in turn helps us to work better and to give the best output. We can also be engaged to some hobbies; even we can encourage others also to take up some hobbies which can keep us happy. We should take time off from our work which in turn will help us in dealing with our stress. Our body is not designed to endure for long hours at a stretch. Some physical movements like light walk or desk exercises are of great help. Such breaks may help us recover from fatigue and enhance agility at work. Volunteering is also a great way to socially connect with people and have good connections with them. It's a stress buster and also good relationships can be maintained. And in this way a company's CSR gets a boost. CSR is Corporate Social Responsibility which in turn helps the company to earn goodwill. Maintaining a healthy lifestyle is a very significant factor for an employee to achieve healthy work life balance. Healthy employees are an asset for the organization because health is directly linked to productivity. This health positively affects both work life and personal life and also helps the employees to cope up with stress. Post work hours, we should not work at home. A perfect blend of productivity, happiness and time affluence is to work slightly below 40 hours per week. We should always keep flexible working hours and work schedule to keep diseases at bay.

We should relax in between to keep us mentally fit. Time management plays an important role in every person's life. He is happy who manages time for himself. Work from home should also be encouraged. The working mothers who have children and elderly people at home find it easier to work from home. Time to time feedbacks and work life balance surveys can be conducted to promote a healthy lifestyle. Even maternity and paternity leaves are common in today's perspective. Child care facilities are also practiced nowadays. And it has been quite a help to working mothers. Some clubs and gatherings are always very useful for people to come and relax and spend quality time there to rejuvenate themselves. An employee assistance program should be kept in all workplace to help employees address their problems and get their solutions from experts who will solve employee grievances. It should be kept mandatory for every concern in this modern world. An important survey regarding 'work-life balance' was done where Indian working professionals were asked to rate their work-life balance. Here, 45% of the individuals involved were not from metropolitan cities where this topic is not much seriously accounted for. But the result of the survey denoted few major physical illnesses which relates to stress. Insomnia, depression, irritation, anxiety and hypertension were few of them to name. Again obesity was witnessed among a few individuals, back pain occurred when they spent many hours in front of the laptops or computers and fatigue which resulted in frequent headaches were some serious health concerns. Here, all the individuals blamed the gadgets (laptops, computers, mobile phones) to be an impediment in managing work along with family responsibilities in spite of being a great help. Here, majority of the respondents were unmarried. Some other obstacles were formal meetings, calls and tutoring sessions or trainings for development post office hours and the cynical attitude of the office boss towards a right balance of work and home.



Fig-2. Source: Work-Life Balance needs responsibility balancing – HBF Direct.com

Table -1: Benefits of Work-life Balance to employees as well as to the organization:

To employees	To organization
1. Improved on-the job and off-the-job relationship.	1. Increased productivity.
2. Self-satisfaction.	2. A reduction in staff turnover and recruitment costs.
3. Improvement in one's health and well being.	3. Improved morale.
4. More value and balance in daily life.	4. Better team work and communication.

It is very important for the employees to experience a sound work-life and then only the organization can also improve its position and goodwill in the market. It is healthy and of utmost significance to both because if the employee remains satisfied, he will give his 100% to his job and in turn the organization will also flourish as a result of the hard work of the employees. Thus, both the parties give its maximum to obtain maximum benefit.



Fig-3. Source: 41,110 Work-Life Balance images, stock photos & photos – Shutterstock.com

CONCLUSION

Work-life balance can be perceived as to maintain and integrate multiple domains of personal time, family time and work with minimum role conflict. Research shows that the failure to achieve a satisfactory balance of effort is directly connected to lack of energy to fulfill personal commitments and lack of control over the workload. The lack of harmony here leads to after effects such as fatigue, lower standard of living and most importantly lower performance. When proper work-life balance is achieved, the individual feels relaxed and sorted out. Productivity of the person increases which leads to accomplishing task efficiently as well as to attain greater success. The bond between friends and families get stronger day by day. Better mental and physical alertness is another benefit. We will be able to make priorities over sacrificing. Leisure time is another added advantage of work-life balance. Recently the pandemic has adversely affected the work-life balance of all people in the world and we are still trying to cope up with the adversities. Here, self- management is the key where people need to control their own behavior and expectations regarding work-life balance.



Fig-4. Source: 235,943 Work-Life Balance Stock Photos, Pictures & Royalty –Free Images- iStock.com

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MoS₂ Composite Membrane Manufacturing on Ceramic Hollows Fibres for Desalination

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ABSTRACT

As it uses ionic and molecular screening capabilities, molybdenum disulphide (MoS₂), a potential superficial substance, has emerged as a substitute membrane material for desalination. The creation of an electrocharged MoS₂ composite layer on a (CHF) ceramic hollow fibre is described in this article. To reduce the size of the pores and enhance the area of the CHF, a TiO₂ multilayer was previously produced. In order to improve the interfacial bonding among neighbouring MoS₂ plates and also between the substrate and the layer, polyethyleneimine (PEI) was added. This made it easier to construct a nicely packed separation layer. The composite membrane was additionally given a positively charged, hydrophilic surface using PEI. Measurement of the water contact angle, scanning electron microscopy, atomic force microscopy, energy-dispersive X-ray spectroscopy, and X-ray diffraction were used to examine the architectures and characteristics of these layers. The nanofiltration (NF) performance and durability of the MoS₂/PEI composite layer were exceptional. Our research gave a thorough grasp of how MoS₂ composite membranes are made on the CHF for effective desalination of water.

Keywords: Molybdenum disulphide, Desalination, ceramic hollow fibre

1. INTRODUCTION

The condition of water contamination and scarcity, which is becoming increasingly serious, might be greatly improved with membrane-based technologies, according to Werber et al (2016). An enticing membrane separation method known as nanofiltration is thought to have a number of distinctive benefits, including strong denial for polyvalent species and organic matter with molecular weights greater than 167 amu, modest operating pressure, simple and sophisticated handling, and lower rates Zhou et al (2015). These characteristics have led to the use of NF in numerous sectors, particularly wastewater treatment and saltwater desalination Bai et al (2019). Even though the efficiency of NF membranes has significantly improved over the last few years, research into new membrane technology and ways of membrane manufacturing must continue. Due to the fact that stacked two-dimensional (2D) nanosheets may create channels with subnanometer-scale dimensions and exhibit high water penetration and ionic selectivity, these materials have recently been investigated as potential membrane materials. Anand et al (2018). Due to its distinct physical and chemical characteristics, molybdenum disulphide (MoS₂) nanosheet has gained more and more attention in the latest days. It is a type of conventional 2D material that resembles graphene. For example, the lack of functional groups enables the construction of reasonably straight and stiff nanochannels using stacked MoS₂ nanosheets. Moreover, the durability of stacked MoS₂ membranes can be maintained by the London dispersion forces and inundation forces among adjacent MoS₂ layers. Wang et al (2017). On the one hand, nano porous single-layered MoS₂ layers exhibit extraordinary water pervasive and salt elimination qualities above any certain nano porous layers, according to molecular dynamics simulations. Kou et al (2016). However, some studies have empirically shown that MoS₂ nano layers can be used in membrane separation like RO, engineered osmosis, pervaporative separation, and fractional distillation. A layer-stacked MoS₂ layer made of atom-thick nano layers was put together by Sun et al. (2013). This membrane had a high-water penetrating flow and demonstrated Evans blue molecule rejection.

As CHFs have several advantages over flat-sheet polymeric substrates, like superior tensile force, intense heat indulgence, and strong compound balance, they would be a significant gain for the MoS₂ functional layer. Aba et al. (2015), CHFs have a somewhat coarse surface structure owing to a typical pore dimension of 600–1200 nanometres. The lateral size of MoS₂ nano layers produced by liquid phase exfoliation is approximately 200 - 800 nm Shen et al (2016).

1.1 RESEARCH GAP

On CHFs, it is challenging to create a MoS₂ layer that is densely packed and void-free. Hence, the evolution of MoS₂ nano layers in the area of CHFs merits thorough investigation.

1.2 RESEARCH AIM

- A moderately dense TiO₂ interlayer was built conducive to manufacturing densely packed and vacuous MoS₂ sheets on the CHF.
- To make the surface of the CHF smoother and the pore size smaller.

2. LITERATURE REVIEW

Sapkota et al (2020) In comparison to their thoroughly researched analogues, graphene-based membranes, MoS₂ laminar membranes have lately shown to be steadier in a watery habitat; moreover, difficulties like modest ion exclusion for high salt water, modest water stream, and modest steadiness over time hinder their possible endorsement as a practical innovation. Here, we present composite exfoliate multilayer MoS₂ sheets with layered interdimensional porous nanosheets and nano disks that range in thickness from one to two layers. The multimodal porous network of these membranes allows for adjustment of the surface charge, pore dimension, and multilayer distribution. Our layers reliably filter small-molecule organic dyes and salts during reverse osmosis while rejecting greater than 99% of salts at extreme saltiness during forward osmosis.

Zhu et al (2021) Osmotic energy harvesting has shown great promise for MoS₂. Yet, the current research is mostly focused on semiconductor phase-structured prototype nanoscale single-pore systems. Exploring MoS₂ potential for use in a more durable two-dimensional (2D) nanofluidic membrane at the macroscopic scale and learning the basics of how the phase arrangement affects the power production activity are urgently needed. Here, we show the ability of 2D metallic MoS₂ composite membranes to function as high-performance osmotic power producers. Owing to the analysis and simulation, MoS₂'s higher electron density promotes the adhesion of ionic species to the membrane, giving the material better ion selectivity, greater ionic flux, and dramatically improved transmembrane ion transport. The power density can reach around 7.6 Wm⁻² when seawater and river water are combined.

Liu et al (2021) The aim of this research is to objectively evaluate the recent up-to-date in water treatment and purification using MoS₂-based membranes. Initially, we quickly go over the primary techniques for creating MoS₂ nanosheets, which are frequently used to create membranes. The creation of MoS₂ layers is then succinctly described in the form of nanoporous layers, layer-stacked, MoS₂ composite layers with membranes integrating, and molecularly modified membrane surfaces. Then, with an emphasis on distillation, sewage treatment, and parasiticidal features, scrutinise current developments in applications of MoS₂ layers for water processing and sanctification. Lastly, go over the current issues, upcoming research initiatives, and potential of MoS₂ layers.

Arshad et al (2022) L-cysteine was employed as a sulphur pioneer in a bottom-up green chemical procedure that produced MoS₂ nanosheets. MoS₂ nanosheets with dimensions of 200–300 nm and a mean thickness of 4.2 nm were produced successfully using particular concentrations, the mole concentration of the reagent, and pre-mixing circumstances. The MoS₂ nanosheet suspension was then applied in repeated batches to a poly(vinylidene difluoride) membrane purifier with a pore dimension of 1.1 μm to create porous membranes. The elimination of 82.87% of BSA was obtained by the membrane that contained 12 batches of MoS₂ nanosheets. After the second filtration run, 95.65% of the acid red was removed. Additionally, a great water flow of 291 L/s was shown by the porous MoS₂ nanosheet membrane. This outcome resolved the trade-off that polymeric ultrafiltration membranes had to make between selectivity and permeability.

3. RESEARCH METHODOLOGY

3.1 MATERIALS

TiO₂, Polyethyleneimine (PEI), Molybdenum Disulfide (MoS₂), and Isopropanol (IPA). With molecular weights of 200, 300, 400, and 600, poly(vinyl alcohol), inorganic salts (Na₂SO₄, Sodium chloride, MgSO₄, MgCl₂, Copper (II) nitrate, Zinc Chloride, Calcium Chloride, Manganese (II) Chloride, and NiCl₂), and polyoxyethylene were used. Without additional purification, all of the compounds were used in their original form. The entire project was conducted with Milli-Q water. Using Al₂O₃ particles, CHFs of 120 millimetres in length, 3 millimetres in outer radius, and 2 millimetres in inner radius were created.

3.2 MEMBRANE FABRICATION

3.2.1 Exfoliation of mass MoS₂: Direct LPE method was used to create MoS₂ nanosheets. A specific quantity of mass MoS₂ was dissolved in IPA and water, at a proportion of 0.005 g, and then subjected to bath ultrasonography for 12 hours. To get rid of big particles, the cessation was extracted for 30 minutes at 471.24 rad/s. Pipettes were used to collect the supernatants for further use. A specific quantity of the MoS₂ filtrate was

put on a Polyflon plate, dried at 140 °F for 720 minutes to entirely exhaust the solvent, and then precisely calculated to estimate the proportion of the resulting MoS₂ dissolution.

3.2.2 Formation of TiO₂-CHF: By means of the combination of dip-coating and frittage process, the TiO₂ sheets aided on the CHF's exterior area were created. By combining TiO₂ molecules with PVA aqueous solution, a coating suspension for a 10-weight per cent TiO₂ content was created. CHFs were carefully removed from the suspension after 2 minutes and dried completely at room temperature. The two edges of the CHFs were tightened with Teflon tape. These TiO₂-CHFs were then calcined for 2hrs at 800 °C. With a view to achieve the uniformity of the TiO₂ sheets, this production process was done twice.

3.2.3 Fabrication of MoS₂ composite layer: To create a homogenous cessation with a PEI proportion of 0.0002g and a MoS₂ proportion of 0.0001g, PEI was stirred in the dilute MoS₂ dispersion. One side of the TiO₂-CHF was tightened, and the other side was linked to an inflator as it was soaked into the MoS₂/PEI solution. MoS₂ nano layers are deformed on top of TiO₂-CHF at the pressure of the transmembrane of -0.1 MPa. By adjusting the filtrate quantities or the preparation time, the MoS₂ layer's thickness can be changed. After 12 hours of drying at 40 °C, the MoS₂/PEI composite membranes were eventually obtained. The same technique was used to create pure MoS₂ composite membranes devoid of PEI as a point of reference.

3.3 Characterization: Anomalous force microscopy and TEM were used to describe the structure of exfoliated Molybdenum disulphide. By using capillary flow porosimetry, the pore dimension of TiO₂-CHFs and CHFs was determined. A field emission SEM was used to analyse the MoS₂ composite layers' surface and cross-section structures. The membrane surface roughness was calculated using AFM with a 10µ m * 10 µm scanning area. For the purpose of analysing the particle distribution of the composite layers, an energy-dispersive X-ray spectrometer was employed. A drop shape analysis was used to quantify water contact angles (WCA) in order to study surface wettability. In order to measure X-ray diffraction, a Cu Kα radiation-using XRD device was used.

3.4 NF Performance: The water permeance of the composite layer was evaluated by $Permeance = V / (A * t * \Delta p)$

where V (L) is the quantity of the permeate specimen that was gathered over the course of the time interval t (h), and p (bar) is the pressure that was used. The rejection was made based on $R = (1 - C_p/C_f) * 100\%$

where C_f and C_p stand for the relative solute concentrations in the feed and permeate.

4. RESULTS AND DISCUSSION

4.1 Characterization of Molybdenum disulphide nanolayers: It was created using the direct LPE technique had a distinctive 2D lamellar structure with asymmetrical geometries, as illustrated in Fig.4.1 (a). Exfoliated MoS₂ has lateral dimensions of about 100 ~ 600 nm. The density of the produced MoS₂ was around 7.8 nanometres, as shown by the AFM picture (Fig. 4.1(b)) and equivalent height profile (Fig. 4.1(c)) of a single Molybdenum disulphide nanolayer. Since a single membrane of MoS₂ has a density of roughly 1.8 nanometre, the produced MoS₂ nanolayers used in this investigation had a stacking of 7–8 layers.

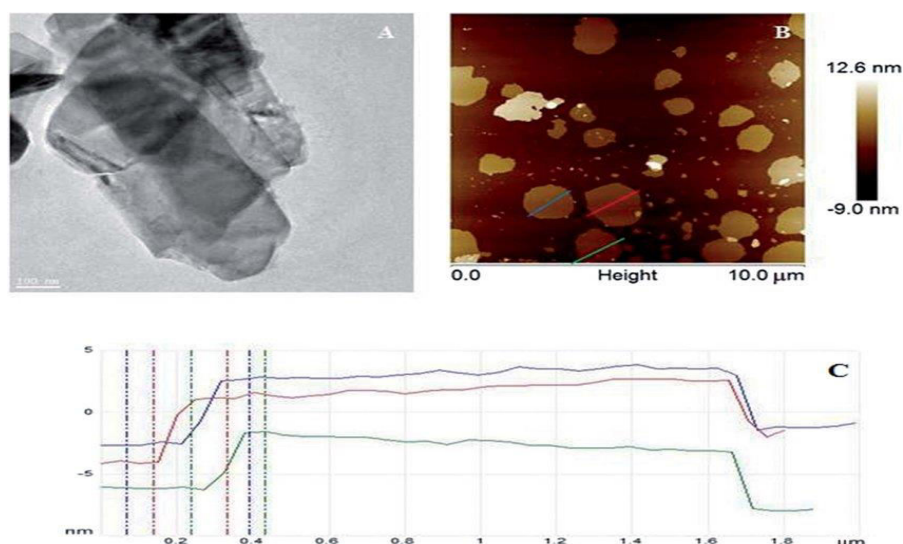


Fig 4.1 A) TEM image; B) AFM image; C) High profile of exfoliated Molybdenum disulphide

4.2 Characterization of MoS₂ Composite Membranes

Vacuum suction construction techniques were used to create MoS₂ composite membranes. Fig. 4.2 illustrates the investigation into the association across membrane formation time and MoS₂ encumbering.

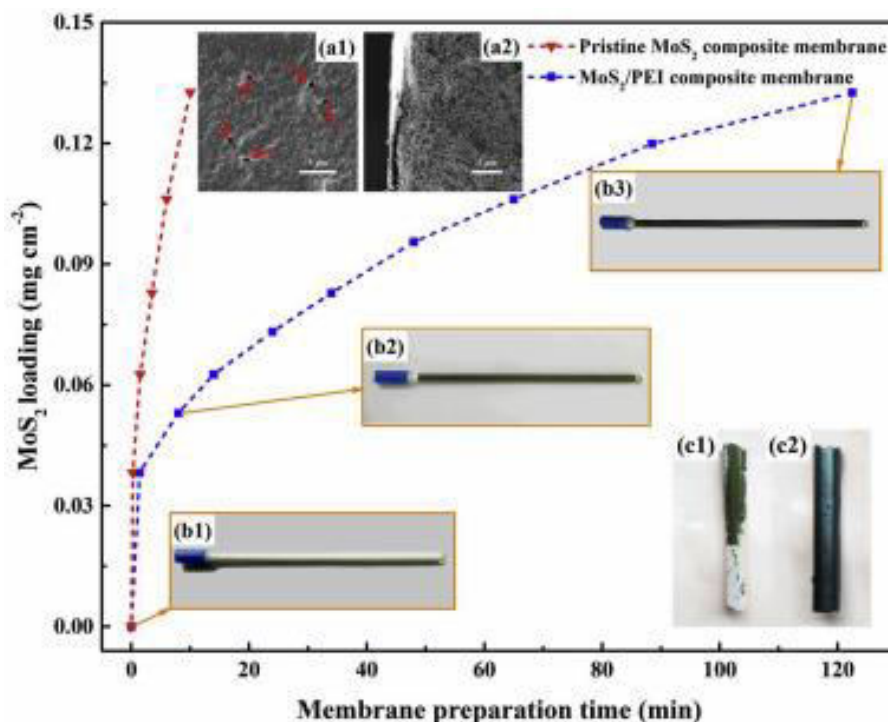


Fig 4.2. MoS₂ loading and membrane preparation times for both pure Molybdenum disulphide composite layers and MoS₂/PEI composite layers are correlated.

The TiO₂-CHF and MoS₂/PEI layers were firmly bonded together, exhibiting a strengthened bonding strength. With higher MoS₂/PEI loading, the exterior area of the MoS₂/PEI composite layer also came significantly flatter. It could be assumed that PEI served a substantial part in the coherence and durability of the composite layer based on the magnified SEM picture of the surface microstructure for the MoS₂/PEI composite layer and the pristine Molybdenum disulphide composite membrane (Figure.4.3).

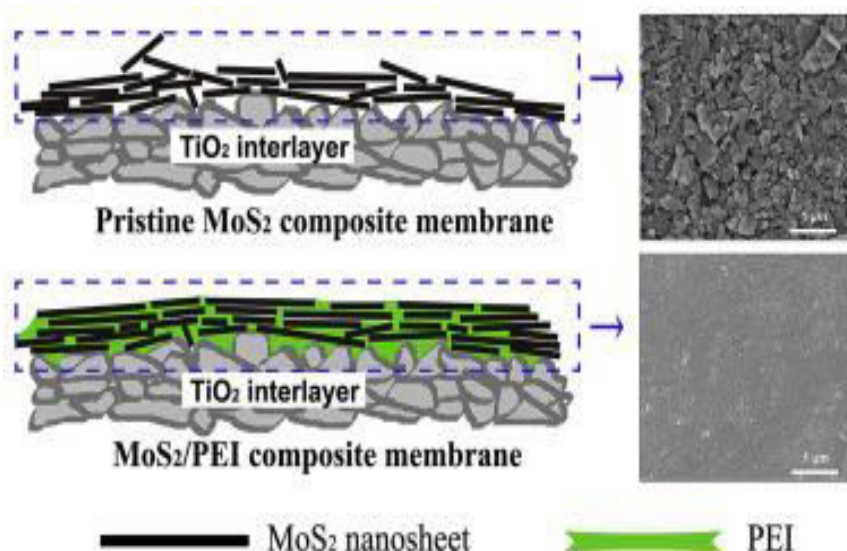


Fig.4.3. Surface microstructure of the unaltered Molybdenum disulphide composite layer and the MoS₂/PEI composite layer shown schematically and in a magnified SEM image.

4.3 Crystalline Properties

As per the XRD spectra (Fig.4.4), a rather faint signal for the deformed MoS₂ sheets was seen beside the normal diffraction peak of TiO₂ at $2\theta = 27.6^\circ$ after the assembly of MoS₂/PEI on the TiO₂-CHF. Therefore, it is possible to assume that PEI chains served primarily as folders for the oblique arrangement of Molybdenum disulphide flakes, promoting the development of an accurately arranged Molybdenum disulphide separation membrane.

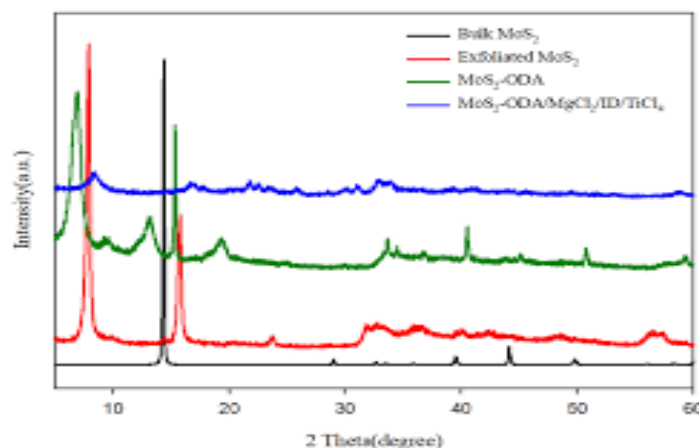


Fig.4.4. MoS₂/PEI composite membrane, exfoliated Molybdenum disulphide, TiO₂-CHF, and bulk Molybdenum disulphide XRD patterns.

4.4 Desalination Effect of MoS₂/PEI Composite Layers

By examining pure water permeance and Magnesium Chloride exclusion, the separation effect of MoS₂/PEI composite layers with varied Molybdenum disulphide loading was assessed. When seen in Fig. 4.5(a), as the MoS₂ loading increased, pure water permeance decreased and the elimination of MgCl₂ rose. With a MoS₂ loading of 0.053 milligram/cm², the MoS₂/PEI composite layer displayed a modest Magnesium chloride elimination of 15.9%. The resulting membrane showed a pure water permeance of 4.6 L/m²h bar and Magnesium Chloride exclusion of 89.4% as the MoS₂ loading rose to 0.13 mg/cm². The MoS₂/PEI composite layers with Molybdenum disulphide loading of 0.13 milligram /cm² was called for future research since it is believed that the membrane will have both sequential permeability and selectivity. Investigative work was done on the neutral organic solute rejection of the MoS₂/PEI composite layer (Figure. 4.5(b)). The membrane's molecular weight cut-off was inside the NF scale at about 400 Da.

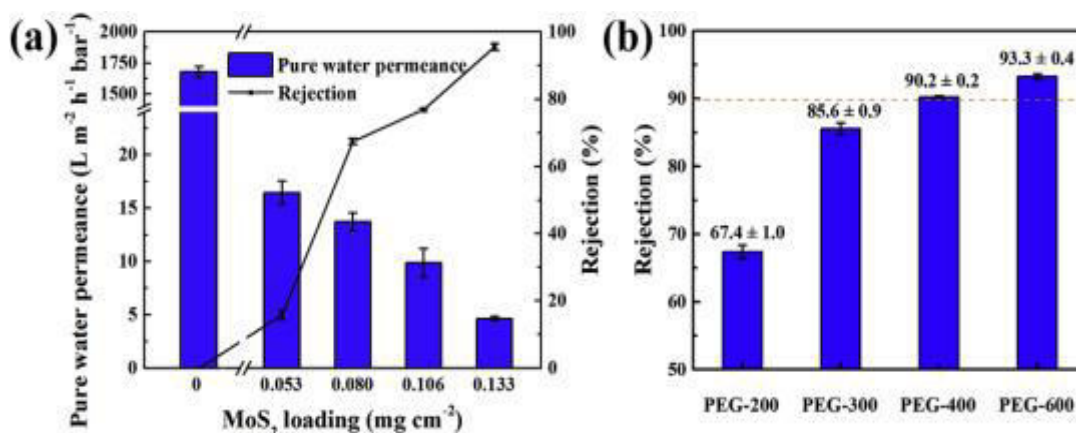


Fig.4.5 (Magnesium chloride concentration: 0.01 M; pressure: 87.02 psi) The impact of molybdenum disulphide loading on the separation effect of MoS₂/PEI composite layers, and (b) exclusion of the MoS₂/PEI composite layers for various inactive organic solutes

5. CONCLUSION

In this work, we have created an approach for creating MoS₂/PEI composite membranes that are positively charged on the outside of CHF's. The TiO₂ interlayer, which was ready beforehand, reduced the CHF's pore dimension and smoothed its surface. The use of PEI increased the stability and hydrophilicity of the composite layer by producing a cleanly and densely stacked nanostructure. With pure water permeance of 4.6 L/m²h bar and Magnesium chloride exclusion of 95.5%, the resulting MoS₂/PEI composite layer demonstrated exceptional desalination effect.

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Comparative Evaluation of Different Extracts of *Phyllanthus Niruri* for Hepatoprotective Activity against Paracetamol

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ABSTRACT

In this study, we aimed to evaluate the protective effects of *Phyllanthus niruri* leaves extract on paracetamol-induced liver injury in mice. The hepatoprotective effects was studied as per the standard protocol using 6 groups comprising of 6 rats each were employed for the study: Group-1 (Control Group): CMC solution (0.5%), 5 mL/kg p.o.; Group-2 (Toxic Group): Paracetamol, 1.5 mL/kg p.o.; Group-3 (Standard Control): Silymarin, 25 mg/Kg p.o.; Group 4 (Experimental Group-1): Ethanolic extract, 100 Kg/daily p.o. (Low-dose); Group 5 (Experimental Group-2): Ethanolic extract, 200 Kg/daily p.o. (Medium dose); and Group 6 (Experimental Group-3): Ethanolic extract, 400 Kg/daily p.o. (High-dose). The biochemical parameters [alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), direct bilirubin (DB) and total bilirubin (TB)] were determined and histopathology was performed to view the changes cum improvements. The results revealed that treatment of an ethanolic extract of *P. niruri* restored normal levels of biochemical parameters. In the fortification against paracetamol-induced hepatopathy, the inhibition of free radical production or free radical scavenging activity is also important; it appears that the antioxidant activity of *P. niruri*'s extract may contribute to its hepatoprotectivity.

Keywords: *Phyllanthus niruri*, Extract, Paracetamol-induced hepatotoxicity, Hepatoprotective, Biochemical, Histopathology

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Abstract

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References

1. INTRODUCTION

The plant *Phyllanthus niruri* (Euphorbiaceae) is locally called as 'dukung anak' since it is indigenous to Malaysia. This plant has been used in Chinese medicine for centuries. As a means of treating kidney stones and renal difficulties, liver illnesses such jaundice, viral infections and cancer, such as liver cirrhosis, hepatitis and malaria, and fever (Narendra *et al.*, 2012). It's been shown that *P. niruri* contains antiviral, antihepatotoxic and anti-hépatitis characteristics, as well as analgesic, antimutagenic, hypotensive, antispasmodic and antibacterial qualities. Both ethanolic and alcohol extracts have been shown to inhibit the hepatitis-B virus (HBV) *in vitro* and *in vivo* (Lee *et al.*, 2016). In 1861, Ottow did conventional phytochemical tests on this plant and discovered the lignan phyllanthin for the first time during this period of study into Chinese herbs. Many hepatotoxic compounds have been linked to the antiviral activities of the extract, also known as 'zhu zi cao,' which has been used to treat liver damage in traditional Chinese medicine (Kaur *et al.*, 2017).

P. niruri was examined *in vivo* for the first time by Venkateswaran and colleagues to assess its antihepatitis activity. Lignins, tannins, flavonoids, and terpenes all include antioxidants, which may explain why *P. niruri* seems to have antioxidant and hepatoprotective properties (Dahanayake *et al.*, 2020). Phyllantin and hypophyllanthin, two lignans found in high concentrations in *P. niruri* Hexane extract, are among the most potent active components. The antioxidant and hepatoprotective action of *P. niruri* has been studied *in vitro* using carbon tetrachloride and galactosamine, and these primary constituents reveal that it protects rats from hepatotoxicity generated by these chemicals. There is, however, a particular reason for this drop in enzyme levels, although the precise mechanism has not yet been discovered (Kamruzzaman and Hoq, 2016).

A variety of factors may be at play in the lowering of certain liver enzymes, since the quantity and kind of lowered enzymes look different in different studies. Lipid peroxidation is the primary process for reducing glutathione, and it aids in this decrease. It is also an effective NO inhibitor where its action in removing nitric oxide from the body is 1.6 times more when combined with the Ayurvedic multi-herb composition than when taken alone (Bagalkotkar *et al.*, 2006). Using *P. niruri*'s anti-NO agent results in an excessively high quantity of NO, which causes chemical intermediates linked to genotoxicity to be formed. The protein component of the ethanolic extract was shown to be more efficient in protecting the liver from tetrachloride toxicity than the methanol formulation at lowering ALT levels (Twahirwa *et al.*, 2018). Especially in the past decade, when increasingly effective herbal medicines have been used, trees have proved to be a significant supply of raw materials for sustaining the population's well-being. Herbal medicine plays a significant role in the development of a useful diagnostic agent. These natural materials have historically been used in the treatment of disease situations (Rizki, 2020).

The present work involves exploring the hepatoprotective effects of paracetamol-induced hepatotoxic animal model. The biochemical parameters [alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), direct bilirubin (DB) and total bilirubin (TB)] were determined and histopathology was performed to view the changes cum improvements.

2. MATERIALS AND METHODS

2.1. Selection and Collection of Plant Material

Because of their pharmacological actions, low toxicity, and commercial feasibility, the therapeutic qualities of plants have been explored in light of contemporary scientific discoveries all over the globe. The leaves of *P. niruri* L. were chosen based on information gathered from local vaidhyas and other traditional medicine practitioners in Akole, Ahemadnagar, India. The healthy half of the experimental plant was gathered from the cultivated fields of Veet, Tal.- Akole, Dist.- Ahemadnagar, State - Maharashtra, from June to September.

2.2. Authentication of Plant Material

In the Department of Botany, Yashwantrao Chavan College of Science, Karad, Maharashtra, the plant material was identified and authenticated, and the voucher specimen (No. AMB-1) was deposited in the same department's herbarium.

2.3. Preparation of Crude Drug for Extraction

The extract was made from the leaves and stem bark of the chosen plants. The leaves and stem bark of the plants were gathered, dried in the shade, and roughly pulverized using a mechanical grinder. For the extraction, the powder was sieved No. 40 and kept in an airtight container (Moshai-Nezhad *et al.*, 2018).

2.4. Animals

Albino rats (Wistar strain) of either sex weighing 150-200 g were facilitated from the Oriental College of Pharmacy and Research Centre in Indore, Madhya Pradesh. Under laboratory conditions, the animals were acclimatized for 7 days. The animals were fed a normal feed and given free access to water under strict sanitary conditions (24–25°C temperature, humidity 50–60%, and 12 hr light and dark cycle). The Institutional Animal Ethics Committee (IAEC) gave its approval (IAEC/2019-20/RPO-11) for the protocols and study. The research was carried out in compliance with the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines.

2.5. Pharmacological Evaluations

2.5.1. Determination of Acute Toxicity (LD₅₀)

In order to decide the dose, toxicity studies (acute oral toxicity) were carried out as per OECD (Organization for Economic Cooperation and Development) Guideline number 420. The extract was given in a single dose by oral gavage stomach tube. Animals were one by one observed after dosing at least once every after the first 30 mins, periodically for 24 hr. A special attention must be given during the first 4 hr. Mortality as well as the toxicity were not found even after over dose and administration of a 2000 mg/kg body weight limit dose of extract. As per OECD guidelines the substance said to be or considered to have an LD₅₀ value above 2000 mg/kg body weight. Three doses were selected first 100 mg/kg, second dose of 200 mg/kg, and third dose of 400 mg/kg as per body weight to study LD₅₀ value (Hazarika *et al.*, 2019).

2.5.2. Hepatoprotective Activity

The hepatoprotective effects of *P. niruri* against paracetamol-induced hepatotoxicity was studied as per the standard protocol (Parmar *et al.*, 2010). 6 groups comprising of 6 rats each were employed for the study:

- Group-1 (Control Group): CMC solution (0.5%), 5 mL/kg p.o.
- Group-2 (Toxic Group): Paracetamol, 1.5 mL/kg p.o.
- Group-3 (Standard Control): Silymarin, 25 mg/Kg p.o.
- Group 4 (Experimental Group-1): Ethanolic extract, 100 Kg/daily p.o. (Low-dose)
- Group 5 (Experimental Group-2): Ethanolic extract, 200 Kg/daily p.o. (Medium dose)
- Group 6 (Experimental Group-3): Ethanolic extract, 400 Kg/daily p.o. (High-dose)

48 hours after paracetamol treatment, blood was collected by post-orbital puncture with mild ether anesthesia. Blood was coagulated, cold-centrifuged, and serum was separated at 4000 rpm at 4°C for 20 mins. The animals were sacrificed after they were under ether anesthesia. The liver was isolated from all animals where it was first collected, secondly washed, and then dried. After that weighed and stored for histopathological examination in buffered formalin.

2.5.3. Biochemical Parameters Estimation

Serum biochemical parameters like alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), direct bilirubin (DB) and total bilirubin (TB) were determined using biochemical kits (Slobodianiuk *et al.*, 2020). The procedure for testing provided by kit manufacturer was thoroughly followed.

2.6. Histopathological Studies

The histological investigations of liver slices were carried out using selective staining with the dyes hematoxylin and eosin. The 7–10 mm thick portions were chopped and cured in formaldehyde before being imbedded in paraffin wax. The cut sections were dewaxed with xylene, hydrated with a decreasing quantity of alcohol, and stained with hematoxylin. The sections were then dehydrated with alcohol until they were 70% dry, and then stained with a 1% alcoholic eosin solution. The slices were then differentiated in a 90% alcohol solution, cleaned with xylene, carefully mounted, and examined under the microscope (Yuvaraja *et al.*, 2020).

2.7. Statistical Analysis

The acquired data were represented as mean standard deviation (SEM) and analysed using one-way ANOVA and the Tukey test (Prismstat software v.2.0). For all comparisons, a P-value of 0.05 was deemed statistically significant.

3. RESULTS AND DISCUSSION

3.1. Acute Toxicity (LD₅₀) Determination

Based on the phytochemical results, acetone, ethanolic and ethanolic extracts of *P. niruri* L., were selected and screened for acute toxicity study by OECD Guideline 420. The results showed that there was no mortality amongst the graded dose groups of animals and they did not show any toxicity or behavioral changes at a dose level of 5000 mg/kg. This finding suggests that all the extracts were safe in or non toxic to rats and belonging to category 5 (>5000).

3.2. Biochemical Parameters

The essential physical liver parameters are described in **Table 1**. Hepatoprotection was provided by plant extracts that showed noteworthy disparities in SGOT and ALP levels from serum values (**Table 2**). As compared to the vehicle control group, PCM control groups showed a considerable augmentation in levels of SGOT, SGPT, and ALP. In the treatment groups, levels were considerably ($p < 0.05$) lower than in the PCM-treated control group after administration of plant extract. In terms of efficacy, treatment with extract was substantially identical to that of the SL-treated group.

Table 1: Effect of *P. niruri* ethanolic extract on various liver parameters.

Groups	Wet liver weight (g/100g)	Wet liver volume (ml/100g)	Cholesterol (mg/dl)	Triglycerides (mg/dl)	Total protein (g/L)
Normal control	5.85 ± 0.25	4.96 ± 0.46	108.23 ± 2.16	61.26 ± 2.15	71.0 ± 1.16
Paracetamol	8.99 ± 0.84 ^a	9.33 ± 0.56 ^a	206.26 ± 4.39 ^a	38.52 ± 1.25 ^a	57.23 ± 1.06 ^a

Silymarin	4.62 ± 0.12**^b	5.36 ± 0.81**^b	123.49± 5.31**^b	142.26 ± 3.02**^b	66.28 ± 2.62^c
Low dose (100 mg/ Kg daily p.o.)	7.53 ± 0.07*^b	7.24± 0.23*^b	250.95± 3.31*^b	210.21 ± 1.61*^b	69.0 ± 1.26^c
Medium dose (200 mg/kg daily p.o)	6.854± 0.05**^b	7.45 ± 0.07*^b	161.62± 5.05**^b	142.30 ± 2.41**^b	70.64 ± 0.56^c
High dose (400 mg/kg daily p.o)	6.52 ± 0.05**^b	4.96 ± 0.02**^b	146.32± 3.0*^b	135.31± 1.62**^b	67.39 ± 0.63^c

Table 2: Effect of *P. niruri* ethanolic extract on various hepatic biochemical parameters.

Groups	ALT (U/l)	AST (U/l)	AIP (U/l)	Direct bilirubin (mg/dl)	Total bilirubin (mg/dl)	Albumin (g/L)	GGT (IU/L)
Normal control	76.21 ± 1.91	185.30 ± 2.86	132.22 ± 4.61	0.215 ± 0.03	1.22 ± 0.02	11.02 ± 0.32	7.96 ± 0.40
Paracetamol	316.51 ± 2.32^a	495.65 ± 5.36^a	265.22± 5.85^a	6.65 ± 0.46^a	4.86 ± 0.23^a	8.6 ± 0.29^a	17.9 ± 3.7^a
Silymarin	111.12± 2.91**^b	180.95 ±4.01** ^b	154.96 ± 3.64**^b	1.03± 0.04**^b	1.46 ± 0.04**^b	10.28 ± 0.73*^b	13.63 ± 0.97*^b
Low dose (100 mg/ Kg daily p.o.)	162.85± 3.29**	295.92 ± 6.43*^b	196.31 ± 7.32**^b	3.25 ± 0.02**^b	2.01 ± 0.02**	10.41 ± 0.46*^b	14.36 ± 1.95*^b
Medium dose (200 mg/kg daily p.o)	140.10± 5.42**^b	245.45 ±1.58** ^b	183.05 ± 2.10**^b	1.90 ± 0.04**^b	1.71 ± 0.01**^b	10.57 ± 0.14*^b	11.20 ± 1.26**^b
High dose (400 mg/kg daily p.o)	52.56± 0.08*^b	132.23 ±0.89** ^b	132.45 ± 0.89**^b	0.352 ± 0.05**^b	0.89 ± 0.03**^b	10.5 ± 0.15*^b	14.0 ± 0.8*^b

3.3. Histopathology Studies

Hepatic nuclear picnosis was seen in liver sections from Wistar rats given large dosages of paracetamol. The cytotoxic intermediate metabolite of paracetamol, N-acetyl-para-benzoquinoneimine (NAPQI), resulted in acute hepatocellular damage and intrahepatic cholestasis, as well as sinusoidal congestion in mice (**Figure 1**). Symptoms such as reduced cytoplasmic vacuolation and lessened symptoms of restriction inflammation improved significantly after therapy with plant extract. The lowest level of necrosis and removal of sinusoidal congestion were seen in the liver tissues of the rats after extract administration, indicating that the tissue was working normally. Based on the plant extract's recovery, it can be inferred that this study's findings are comparable to those of the commercial product silymarin.

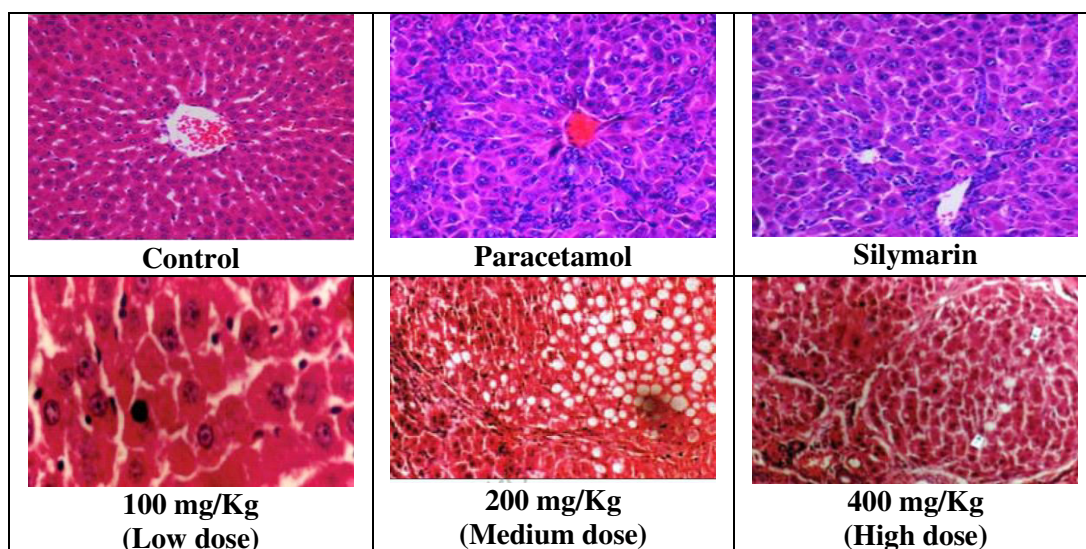


Figure 1: Histopathological results showing the improvement effects of *P. niruri* ethanolic extract.

The effect of plant compounds on liver preservation was quantified in terms of the rate of cytotoxicity. Researchers often use paracetamol as a hepatotoxin. Paracetamol metabolites gives reaction with oxygen to form trichloromethyl peroxy radicals, which leads to hepatotoxicity. In the endoplasmic reticulum, both the radicals can form the covalent bind macromolecules and trigger peroxidative cleavage of polyunsaturated fatty acid-rich membrane lipids. This gives formation of lipid peroxide, which results in pathological changes in high levels of serum marker enzymes (SGOT, SGPT, and ALP) and also in inhibition of protein synthesis. Paracetamol was chosen as the experiment model because the changes associated with paracetamol-induced liver damage and are comparable to acute viral hepatitis. SGPT, SGOT, ALP and total serum bilirubin levels higher than normal are indicators of liver injury and sign of hepatotoxicity.

On paracetamol exposure, there was a significant increase in total blood bilirubin levels, as well as a drop in total serum proteins and albumin levels, increase in SGPT, SGOT, AIP. This indicates serious hepatic injury. At three dose levels (100, 200, and 400 mg/kg), administration of *P. niruri* lin. ethanolic extract reduced the raised levels of blood enzymes and bilirubin and lowered levels of total serum proteins and albumin induced by Paracetamol. It shows the exact normalcy resulted in a similar recovery to Silymarin treatment. From the preceding, it can be concluded that the ethanolic extract of *P. niruri* has hepatoprotective effect in dose dependent manner that is comparable to the standard treatment with Silymarin. *P. niruri* ethanolic extract phytochemical screening revealed the presence as significant components saponins and flavonoids. These antioxidant phytochemicals might put in to the hepatoprotection activity.

4. CONCLUSION

The study shows that the ethanolic extract dose dependent hepatoprotective activity (100 mg/kg, 200 mg/kg, and 400 mg/kg) possesses the evidence by reduction in the prominent levels of serum marker enzymes (SGOT, SGPT, and ALP) in Paracetamol intoxicated albino rats. The treatment of an ethanolic extract of *P. niruri* restored normal levels of AST, ALP, ALT, total bilirubin, proteins, and albumin. The results were comparable to the standard Silymarin medication. In the fortification against Paracetamol-induced hepatopathy, the inhibition of free radical production or free radical scavenging activity is also important; it appears that the anti-oxidant activity of *P. niruri*'s ethanolic extract may contribute to its hepatoprotectivity.

CONFLICT OF INTEREST

No conflict of interest declared.

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Comparative Investigation to Assess the Impact of Syzygium Cumini Seed Extract and its Solid Lipid Nanoparticles on Murine Mesenchymal Stem Cell Line C3H10T½

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ABSTRACT

Objective: A murine mesenchymal stem cell line C3H10T½ was used to study the influence of Syzygium cumini seed extract (SCSE) and Syzygium cumini solid lipid nanoparticles (SC-SLNPs).

Background: *S. cumini* has exceptional therapeutic potential to treat various ailments because of its potent pharmacological properties and plethora of bioactive compounds.

Methods: SCSE was obtained through soxhlet solvent extraction method where ethanol was used as a solvent. SC-SLNPs were prepared using high shear hot homogenization technique. Preliminary phytochemical estimation was done by Gas Chromatography-Mass Spectrometry (GC-MS). Additionally, SC-SLNPs were characterized by particle size and zeta analyzer and High-Resolution Transmission Electron Microscopy (HR-TEM). Cell viability, cytotoxicity, antioxidant potential, and adipogenic differentiation potential were evaluated experimentally.

Results: Bioactive compounds in SCSE were identified by GC-MS. According to data analyzed from tests, nanoparticles of appropriate size and moderate stability were reported. SC-SLNPs were discovered to be more cytotoxic and effective at removing reactive oxygen species. SCSE and SC-SLNPs were discovered to have an anti-proliferative effect on C3H10T½ cells. The morphology and staining study of C3H10T½ cells revealed that after treatment with SCSE and SC-SLNPs, the cells did not develop into adipocytes, demonstrating their anti-adipogenic activity.

Conclusions: The phytoconstituents of *S. cumini* found by GC-MS are potent compounds that may be essential in obstructing or altering the pathways for adipogenic differentiation. The findings strongly suggest the need of in-depth research in demonstrating a potential connection between the pharmacological activities of *S. cumini* and its nanoparticles on different cell lines.

Keywords: Syzygium cumini, Solid Lipid Nanoparticles, Stem Cells, Adipogenesis, Murine Mesenchymal Stem Cells.

INTRODUCTION

Richard Feynman's breakthrough into the enigma of nanotechnology in 1959 led to the emergence of a revolutionary 21st century technology [1]. Nanotechnology has a beneficial impact on almost all sectors of the economy and is prominently used in industries including pharmaceutical, engineering, agricultural, energy, healthcare, and environmental remediation fields. [2] [3] [4] [5]. Fatal diseases such as cancer, diabetes mellitus, and some neurological disorders, are benefited from the use of nanotechnology [6] [7] [8]. With the use of nanotechnology, different nanomaterials can have a wide range of physical, chemical, and biological properties for a variety of applications [9] [10] such as diagnosing any diseases, drug administration, and monitoring any targeted location of cells and tissues. The distinctive attributes of nanomaterials, such as high surface-to-volume ratio help to increase the efficiency of stem cells [11]. Nanomaterials can be added directly to the culture media or coupled with scaffolds to alter cell signaling. [12] SLNPs are composed of natural lipids and act as cargo for the administration of oral, nasal, and ocular medicines [13]. SLNPs can incorporate both hydrophilic and lipophilic drugs. They offer enhanced physical stability, protection of environment-sensitive, and decreased toxicity. Drug administration through SLNPs is desirable, particularly for medications with poor water solubility. Additionally, SLNPs permit the regulated release of the encapsulated drug [14]. Syzygium cumini popularly known as Jamun or black plum has numerous pharmacological properties like anti-microbial, anti-diabetic, anti-cancer, anti-inflammatory, cardioprotective, and gastroprotective activities that are proven to be responsible to cure various ailments due to the presence of abundant phytochemicals [15]. In recent decades,

science has witnessed the consolidation of nanotechnology and stem cells which boost cell-based therapeutic efficacy [16]. Therefore, plant mediated synthesis of solid lipid nanoparticles (SLNPs) has been investigated upon murine mesenchymal stem cell line C3H10T^{1/2}. This paper reports the synthesis and characterization of SC-SLNPs and SCSE using particle size and zeta potential analysis, high resolution-transmission electron microscopy (HRTEM) and particle size analysis, and gas chromatography–mass spectroscopic analysis (GC-MS) respectively. Further, in vitro experiments were performed on the C3H10T^{1/2} cell line to study the effect of SCSE and SC-SLNPs, the current study was to determine the effect of SCSE and SC-SLNPs on the C3H10T^{1/2} cell line. It is a new multidisciplinary area in regeneration medicine and material science that the relationship between the structure and properties of nanostructures and the proliferation and differentiation of stem cells is acknowledged to assess how SCSE and SC-SLNPs influenced stem cells.

MATERIALS AND METHODS

Murine mesenchymal stem cell line C3H10T^{1/2} procured from NCCS Pune, Maharashtra, India. Syzygium cumini seeds were purchased in the month of April from a certified local grain market, Saju Mal Gobind Ram pansari shop in sector 26 Chandigarh, India. DMEM, DPBS, FBS, DMSO, Trypsin- EDTA, Penicillin-streptomycin, Trypan blue, MTT, Glycerol monostearate, Lecithin, Tween 80, Dexamethasone, IBMX was purchased from HiMedia. All the chemicals were of analytical grade.

Cell Culture

The murine mesenchymal stem cell line C3H10T^{1/2}, an adherent cell line with fibroblast-like morphology in culture, was used for all investigations in the current work. The C3H10T^{1/2} was procured from NCCS Pune, and grown in full growth medium (FGM) i.e. DMEM with 10% fetal bovine serum (FBS) and 1% penicillin-streptomycin in a CO₂ incubator with 5% CO₂ at 37 °C.

Extract Preparation of Syzygium Cumini

Seeds were washed with distilled water and then with 30% Hydrogen peroxide (H₂O₂) for bio-decontamination. Seeds were crushed to make a coarse powder. The soxhlet solvent extraction method is used to prepare ethanolic extract of S. cumini seeds. 120 grams of seed powder was dissolved in 275 ml of ethanol and boiled at its boiling point of 65 °C for 12–14 cycles and 10-12 hours for complete extraction. The extract is dried by using a rotary evaporator at 50 RPM, 80°C of temperature, and 45° angle of rotation. The crude extract was then lyophilized in order to remove the remaining solvent, Extract was preserved in an air-tight flask in a refrigerator at 4 °C as a crude extract and covered with aluminum foil to prevent oxidation. The final product 50mg was stored at – 20 °C and dissolved in 50ml distilled water and centrifuged at 10000 rpm for 10 minutes, then takes the supernatant and lyophilized to get the fully dissolved water extract and used in the different assays.

Characterization of Syzygium Cumini Seed Extract (SCSE)

Gas Chromatography – Mass Spectroscopic Analysis (GC-MS)

Lyophilized 50mg SCSE was dissolved in 50ml ethanol and analyzed by GC-MS. The GC-MS was performed using Thermo Scientific Triple Quadrupole GC–MS (Trace 1300 GC, Tsq 8000 triple quadrupole MS) equipped with TG 5MS (30 m × 0.25 mm, 0.25 μm) column. Helium was used as the carrier gas at a flow rate of 1 mL/min. using an injection volume of 1.0 μl at Sophisticated Analytical Instrumentation Facility, CIL, Panjab University to identify various bioactive compounds and measure the quantity of organic volatile and semi-volatile compounds.

Particle Size Analysis of SCSE

Particle size of SCSE is assessed using the Zetasizer Nanoseries Nano-ZS from Malvern Instruments.

Nanoparticles Formation

Solid lipid nanoparticles of SCSE were prepared using the high shear hot homogenization technique. Glycerol Monostearate (GMS) was selected as lipid with SCSE. After melting 300mg GMS using a hot magnetic stirrer, 100mg SCSE was added and maintained at 80°C. Simultaneously, an emulsion of 100mg lecithin and 5gm Tween 80 was prepared for addition to SCSE on a hot magnetic stirrer for 4-6 mins. Further, ultrasonication facilitated nano formation. The nanoemulsion was kept in an ice bath and cooled down to 20°C to create SC-SLNPs.

Characterization of Syzygium Cumini Solid Lipid Nanoparticles (SC-Slnps)

SC-SLNPs were characterized for surface morphology, particle size, and surface charge.

Measurement of Particle Size and Zeta Potential

Particle Size and Zeta Potential are assessed using the Zetasizer Nanoseries Nano-ZS from Malvern Instruments.

Morphological Characterization

The morphological assessment of SC-SLNPs was done at CIL (Central instrumentation laboratory) Panjab University, Chandigarh using high resolution transmission electron microscopy (HRTEM) operating at 200kV.

IN-VITRO EXPERIMENTS

Cytotoxicity Assay: The cytotoxicity was assessed using the MTT assay and trypan blue exclusion assay. In a 6-well plate, 2ml of 1.5×10^5 cells/ml per well in FGM were for 24 hours in a CO₂ incubator at 37 °C. After adding 50 µg/ml doses of each SCSE and SC-SLNPs and incubating for 24 hours, viable cells were counted using a hemocytometer. For this purpose, cells were trypsinized and 100µl of this cell suspension was mixed with 100µl of trypan blue dye. The number of viable cells were calculated by the provided formula.

$$\text{Percentage of Viable Cells} = \frac{\text{Number of unstained cells} \times 100}{\text{Total number of cells}}$$

MTT Assay

The colorimetric MTT assay was performed to further validate the results of the trypan blue exclusion assay by determining the viability and proliferation potential of the C3H10T^{1/2} cells. Following a 24 hours of incubation period, the cells with a density of 10⁴ cells/100µl/well in a 96-well plate were dosed with SCSE and SC-SLNPs (50 µg/ml for both). After 24-hour incubation, 100 µl of MTT reagent (0.5 mg/mL) was added followed by incubation at room temperature for four hours until purple precipitates were evident. 100 µl of DMSO was added after the incubation period of 4 hours to dissolve formazan crystals. The optical density (O.D.) of the purple-blue formazan dye was measured in a microplate ELISA reader at 570 nm.

Lipid Peroxidation Assay

Lipid peroxidation assay is used to analyze the cellular oxidative stress. 1 ml of 1×10^5 cells/ml were plated in 24- well plate to create a confluent monolayer. Incubated plate for 24 hours at 37°C. After 24 hours, H₂O₂ injury was given to cells by the addition of 100µM H₂O₂ for 30 minutes, the reaction was then stopped by replacing the medium with full growth media (1ml per well). Cells were then treated with SCSE (50µg/ml) and SC-SLNPs doses (50µg/ml) and again incubated for 24 hours at 37 °C in a humidified incubator. After 24 hours of incubation, media was removed then 1ml of trypsin was added and incubation for 5-6 min was given to cells at 37 °C in a CO₂ incubator. Then, 1ml of full growth media was added to the cells to stop trypsinization. Trypsinized cells were collected in eppendorf tubes and sonicated three times for 5 seconds of intervals at 40V setting over ice to prepare cell lysate Then 1ml of this cell lysate was mixed with 2ml of TBA (thiobarbituric acid) in a test tube and incubated in a boiling water bath for 60 minutes followed by incubation in an ice bath for 10 minutes. The samples were then centrifuged for 4 min at 4°C at 4000rpm and finally, the readings were taken at 530nm by ELISA Reader. Dilutions of 500µM MDA were prepared for standard curve: 2µM, 4µM, 6µM, 8µM, 10µM.

Adipogenic Differentiation

2 ml of cells (10000 cells/ml) were plated in 6 well plate and incubated at 37°C with 5% CO₂ for 48 h before initiating adipocyte differentiation. Then, the media was removed and cell monolayers were rinsed with room temperature DPBS. Then in order to induce differentiation into adipocytes, 2 ml of adipocyte differentiation medium [FGM containing 0.66µM Dexamethasone, 0.3mM IBMX (Isobutylmethylxanthine) and 0.66µg/ml insulin] was added to each well in the presence and absence of the SCSE and SC-SLNPs doses (50µg/ml). Later, on every 3rd day, media from each well was replaced with 2 ml of adipocyte differentiation medium with or without doses in each respective well for another 09 days until adipocytes reached full maturity. Subsequently, oil red O staining was performed to confirm the differentiation of mesenchymal cells into adipocytes since it has a greater solubility in the lipid than in the solvent.

1ml of 10% formalin was added into each well and incubated at room temperature for one hour. Formalin was then removed from the wells using an auto-pipette and cells were washed with 1ml of 60% isopropanol per well. The wells were completely dried followed by the addition of 1 ml of oil red O working solution ((1mg/1ml) per well and incubation at room temperature for one hour. The stain was removed and cells were then rinsed with distilled water. The wells were dried completely and finally the cells were viewed under a phase contrast microscope at 10X and pictures were taken.

RESULTS AND DISCUSSION

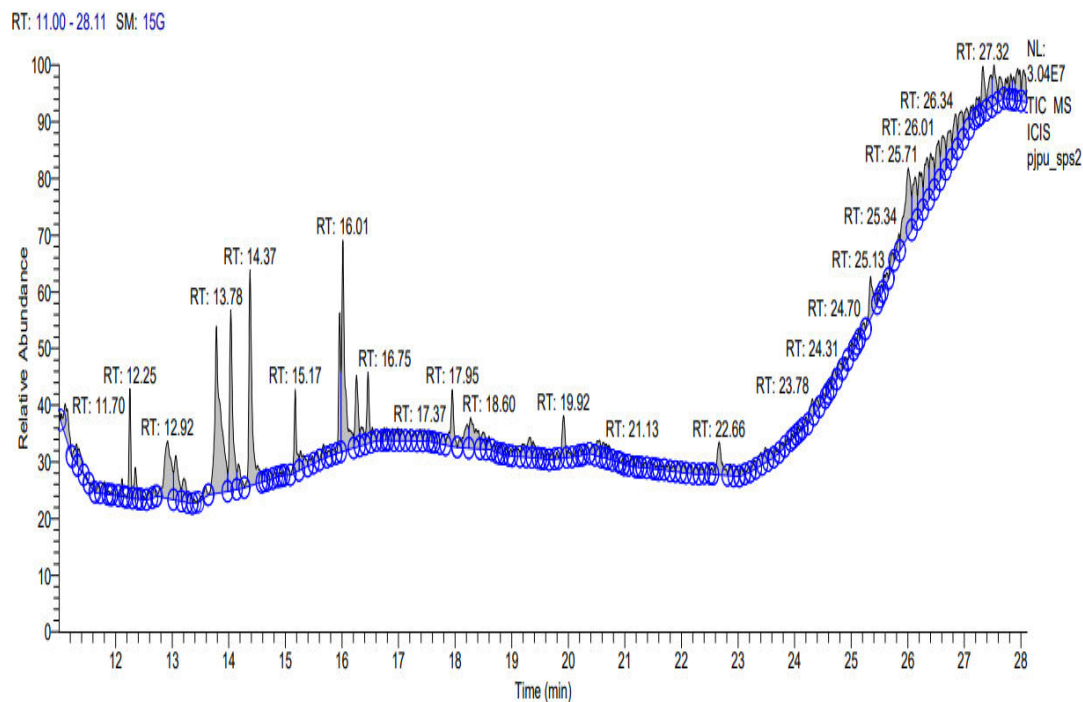


Fig 1: GC-MS graph of SCSE

The crude extracts of dried *S. cumini* seeds were profiled using the Gas Chromatogram Mass Spectrometric (GC-MS) technique (Fig 1). SCSE exhibited various different phytochemical compounds, and the mass spectral (MS) analysis of all the phytochemicals was identified based on the results of the National Institute of Standards and Technology (NIST) database as mentioned in Table 1. The major compounds were 9,12,15-Octadecatrienoic acid, Octadecanoic acid, 4-hydroxy-, methyl ester, Tetracos-2,6,14,18,22-pentaene-10,11-diol, 2,6,10,15,19,23-hexamethyl,2-Bromotetradecanoic acid, Hexadecanoic acid ethyl ester, 1-Heptatriacotanol, 1,2-Benzenedicarboxylic acid, butyl 2-ethylhexylester, 1-Monolinoleoylglycerol trimethylsilyl ether, etc. [17] contributing to have proved medicinal property. 1-Monolinoleoylglycerol trimethylsilyl ether was found to have antimicrobial, Diuretic, Antioxidant, Anti-inflammatory, Antiarthritic, and Antiasthma activities [18]. octadecatrienoic acid has antioxidant, anti-inflammatory, hypocholesterolemic, hepatoprotective and cancer preventive activities [19] [20] [21] [22]. Trilinolein is an unsaturated fatty acid has inhibitory effects and apoptotic activity in human lung cancer cells A549. [23] Derivatives of decane have shown anti-inflammatory activity [24]. 13- Docosenamide (z) was observed to have antioxidant activity [25] antimicrobial [26] [27] antinociceptive and anti-inflammatory activities [28].

S.No	Bioactive Compound	Retention Time	Molecula Formula	Uses
1	9,12,15-Octadecatrienoic acid	11.48	C27H52O4Si2	Antidiabetic, Anti-cancer, Anti-inflammatory, antiandrogenic, cancer preventive, spermatogenic, hypo cholesterolemic
2	Octadecanoic acid, 4-hydroxy-, methyl ester	12.42	C19H38O3	anti-inflammatory, antiviral and antiasthmatic
3	Tetracos-2,6,14,18,22-pentaene-10,11-diol, 2,6,10,15,19,23-hexamethyl	14.66	C30H52O2	Antimicrobial, Antidiabetic, and antioxidant
4	2-Bromotetradecanoic acid	15.57	C14H27BrO2	Antidiabetic, Larvicidal and repellent activity
5	Hexadecanoic acid, ethyl ester	16.26	C18H36O2	Antioxidant and antimicrobial activity

Table 1: GC-MS profile of some major phytochemical compounds present in ethanolic seed extract of *Syzygium cumini*

Particle Size Analysis of SCSE

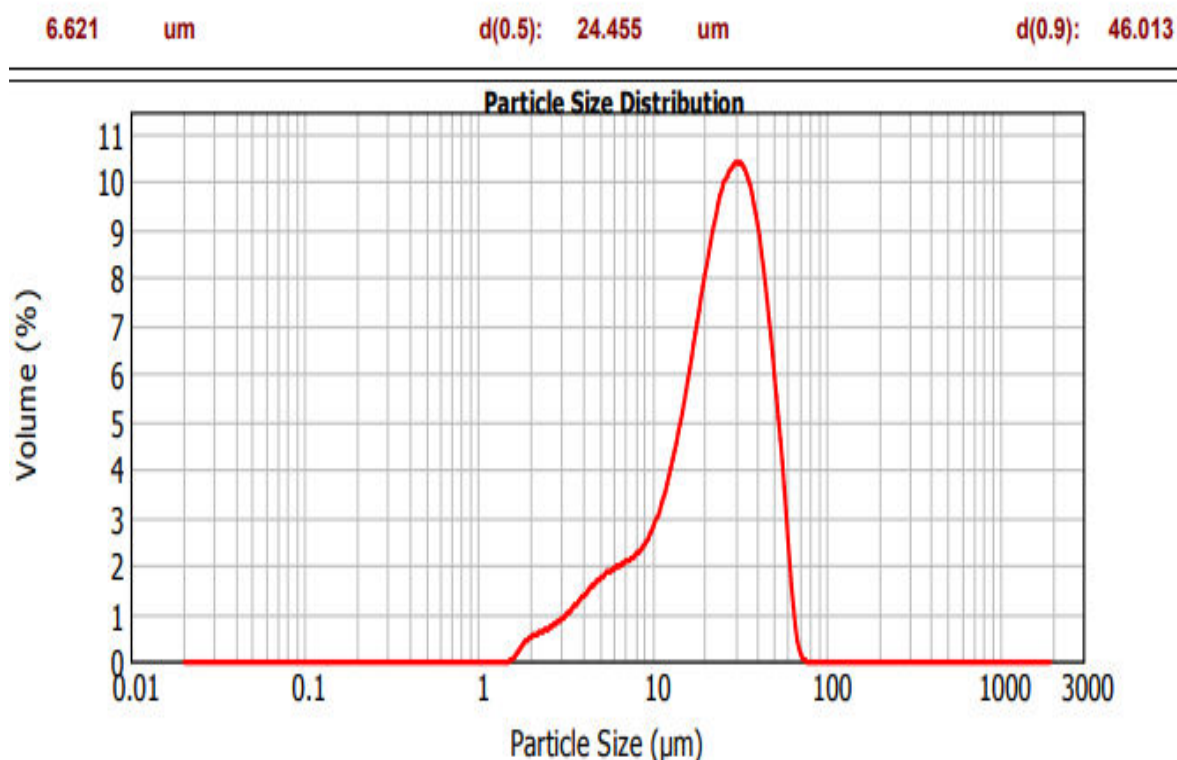


Fig 2: Particle Size Analysis of SCSE

For SCSE the average particle size is found to be 24.45 µm (Fig 2).

CHARACTERISATION OF SOLID LIPID NANOPARTICLES (SC-SLNPs)

Particle Size and Zeta Potential Analysis

The average particle size, zeta potential of the solid lipid nanoparticles, determined using Malvern Zetasizer Nanoseries Nano-ZS, were found to be 79.46 nm, -15.0 mV respectively (Fig 3 and 4).

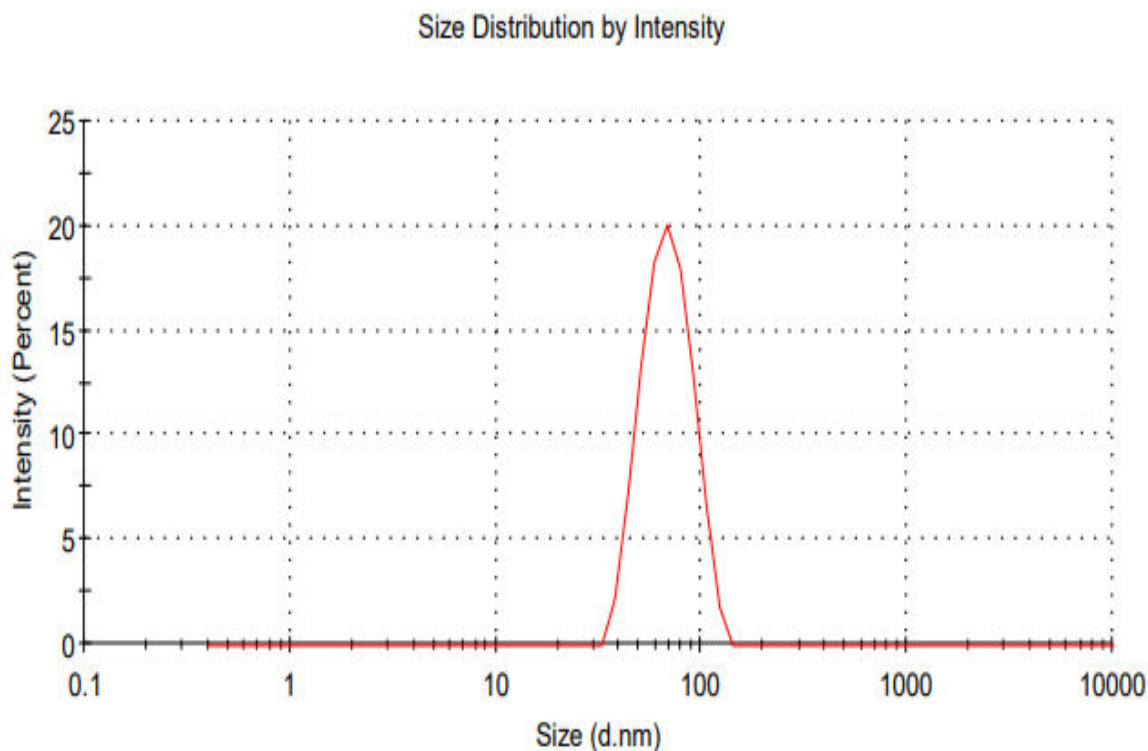


Fig 3: Particle size distribution graph of SC-SLNPs

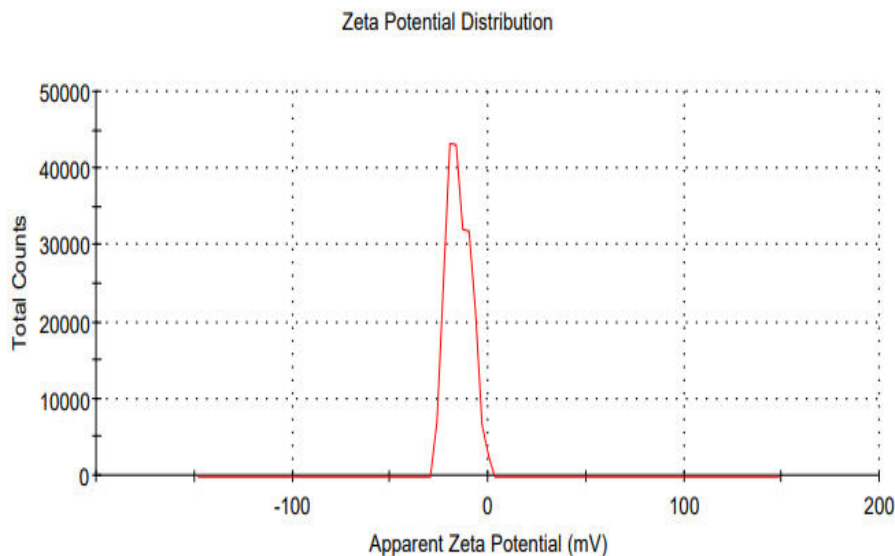


Fig 4: Zeta potential graph of SC-SLNP

Morphological Analysis (HR-TEM)

High-resolution transmission electron microscopy (HR-TEM) images at various magnifications revealed that the particles were spherical, uniformly dispersed, and between 10nm-100nm in size as shown in Fig 5. HRTEM analysis was done in CIL, Panjab University, Chandigarh.

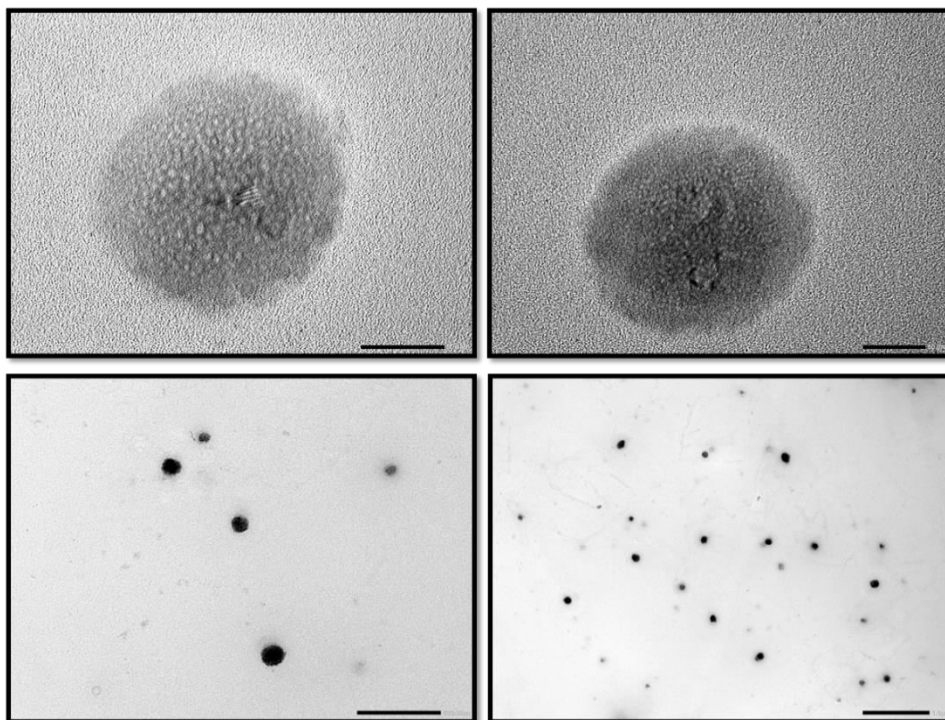


Fig 5: HR-TEM micrograph of SC-SLNPs at a concentration of 50 $\mu\text{g/ml}$, with different Magnification showing spherical shape

IN-VITRO RESULTS

Cytotoxicity Assay

Cytotoxicity test states how metabolically active the cell is. The antiproliferative effect of 50 $\mu\text{g/ml}$ doses of each SCSE and SC-SLNPs was carried out to evaluate the number of viable cells and cell proliferation by trypan blue assay. It was observed that the SCSE exhibited less cytotoxic effect than SC-SLNPs (Fig 6). SCSE did not show a significant decrease in the cell population and is considered noncytotoxic since there should be at least 50% growth inhibition by extract to be counted as cytotoxic [29]. Unlike cervical cancer cells where it was reported that *S. cumini* seed ethanolic extract shows inhibitory and cytotoxic activity [30].

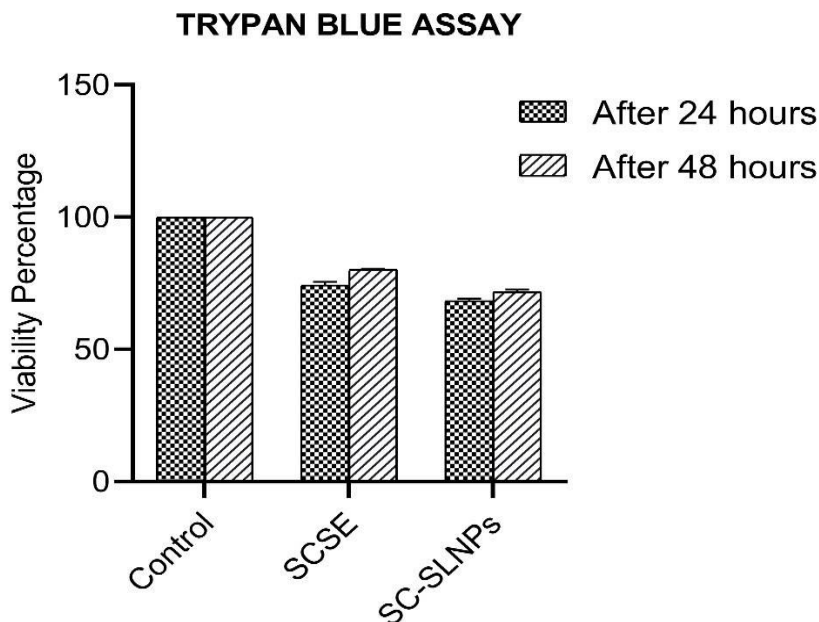


Fig 6: Graph depicting anti-proliferative effect of SCSE and SC-SLNPs to evaluate the number of viable cells and cell proliferation by Trypan Blue assay

MTT Assay

Using the MTT assay, the cytotoxic effect of 50 $\mu\text{g/ml}$ doses of each SCSE and SC-SLNPs on C3H10T $^{1/2}$ cells was determined. MTT test demonstrates that SCSE and SC-SLNPs do not exhibit any significant cytotoxicity on C3H10T $^{1/2}$ cells. The SCSE was found to be less cytotoxic, than SC-SLNPs (Fig 7).

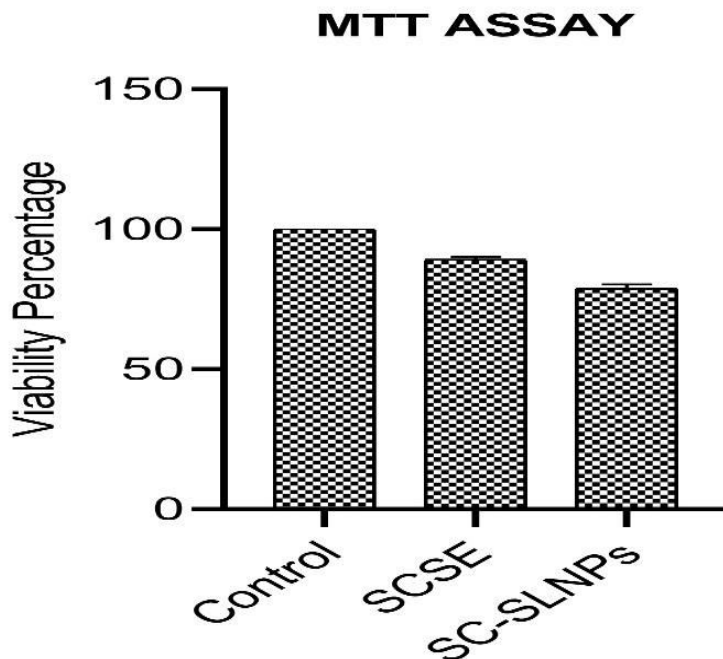


Fig 7: Graph showing the cytotoxic effect of SCSE and SC-SLNPs on C3H10T $^{1/2}$ cells

Lipid Peroxidation Assay

The MDA concentration in untreated cells was highest as the reactive oxygen species (ROS) produced after adding H $_2$ O $_2$ as shown in Fig 8, whereas SCSE and SC-SLNPs showed protection against H $_2$ O $_2$ induced cellular senescence compared to the untreated (control) cells. The MDA concentration was lowest in SC-SLNPs dosage. The results showed that SC-SLNPs had better capability in the elimination of reactive oxygen species produced by H $_2$ O $_2$.

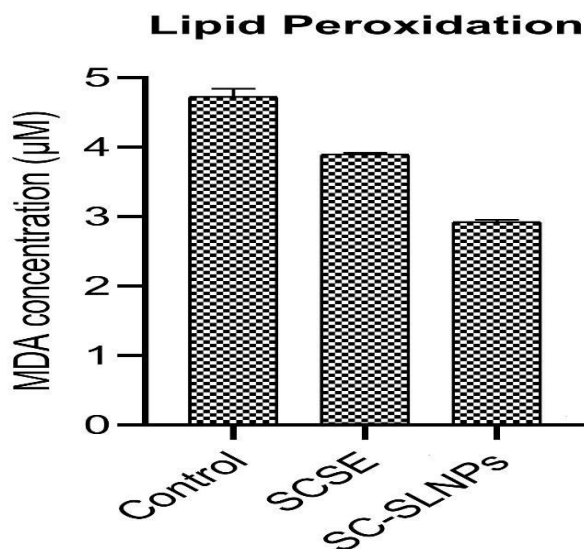


Fig 8: SC-SLNPs and SCSE shows better capability in elimination of ROS produced by H₂O₂ in cells as compared to the control

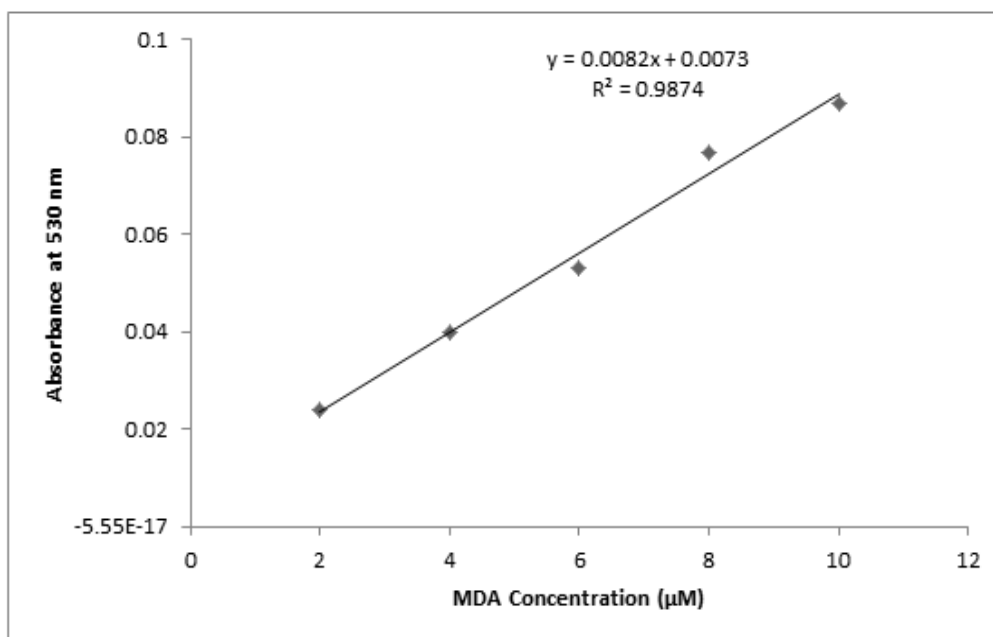


Fig 9: Standard Calibration curve of MDA

Adipogenic Differentiation

C3H10T^{1/2} cells were cultivated in adipogenic medium for 6 days with the dosage of 50 µg/ml of each SCSE and SC-SLNPs. On day 6, oil red O staining was carried out to detect lipid buildup through cell staining. The extent of adipose conversion was determined by the amount of intra cytoplasmically accumulated lipid in oil red O stained cells. *S. cumini* showed inhibitory effects. Cells failed to exhibit the formation of lipids, the morphology of the cells did not change to an oval shape and they remained fibre-like and did not show binding of color stain on cells (Fig 11). A wide range of gene and protein expressions contribute to adipogenic differentiation. The results are preliminary but noteworthy. Therefore, there is a need of further investigation. One can prove or determine by detecting the expression of PPAR γ by RT-PCR analysis. The control (Fig 11.A) group showed a substantial number of oil red O stained cells in well which were tested with only adipogenic media demonstrating initiation of cells of adipocytic lineage. However, on comparing morphological assessment of wells with SCSE (Fig 11.B) and SC-SLNPs (Fig 11.C) dosage, it is observed that on treatment with SCSE and SC-SLNPs, cells did not differentiate into adipocytes exhibiting inhibitory effects of *Syzygium cumini* on adipogenesis of murine mesenchymal stem cell line C3H10T^{1/2}.

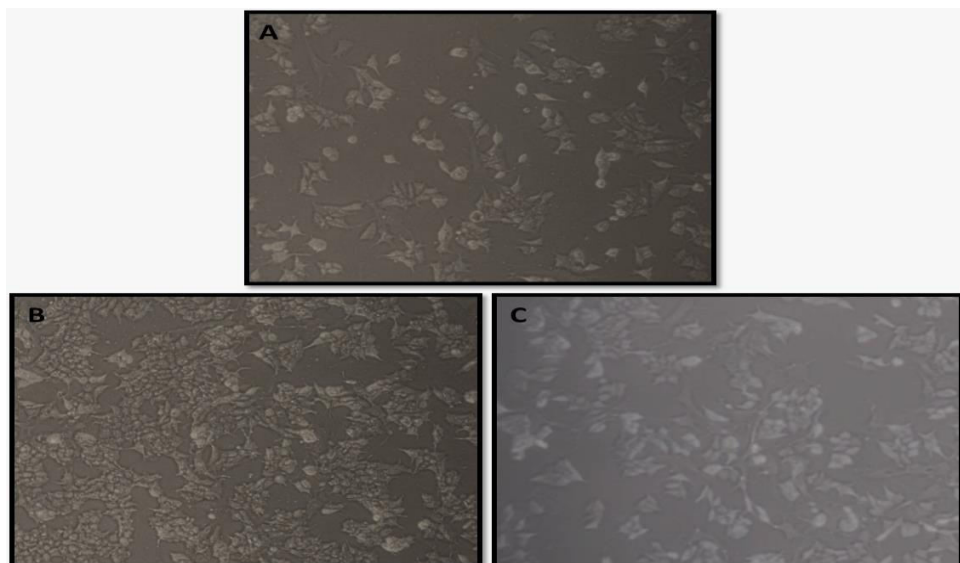


Fig 10 - Cells with adipogenic cocktail on day 9

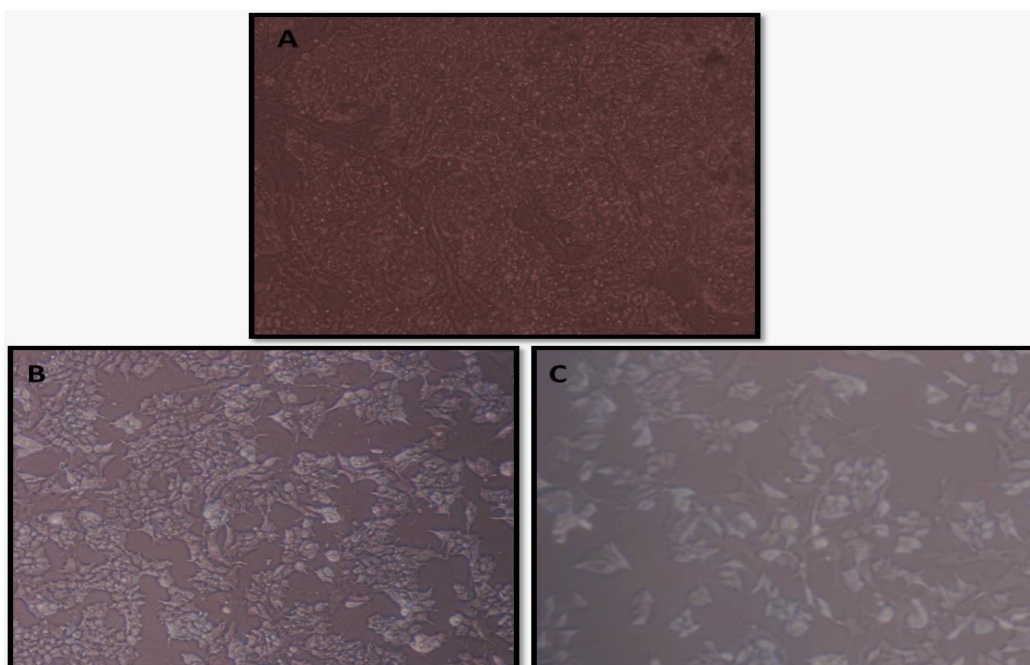


Fig11– 11.A-control showing stained cells whereas in 11.B- SCSE and 11.C- SC-SLNPS dosages, stained cells were not visible

CONCLUSION

The present study aims to investigate the effect of *Syzygium cumini* on the murine mesenchymal stem cell line C3H10T^{1/2}. There are many folklores that mention the great pharmacological properties of *S. cumini* which aids to prevent many diseases. *S. cumini* is easily accessible and reasonably priced for people from all socio-economic classes. Early Indian Ayurvedic manuscripts like Charak Samhita also mention how *S. cumini* seeds help to prevent diabetes. The science fraternity is trying to unfold these benefits to mankind. *S. cumini* contains diverse phytochemicals or secondary metabolites. Stem cell nanotechnology offers new opportunities and it is rapidly growing. Also, it is extensively used in stem cell tissue engineering, stem cell imaging and tracing, stem cell gene delivery systems etc. We tried to reveal the biomedical application of *S. cumini* and its nanoparticles by performing various in-vitro assays. SCSE and SC-SLNPs were administrated to mesenchymal stem cell line and comparison was made to determine which one is superior for use in future. Initially, SCSE was prepared using Soxhlet apparatus and then its solid lipid nanoparticles were prepared. Analytical tests were performed to characterize the prepared extract and its nanoparticles. GC-MS revealed the presence the bioactive compounds contributing to the medicinal properties of *S. cumini*. Particle size analysis, zeta potential determination, HR-TEM were analytical studies, carried out to characterize SC-SLNPs. We observed the anti-proliferative and anti-adipogenic effect of SCSE and SC-SLNPs on C3H10T^{1/2}. The findings were confirmed using trypan blue

exclusion assay, MTT assay and oil red O staining. Lipid peroxidation assay revealed that MDA concentration was lowest in SC-SLNPs dosage. The morphological and staining assessment of C3H10T^{1/2} cells revealed that on treatment with SCSE and SC-SLNPs cells did not differentiate into adipocytes showing its anti-adipogenic activity.

Declaration of Competing Interest

None

ACKNOWLEDGMENT

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An Investigation on Forward Osmosis Membrane Using Carbon-Based Nano-Materials for Water Treatment

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ABSTRACT

Contemporary water recycling modalities are required because of water pollution and the paucity of freshwater. Currently, carbon-based nano-material like carbon nanotubes (CNTs) has been used to achieve significant membrane separation efficiency. In this investigation, polydopamine-altered multi-wall CNTs were coated onto the micro-filtration (MF) membrane of polyethersulfone (PES) to create innovative porous hybrid forward osmosis (FO) membranes. These multi wall-CNTs based PES membranes' separating abilities were assessed using the FO method for water treatment. The findings demonstrate that the PES-multi wall-CNTs membrane's morphology and characteristics, including particle sizes, zeta potential, surface roughness, water flux, as well as solute denial, can be conveniently customized by varying the PDA-altered multi wall-CNT loadings. The improved PES-multi wall-CNTs membrane demonstrated higher perm-selectivity and an exceptional denial of around 91% against the poly (sodium 4-styrene-sulfonate) poly-electrolyte draw solution (DS). When evaluated in the FO technique using the orientation of membrane of the multi wall-CNTs layer towards the feed solution as well as PSS of 0.50 wt% employed as a DS, the optimal membrane flux is 31.20 LMH and also its reverse salts flux is 0.14 mmolMH. This research offers certain new perspectives on the development of high-performance water treatment membranes for separation that resembles ultra filtration membranes.

Keywords: Water treatment, carbon nano-materials, carbon nano-tubes, forward osmosis, and membrane.

1. INTRODUCTION

The rapid growth of the world's population in past years has put a tremendous strain on the energy and water supplies that are accessible now. Ineffective water usage, climate change based water shortage, as well as industrial pollution have resulted in a situation in which approximately 1.8 billion individuals reside in water-stressed areas, more than 780 million inhabitants lack adequate access to clean drinking water [Tzanakakis, V. A., et.al, (2020)]. To secure a sustainable provision of clean water in the long term, emerging fresh water source like reclaimed effluent and desalinated saltwater must be investigated deeper [Salgot, M., & Folch, M. (2018)].

There are several physical and chemical methods now in application for the treatment of water as well as wastewater, but membrane methods shine out as the most well-known, cutting-edge, and successful techniques for the fields of both water as well as wastewater treatments [Fane, A. G., et.al, (2015)]. Water can flow through a membrane that is particularly permeable, however solute ions or molecules cannot. In contrast to reverse osmosis (RO), which depends upon exterior pressure to work, forward osmosis (FO) primarily fueled by the difference in osmotic pressure along a semi permeable membrane [Lu, P., et.al, (2015)]. In numerous applications, including desalination, energy production, food manufacturing, water treatment, etc., FO as a novel membrane separation technique is at the present acquired more emphasis.

With a number of benefits over the current membrane techniques, FO has recently emerged as a viable membrane technique for water treatment. Low power usage, minimal fouling, and suitability for a variety of feed systems are some of these benefits. The FO technique also has the capacity to combine strong draw solutions with a lower feed osmotic pressure of solutions. The FO method is thus potentially useful for treating a variety of water and effluents [Akther, N., et.al, (2015)].

The FO method has certain disadvantages alongside its strengths, such as reverse solute flux (RSF), concentration polarization (CP), as well as limited permeability. Additionally, when treating complicated input supplies or when the preprocessing procedure is inadequate to deliver a high-quality input solutions to the FO method, fouling elements can accumulate on the membrane surfaces [Mondal, S., et.al, (2017)]. The use of carbon-based nano-materials and metal oxide nano-particles for this reason is widespread. The importance of graphene oxide derivative (hydrophilic additions) among all carbon-based nano-materials is rising because they may alter the process of membrane development to improve the membranes' selection, functionality, and production. As a result, carbon additions have been employed in the manufacturing of polymeric membranes to enhance their properties, like low flux, fouling, as well as weak mechanical and chemical FO membrane stability [Liu, Q., et.al, (2016)].

1.1 Research Statement

A major threat to human life has been posed by the global water catastrophe in respect of (1) inadequate access to clean water, (2) deteriorating water quality, and (3) the havoc caused by water-transmitted illnesses. The investigation of alternate techniques to the established techniques to produce high-quality water has received interest on a global scale. Applying nanotechnology to enhance the functionality of the FO membrane is one potential key to the disadvantages in FO. Additionally, nano-particles aid in overcoming the issues of poor mechanical resilience, limited water permeability, and susceptibility for fouling. Utilizing nano-materials improves permeability and reduces the CP phenomena. It is feasible to identify and address environmental issues due to the special and controlled features of carbon-based nano-materials. Conductive FO membranes have lately received a lot of interest. Whenever treating input fluids with chargeable foulants, the FO membrane surface energy is a crucial factor to take into account. In conducting FO membranes, the electrode is embedded using a conductor with dispensing capabilities, such as carbon nanotubes (CNTs), which are incorporated into the membrane substrate's substance. The membrane is then subjected to an exterior electric field while filtration, which causes electrostatic repulsion among the foulants containing charge as well as the membrane surface, successfully minimizing membrane fouling.

1.2 Research Objective

This investigation aims to study the about carbon based nano-materials for water treatment with the objectives

- To develop multi wall-CNTs-coated FO membranes (PES-multi wall-CNTs) by depositing PDA-altered multi wall-CNTs onto PES MF membranes and to study its performance through FO process
- To study the physio-chemical characteristics of membrane like morphology, Z-potential, pore size etc.
- To compare the performance of membrane of this study with previously reported studies in FO and UF process.

2. REVIEW OF LITERATURE

According to LI, Y. D., et.al, (2017) CNTs demonstrated higher potential in the membrane separation sector than other nanomaterials utilized for FO due of their unique transmission characteristics and 1-D nanostructure. Furthermore, CNTs exhibit features such as mechanical and chemical stability, inoxidizability, chlorine resilience, and antibacterial activity. As a result, CNTs are widely used to improve the effectiveness of the FO membrane by incorporating them into the substrates or the active layers of the membranes.

The research by Park, M. J., et.al, (2015) demonstrated that freshly manufactured FO membranes of TFC with a graphene oxide (GO)-altered supporting layer. The outcomes show that a PSf/GO composite supporting layer exhibiting desirable structural properties assessed in regards of pore size, thickness, and porosity may be obtained at an appropriate level of GO additions (0.25 wt%). Underneath the active layer towards the feed solution, a TFC-FO membrane exhibiting high water flux and reversal flux selection was achieved.

The study of Qin, D., et.al, (2015) employed GO in the supporting layer to drastically reduce ICP by 20% by decreasing the structural parameters of the FO membrane. When tested with simulated shale gas effluent, the resultant FO membrane displayed higher than 3 times greater water flow, better elimination for salts and oils (>99.7% multivalent ions, as well as > 99.9% oil), and much decreased fouling propensity when comparing to market FO membranes.

Through using phase inversion (PI) and interfacial polymerization (IP), Choi, H. G., et.al, (2015) produced a hybrid matrix TFC membranes comprising a functionalized CNT coupled with a polyethersulfone (PES) supporting layer. For the purposes of desalinating saltwater and wastewater, the membrane was examined. The increased membrane hydrophilicity, which was shown as a 72% increase in water flow, was responsible. Although the TFC hybrid matrix membrane had lower water flow than the TFC commercial utilized membrane, it had higher backward salt flux selection than the TFC industrially utilized membrane (4% larger) as well as TFC membrane (15% more), indicating the membrane's perm selection. The TFC hybrid matrix membranes had a 16% lower normalized flow decrease than the TFC membrane throughout the assessment for effluent organic material fouling. Since the enhancement in the repellent membrane-foulant interactions caused by the negatively charged surface of the membrane, there was an 8% lower decrease of the thin composite blended matrix membrane relative to the TFC industrially utilized membrane. TFC hybrid matrix membrane shown enhanced normalized flow compared to the TFC membrane (6%), as well as the industrially available TFC membrane (4%), after mechanical washing for 10 minutes. The study demonstrated the use of TFC hybrid matrix membrane for the inaugural time in water restoration and water treatment.

3. MATERIALS AND METHOD

3.1 Draw and Feed Solutions

The feed solution (FS), ultrapure water exhibiting a resistance of 18.2 MΩ-cm, was produced using a Millipore water purifying unit. Poly-(sodium 4-styrene-sulfonate) (PSS) was employed primarily as draw solution (DS). The PSS aqueous solution's content ranged from 0.25 to 1.00 weight percent.

3.2 Preparation and Characterization of Membrane

Vacuum filtration was used to synthesize PES- multi wall CNTs membranes, as shown in Fig. 1. In further specifics, the provided MWCNTs were homogeneously distributed in water before being changed with PDA in accordance with the described technique. Vacuum filtration was used to transfer the PDA-altered MWCNTs suspensions to the PES MF membrane's upper surface. The PES- multi wall CNTs membrane was produced following at minimum 30 minutes of drying at 50°C in an oven.

By using field-emission SEM using an accelerating voltage of 10 kV, the morphology characterization of these produced PES- multiwall CNTs membranes were examined. AFM in tapping mode and environmental conditions was used to scan the topographical membrane surface. By using KCl (1m mol/L) as the electrolyte and electro-kinetic analysis software operating at 0.4 MPa, the Zeta (Z)-potential surface membrane was determined. The (Z)-potential surface membrane pH dependence was then determined by titrating the electrolyte's pH with either HCl or NaOH solutions. A capillary stream porometer was used to determine the size as well as distribution of pores membrane.

3.3 Experimental Design

The cross-flow cell membranes contain 2 rectangle flow paths on either side, each with a length × width × depth of 20 × 20 × 1 mm. At the similar cross-flow velocity, the FS as well as DS have been re-circulated in a co-current state. Pressure devices were used to keep an eye on the functioning pressures on the DS as well as FS sides to make sure that it was the same across the membrane. The FS as well as DS were maintained at a steady temperature of 25°C (temperature modification: 0.5 < °C) using a magnetic stirrer as well as temperature regulation apparatus. An electronic scale connected to a computer was used to capture the FS tank's time-dependent weight shifts, which were then normalized to determine the water flow (J_w). A UV-vis spectrometer was used to examine the PSS level in the FS to calculate the backward solute flow (J_s). A Nanosize and Z-potential Analyzer was used to analyze the PSS z-potential, Dextran, and Polyethyleneimine (PEI). Utilizing a pH metre, the PSS pH, Dextran, as well as PEI has been measured.

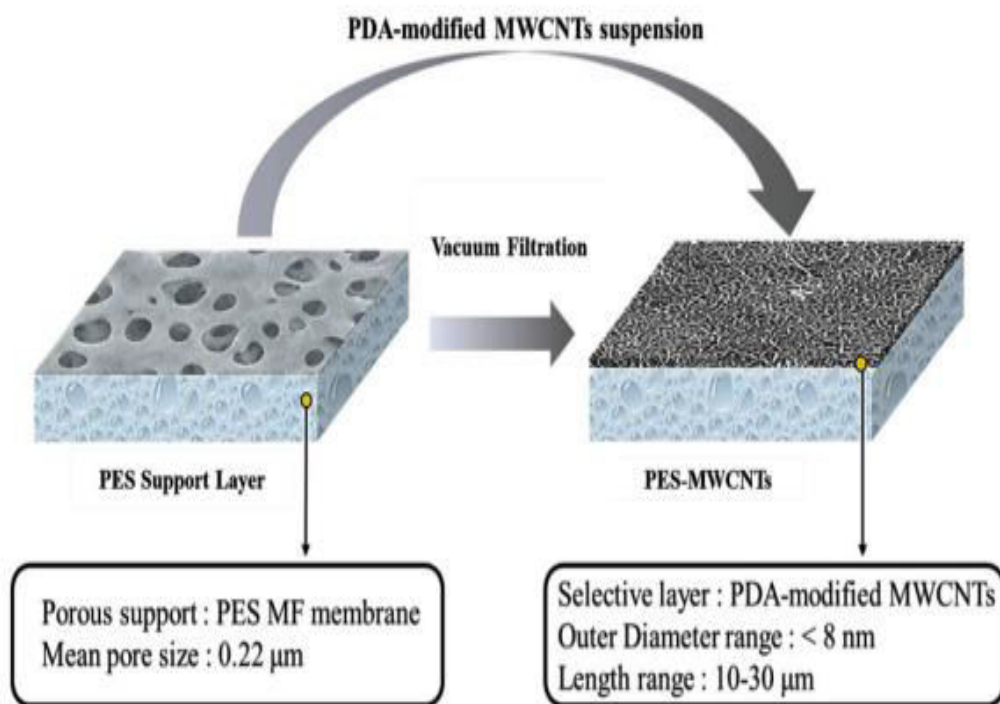


Figure 1: Illustration of the quick manufacturing of PES- multi wall CNT membranes using vacuum filtering to deposit PDA-altered multi wall CNTs onto the PES MF membrane upper surface.

4. RESULT AND DISCUSSION

4.1 Characterization of PES- Multi Wall CNT Membrane

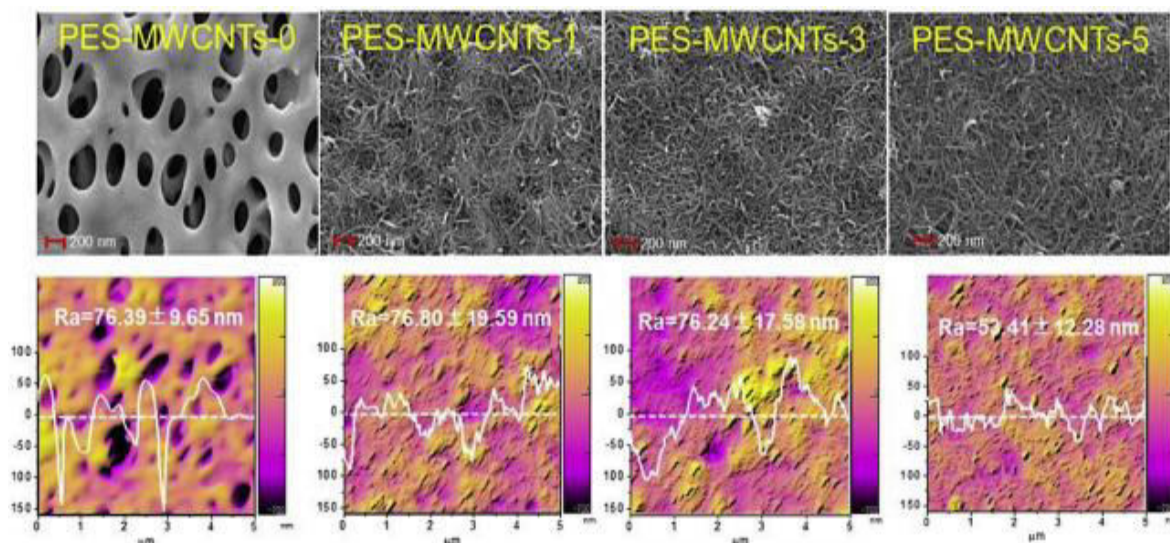


Figure 2: Images of PES-multi wall-CNT membranes with varying PDA-altered multi wall-CNT loading levels taken using a SEM (above) as well as an AFM (bottom). It should be emphasized that PES-multi wall-CNTs-0, 1, 3, 5 refers to the proportion of multi wall-CNTs suspensions that is loaded onto the PES membrane, ranging from 0, 1, 3, to 5 mL.

Figure 2 depicts the PES- Multi Wall CNTs membrane morphologies for various PDA-altered multi wall CNTs depositions. It is clear that multi wall CNTs eventually filled in the PES MF membrane's initial macro pores, and that this process resulted in the ultimate surface membrane exhibiting the multi wall CNTs' network-like nano-fibrous shape. Multi wall CNTs had a tendency to curl and created a loose shape upon the PES MF surface membrane as opposed to the "stiff stick" single-wall CNTs morphology that were placed there. The PES- multi wall CNTs-1, and 3 membranes rough surface varied slightly, but significantly decreased to 53 nm for the PES- multi wall CNTs-5 membranes as the accumulation quantity of PDA-altered multi wall CNTs suspension grew from 1 mL to 5 mL. The multi wall CNTs density loaded also risen in linear fashion on PES MF surface membrane from $0.97 \pm 0.12 \mu\text{g}/\text{cm}^2$ to $4.85 \pm 0.82 \mu\text{g}/\text{cm}^2$. This is due to the PDA-altered multi wall CNTs covering the PES MF surface membrane in varying degrees. Since the PES MF micro pores membrane were not completely coated by the PDA-altered multi wall CNTs and have been nevertheless noticeable from their respective SEM and AFM figure 2, the PES- multi wall CNTs-1 and 3 surface roughness membranes was extremely near compared to the pristine PES membrane with quite multi wall CNTs load capacity.

Table 1: Varied loading rates of PDA-modified multi wall CNTs result in diverse multi wall-CNTs loading densities, pure water fluxes, and PSS denial of PES- multi wall CNTs membranes.

PES-Multi Wall CNT Samples	Water Flux (\pm LMH/bar)	PES-Multi Wall CNTs Loading (\pm $\mu\text{g}/\text{cm}^2$)	PSS Denial (\pm %)
0	8201 \pm 62	0	5.12 \pm 0.28
1	2021 \pm 163	0.97 \pm 0.12	87.73 \pm 0.90
3	1926 \pm 91	2.92 \pm 0.56	90.49 \pm 1.27
5	1768 \pm 35	4.85 \pm 0.82	92.45 \pm 1.19

Table 1 shows that after multi wall-CNTs-1 deposition, the PES-multi wall CNTs membranes' water flux and PSS denial significantly fell from 8201 to 2021 LMH/bar and climbed abruptly from 5.12 to 87.73%, respectively. The water flux decreased furthermore to 1768 LMH/bar when the multi wall-CNTs deposition density grew from 0.97 to 4.85 g/cm^2 (PES-multi wall CNTs-1 to 5), and the PSS denial rose to 92.45%. The PES-multi wall CNTs water flux membrane reduces steadily as the multi wall CNTs loading density raises; however the PSS denial rises quickly. This occurs as a result of the layer's flexible nano-fibers network structure makes it possible for the PES-multi wall CNTs membranes to have outstanding perm selectivity.

Table 2: Z-potential and pH of dextran, PSS, and PEI in water

Nanomaterials	Concentration (Weight %)	Z-potential (\pm mV)	pH
Dextran	0.2	-0.5 ± 0.2	5.96
PSS	0.1	-23.9 ± 2.1	6.06
PEI	0.02	18.8 ± 0.4	9.22

As shown in Table 2, PEI has been chosen as a regulate molecule with a comparable molecular weight to PSS however a positive charge, as well as the PEI denial was evaluated utilizing the PES-MWCNTs-3 membrane in order to examine the Donnan effect contribution to the PES- multi wall CNTs membrane segregation performance.

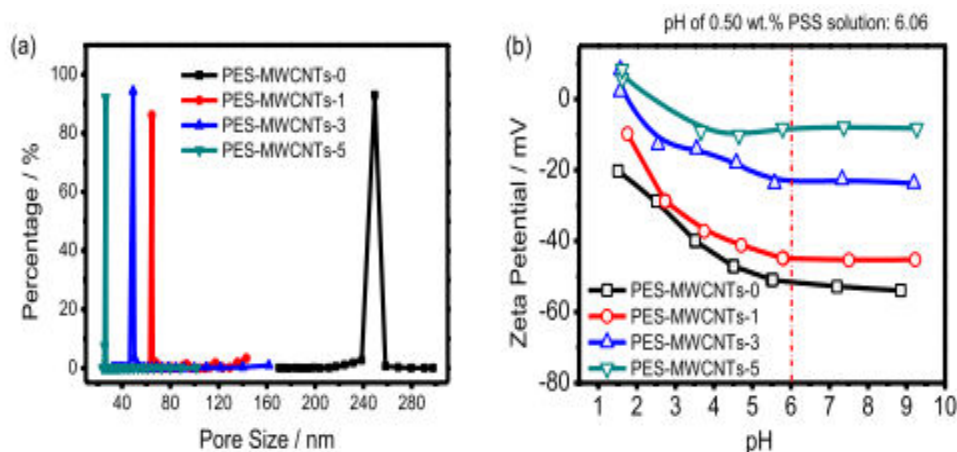


Figure 3: Graphs of PES-multi wall CNTs membranes distribution of pore size and Z-potential with various PDA-modified multi wall-CNT loading quantities

The PES- multi wall CNTs-3 membrane was able to deny 81.17% of PEI during the UF procedure, which is less than the 90.49% denial of PSS (-23.9 mV), according to the findings. This is due to the negative charges of PES- multi wall CNTs-3 surface membrane exhibiting a Z-potential of approximately -23 mV with in pH range (>5.5), as seen in Figure. 3b. These findings show that a larger denial was caused by electrostatic repulsion than attraction involving the solute and surface membrane. Neutral dextran, also used to test membrane denial, had a large 100 kDa molecular weight, but its denial incidence was just 25.93%, significantly lower than that of PSS as well as PEI. These findings demonstrate how the electrostatic contact affects the PES-multi wall CNT membrane's ability to separate charged solutes. Consequently, the Donnan phenomenon had an impact on how the negative charges of PES- multi wall CNTs membrane separated from the similarly negative charges of PSS. The PES- multi wall CNTs membrane's separation process, nevertheless, heavily relied on size exclusion. For instance, while having a far greater negative charge compared to the PES- multi wall CNTs membrane, the pure PES membrane can just block 5.12% of PSS due to its huge pore size. Thus, the Donnan phenomenon and size exclusion play a major role in controlling how the PES- multi wall CNTs membrane separates from the solutes negative charge.

4.2 Comparative Investigation of Porous FO Membranes' Functionality

Table 3: Functionality evaluation of FO membranes with multi wall-CNT coating and Ultra filtration (UF)-based porous membranes.

Membranes	Orientation of membrane	Water Flux	Reverse solution flux	Reference
UF-based PAN	AL-FS	Not mentioned	19.8	Qi, S., et.al, (2015) and Qi, S., et.al, (2016)
UF-based PES	AL-DS AL-FS	0.51 0.47	15.7 13.8	Yang, Y., et.al, (2018)
TFC	AL-FS	0.006	18.0	Yang, Y., et.al, (2017)
CTA	AL-FS	-0.09	-11.0	Hamad, M. J., and Chirwa, E. M. (2019)
PES-Multi Wall-CNT-3	AL-DS AL-FS	0.18 0.14	33.3 31.2	This investigation finding.

Table 3 compares this study's PES-multi wall-CNTs FO fabricated membrane's fluxes and reverse solution fluxes to those of previously published UF and dense active material (TFC as well as CTA) FO membranes made using analogous FO method circumstances. Additionally, the functionality of the TFC as well as CTA FO membranes utilizing additional poly electrolytes acting as DS was evaluated. Irrespective of the orientation of membrane, this manufactured PES-multi wall-CNTs FO membrane manifested a unique growing water flux as well as a significantly reduced reverse solute flux in comparison to the UF-based FO membranes. While utilizing PSS 0.50 wt% as a DS, the PES-multi wall-CNTs FO membrane water flux reached 31.20 LMH, 1.58 fold that of the UF-based FO membranes. Additionally, the flux of reverse solution was 0.14, which is 70.21% less than the previously documented UF-based FO membranes. Because of the compact polyamide surface of TFC membranes possessing a huge water transit resistance and the limited osmotic force of macromolecule poly-electrolytes supplying an extremely tiny driving factor, the broadly utilized TFC FO membranes also seemed to have an extremely poor water flux of approximately 3 LMH utilizing the relatively similar DS (PSS, 0.50 wt%). In order to accomplish the strong perm-selectivity as well as highly efficient of the FO system, there is an ideal fit among the FO membranes pore size as well as the DS size. As a result, while employing polyelectrolyte solutions as DS, PES-MWCNTs membranes may be employed as a very effective FO procedure to handle FS solutions that include macromolecules or particulates.

5. CONCLUSION

In this study, we investigated PES- multi wall CNT FO membranes for water treatment by depositing PDA-altered multi wall-CNTs on the PES MF surface membrane. We then assessed how well these membranes performed throughout the FO operation. The findings demonstrate that the PES-multi wall CNTs membrane's physical characteristics, such as the mean pore size, surface quality, and z-potential, as well as its separation abilities, such as PSS denial and water flux, may be readily customized by varying the multi wall-CNTs loading's. Under a 2.92 g/cm² multi wall-CNT loading, the PES-multi wall-CNTs-3 membrane had the best perm-selectivity as well as had the maximum J_w/J_s in the AL-FS and AL-DS phases. The PES-multi wall-CNTs-3 membranes water flux was 31.20 LMH, much greater than the stated estimates when contrasted to typical UF-like FO membranes (beneath 20 LMH).

While utilizing 0.50 wt% of PSS as a DS, the backward solute flow was 0.14 mmol MH, significantly less than the previously published figure of 0.47 mmol MH. Size extrusion as well as electrostatic force of repulsion was found to control the separation process of PES- multi wall- CNTs membranes for PSS. In the FO method for the treatment of water, the PES-multi wall-CNTs-3 membrane demonstrated a strong and constant water flux, however when utilized in the UF method, the flux rapidly decreased. All of the findings emphasis the better benefits of the porous composite membrane made of multi wall-CNTs, which has a reduced propensity for fouling when employed in the FO method for the treatment of water.

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Identification, Isolation, and Stability Behaviour Studies of Unknown Impurities in Cefpodoxime Proxetil API by HPLC and Mass Spectrometer

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ABSTRACT

Impurities are unwanted substances found in drug substances and drug products that have no therapeutic value. Identification and stability behavior study of unknown impurities and Cefpodoximeproxetil API performed by HPLC and LC-MS/MS. After forced degradation, two major unknown impurities observed in at RRT 1.49 and 1.58 with respect to CefpodoximeproxetilR epimer in HPLC method. From HPLC analysis it is proven that both impurities were converted back to Cefpodoximeproxetil R and Cefpodoximeproxetil S, respectively. A chromatographic method with C18 column, ammonium acetate in water and acetonitrile as the mobile phase with gradient elution in UV at 260 nm has been developed. Mass spectrometric studies of impurities conducted in ESI mode. The molecular weight of Cefpodoximeproxetil R, Cefpodoximeproxetil S and both impurities found at 558[M+H]⁺ and the major fragments found 410 [M+H]⁺. With the help of mass spectra and MS/MS fragmentation, the structure of impurities elucidated and it confirmed that the impurities formed from the drug substance. From this study, it confirmed that the both impurities are rotamer of the respective Cefpodoximeproxetilepimer. This study and its findings will aid in ensuring the quality and safety of Cefpodoximeproxetiluse.

Keywords: Impurities, Drug Substances, Drug Products, Chromatography, Structural Elucidation, MS/MS.

1. INTRODUCTION

Cefpodoxime proxetil is a third-generation cephalosporin antibacterial drug substance used in the treatment of infections due to susceptible Gram-positive and Gram-negative bacteria, including infections of the respiratory and urinary tracts, skin and skin structure, and gonorrhea. Every year may people affected to these disease worldwide. In long term storage of the drug substance or drug product may leads to generate these impurities. So the study of forced degradation behavior is very important. Cefpodoximeproxetil is given orally as the proxetil ester, which is hydrolyzed on absorption to cefpodoxime. In clinical trials, cefpodoximewas similar in both clinical and bacteriologic efficacies to amoxicillin, cefaclor, amoxicillin/clavulanate, and penicillin in the treatment of respiratory and urinary tract infections. It also appeared effective in the treatment of skin and soft tissue infections, although no comparative trials have been performed. It has a similar adverse effect profile to that of other penicillins and cephalosporins, with gastrointestinal effects being the most common¹.

Forced degradation is a process that involves degradation of drug products and drug substances at conditions more severe than accelerated conditions and thus generates degradation products that can be studied to determine the stability of the molecule. Forced degradation is an essential study that provides the knowledge and judgement necessary to develop a stability-indicating analytical method. This study also helps to establish the specifications and shelf life of a drug substance or drug product². Few analytical methods for identifying impurities and degradation products of drug substances and drug products have been developed^{3,4} and compared⁵. Fukutsu et al identified three degradation products of Cefpodoximeproxetil using high-performance liquid chromatography (hyphenated techniques)⁶. As per the ICH guidelines Q3A (R2) requirement all impurities (from processing and degradation) to be identified above the specification limit⁷. Till the date, literature for identification of these impurities is not available. As this medicine used for the treatment of bacterial infection worldwide and generation of unknown impurities may cause serious side effects on human beings. Hence, for identification of these impurities a sensitive, specific, robust and accurate method required. To consider these things, concentration is given to identifying unknown Cefpodoximeproxetil degradation impurities using chromatographic systems HPLC with diode array detection (LC-DAD), mass spectrometer (MS), and mass fragmentation mechanisms of cephalosporins^{8, 9,10}, and related synthesis processes^{11, 12}. In the current study, we have performed forced degradation and mass analysis with a robust, sensitive and specific method.

2. MATERIALS AND METHOD

2.1 Reagents and Samples

HPLC-grade acetonitrile purchased from Thermo Fisher Scientific (Fair Lawn, NJ). A Milli-Q water purification system (Millipore, Billerica, MA) used for water Cefpodoximeproxetil (API) Covalent laboratories

private limited, India with purity 71.50 %. Cefpodoximeproxetil standard of Covalent laboratories private limited, India with purity 71.50%

2.2 Preparation of Reference Standard and Sample Solutions

Preparation of reference solution: Transfer about accurately weighed 50 mg of Cefpodoximeproxetil reference standard in to 50 mL volumetric flask, dissolved in 5 ml methanol, sonicated, dilute the solution with Water: Acetonitrile (2:1 v/v) up to the mark. The solution injected freshly.

Sample solutions preparation: Transfer about accurately weighed 50 mg of Cefpodoximeproxetil API in to 50 mL volumetric flask, dissolved in 5 ml methanol, sonicated, dilute the solution with Water: Acetonitrile (2:1 v/v). up to the mark. The solution injected freshly.

2.3 Instrumentation

The MS/MS system API 3200 of (Applied Biosystem Inc., California), controlled by Analyst® software used for fragmentation of Cefpodoximeproxetil and Impurities. HPLC consist of a Dionex Ultimate 3000 quartnary pump, a Dionex Ultimate 3000 column compartment, Dionex Ultimate 3000 autosampler, a DDA detector (Thermo Fisher Scientific Inc., Waltham, MA).

2.4 Forced Degradation condition

Transfer about accurately weighed 50 mg of Cefpodoximeproxetil API in to 50 mL volumetric flask, dissolved in 5 ml methanol sonicated to dissolve properly, add 15ml Water: Acetonitrile (2:1 v/v) kept at 60°C in water bath for 90 minutes.

2.5 Chromatographic Conditions

The analysis carried out on a Kromasil 100-5 C18 column (4.6 mm×150 mm, 5 µm-particle diameter). Mobile phase A contained 10mM Ammonium Acetate in Milli-Q water. Mobile phase B contained Acetonitrile 100%. UV detection was at 260 nm, the flow rate kept at 2.0 mL/min. Column oven temperature was 30 °C, and the run time was 110min. Mobile phase gradient program was as follows, time (min)/A (v/v):B (v/v); T0.00/90:10, T10.0/68:32, T40.0/68:32, T80.0/50:50, T85.0/50:50, and T90.0/25:75, T95.0/25:75, T100.0/90:10, T110.0/90:10.

2.6 Mass Spectrometry

The MS study performed by using electrospray ionization (ESI) positive ionization mode, decluster potential (DP) 10 V, entrance potential (EP) 10 V, collision energy (CE) 30 V, the curtain gas: 20.0 L/h, ion source gas 1: 50.0 L/h, ion source gas 2: 40.0 L/h, ion spray voltage (IS): 5500 V, temperature (TEM): 500.0 °C. MS fragmentation of Cefpodoximeproxetil and impurities carried out using Mass range acquired from m/z 100 to m/z 1000 in 0.1 amu steps with dwell time of 2.0 s. Analyst software (version 1.5.1) was used for data acquisition and processing. Molecular weights of all components were determined by use of protonated molecular ions ($[M+H]^+$) and were confirmed using minor adduct ions of $[M+Na]^+$ and $[M+K]^+$ peaks.

3. RESULTS AND DISCUSSION

3.1 Impurity Analysis by HPLC

Thermal degradation of Cefpodoximeproxetil API performed at 60°C in water bath for 90 minutes analyzed using the HPLC-DAD. Two significant impurity peaks detected at RRT 1.49 and 1.58. Typical chromatograms of Cefpodoximeproxetil API heated at 60°C in water bath for 90 minutes is shown in Figure 1.

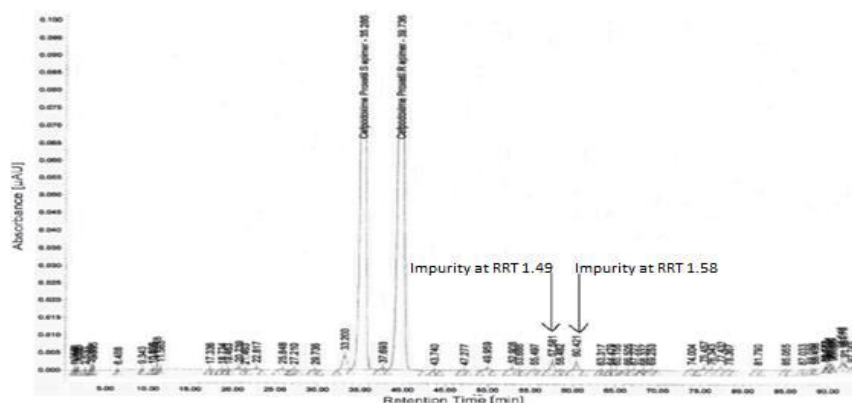


Figure 1. Typical chromatograms of Cefpodoximeproxetil API heated at 60°C in water bath for 90 minutes.

3.2 Mass Fragmentation Pattern of Cefpodoximeproxetiland Impurities

Understanding of Cefpodoximeproxetil fragmentation pattern can help to identify impurity structures^{13, 14}. Fraction of cefpodoximeproxetil and impurity peaks collected from the HPLC run and analyzed in positive ion mode by the mass spectrometer in ESI mode. The molecular weight of Cefpodoximeproxetil R and Cefpodoximeproxetil S found at 558[M+H]⁺ and the major fragments found 410 [M+H]⁺. The molecular weight of impurity at RRT 1.49 and RRT 1.58 found at 558[M+H]⁺ and the major fragments found 410 [M+H]⁺. Mass spectra and fragments of Cefpodoximeproxetil and impurities shown in Figure 2a–f.

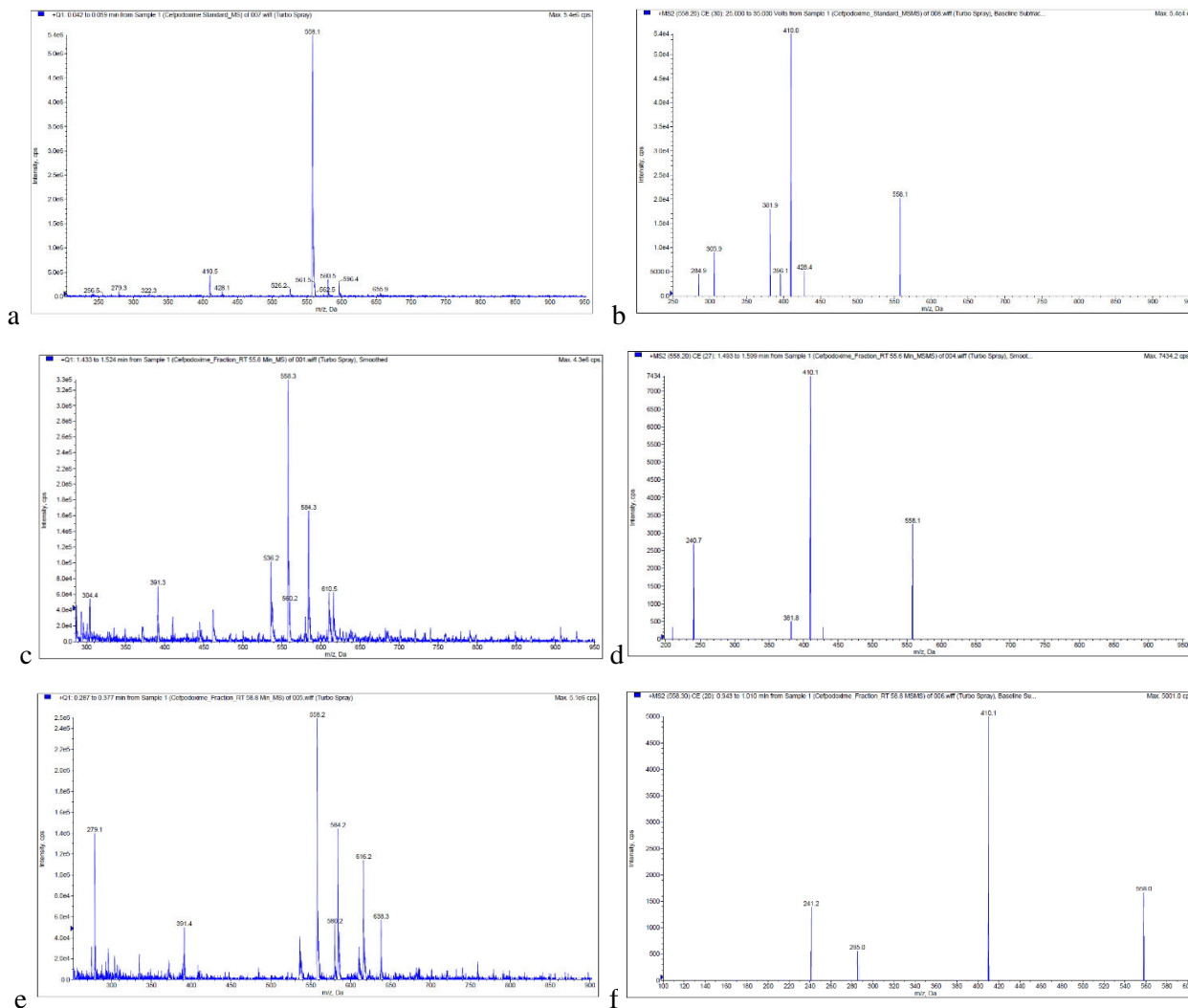


Figure 2. Mass spectra and their respective mass fragmentation of Cefpodoximeproxetil and Impurities (a: Cefpodoximeproxetil MS1 ; b: Cefpodoximeproxetil MS2; c: Impurity at 55.6 minute (RRT 1.49) MS1; d: Impurity at 55.6 minute (RRT 1.49) MS2; e: Impurity at 58.8 minute (RRT 1.58) MS1 and f: Impurity at 58.8 minute (RRT 1.58) MS2:]

3.3. Study of Stability Behavior of Impurities by HPLC

To further investigate the stability and nature of these impurities, the isolated peaks injected over a period into HPLC, and peak behavior monitored at 8°C.

- 1) These impurities discovered to be unstable in isolated solution form, converting back to their respective Cefpodoximeproxetil.
- 2) The impurity at RRT 1.49 converts back to Cefpodoximeproxetil S-epimer, and the impurity at RRT 1.58 converts back to Cefpodoximeproxetil R-epimer.

Table 1: HPLC data of Impurity -1 (RT 56.6 minutes) in Cefpodoximeproxetil.

Time	Impurity -1 (peak area)	Cefpodoximeproxetil S-epimer (Peak area)
Initial	141200	18405
4 Hours	116931	49646

8 Hours	95862	72150
12 Hours	79184	90446
16 Hours	65354	106246
20 Hours	53797	118457
24 Hours	45448	126554
28 Hours	37567	134730
32 Hours	31488	141958
36 Hours	26652	147953
40 Hours	21201	144353

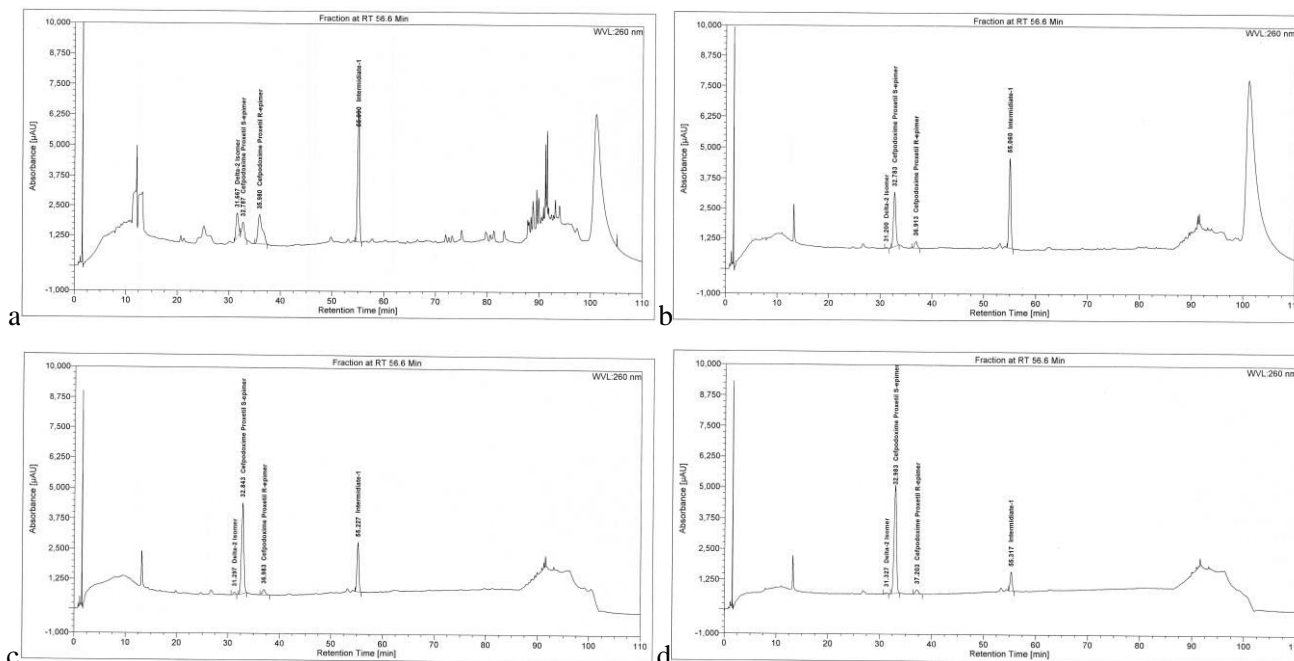
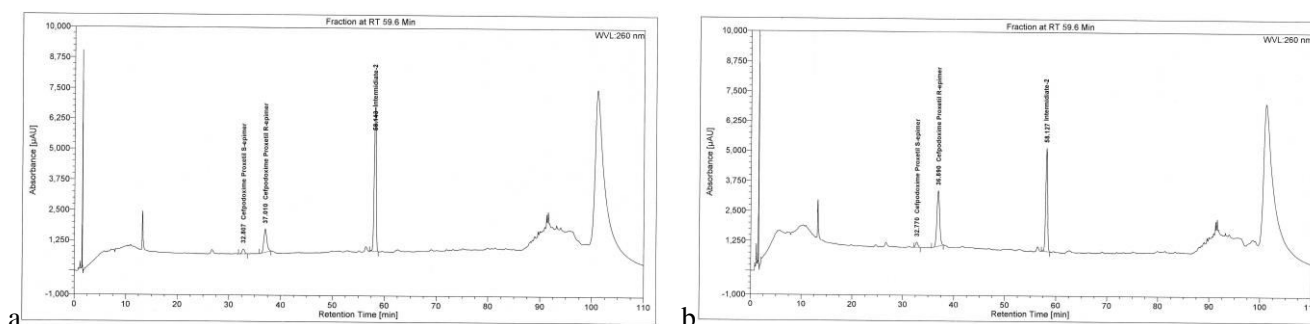


Figure 3. HPLC Chromatograms of impurity 1 of Cefpodoximeproxetil (a: Impurity 1 Initial ; b: Impurity 1 after 8 hrs; c: Impurity 1 after 20 hrs; d: Impurity 1 after 4

Table 2: HPLC data of impurity-2 (RT 59.6 minutes)in Cefpodoximeproxetil.

Time	Impurity -2 (peak area)	Cefpodoximeproxetil R-epimer (peak area)
Initial	152060	37984
4 Hours	126486	62863
8 Hours	105917	85517
12 Hours	90640	102625
16 Hours	75295	120368
20 Hours	62234	130399
24 Hours	53248	140998
28 Hours	47366	149978
32 Hours	40482	158635
36 Hours	23814	112174



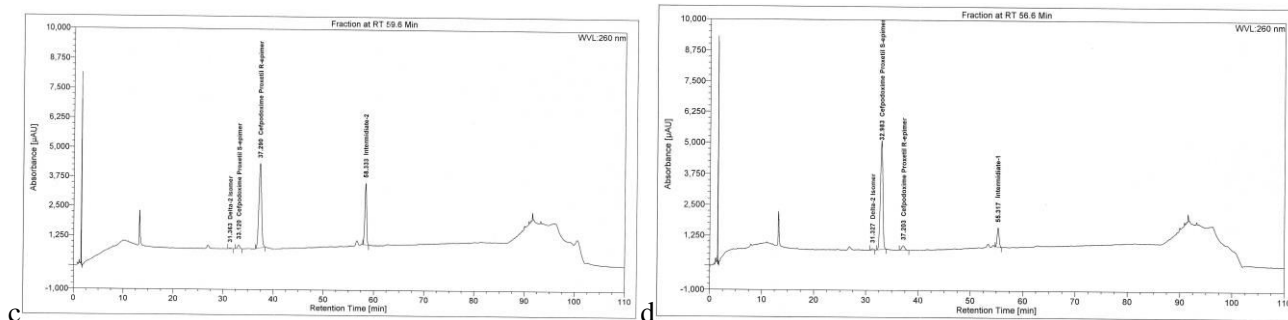


Figure 4. HPLC Chromatograms of impurity 2 of Cefpodoximeproxetil (a: Impurity 2 Initial ; b: Impurity 2 after 8 hrs; c: Impurity 2 after 20 hrs; d: Impurity 2 after 40 hrs).

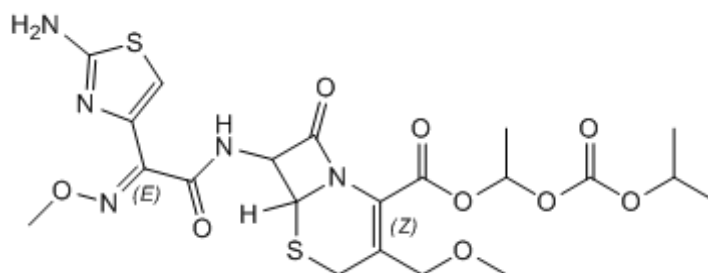
Estimation of Potential Isomerismbehavior of the impurities:

Cefpodoximeproxetil has three chiral centers and it is a mixture of R- epimer (RRR) andS- epimer (RRS). As per the route of synthesis of the API it is being prepared from D-7-ACA and two chiral centers of D-7-ACA (6R,7R)remain intact until end of the synthesis. Incorporation of side chain[(isoproxycarbonyloxy)ethyl] through Racemic mixture, not only added one morechiral center but also leads to mixture of two epimers in CefpodoximeProxetil.

In theforced degradation study ofCefpodoximeproxetiltwo new peaks are observed in HPLC and LC-MS method. The molecular mass of the Cefpodoximeproxetil and its both impurities are found same i.e. 558.1 $[M+H]^+$.Based on the LC-MS and conversion study, it is evident that the impurities 1 and 2 are rotamer of Cefpodoximeproxetil and its isomer moreover they are interconvertible.

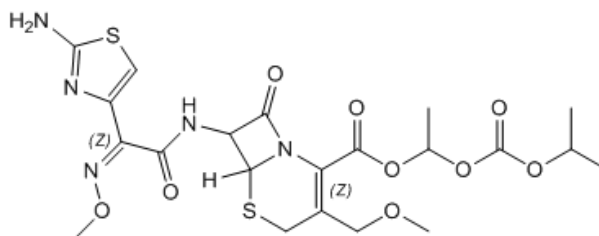
Impurities Structure

Cefpodoxime Proxetil



And its isomer

Rotamers (Anti isomer)



And its isomer

Since these impurities are interconvertible and are in equilibrium with Cefpodoximeproxetil. Hence, it can't be further isolated in its solid form due to its unstable nature for any further characterization.

4. CONCLUSION

The impurity identified with the help of highly sophisticated instrument HPLC and LC-MS/MS. After forced degradation,two major unknown impurities observed in at RRT 1.49 and 1.58 with respect to CefpodoximeproxetilR epimer in HPLC method. From HPLC analysis, it proven that both impurities converted

back to Cefpodoximeproxetil R and Cefpodoximeproxetil S, respectively. The molecular weight of Cefpodoximeproxetil R, Cefpodoximeproxetil S and both impurities found at 558[M+H]⁺ and the major fragments found 410 [M+H]⁺ with the help of mass spectra and MS/MS fragmentation. The structure of impurities elucidated and it confirmed that the impurities formed from the drug substance. From this study, it confirmed that the both impurities are rotamer of the respective Cefpodoximeproxetil epimer. This study and its outcome will aid in ensuring the quality and safety of Cefpodoximeproxetil use and will guide scientists for safety and efficacy studies of drug substance and drug product.

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Implementation of Forest Rights in PESA Area of Maharashtra

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ABSTRACT

This paper investigates the provisions of FRA enactments and its implementation in Maharashtra. Tribal customary rights, community rights, ownership of land, cultural activities and their livelihood are discussed. Implementation of education, sanitation, livelihood, housing, compensation policies are discussed. Prevention of deforestation against the consent of villagers is pointed out. To provide speedy settlement of claims, right to hearing, allotment of alternate land, transportation and marketplace for selling minor forest produce, etc. are considered.

Keywords: Community, compensation, deforestation, minor forest produce, traditional, tribal land.

INTRODUCTION

Maharashtra is the third largest State by area and second most populated. Konkan coastal area and Deccan plateau by Sahyadri range of Western Ghat, Satpura hills and Bhamragad-Chiroli-Gaikhuri ranges are divided the forest lands amongst 36 administrative districts throughout the State of Maharashtra. Mainly, the forest areas are located at Western Ghats, Satpura hills and Gondwana regions. Total population of Tribal is nine percent.

To provide speedy settlement claims, customary and traditional rights, livelihood, housing and education and other essential services to the tribal, etc., the Parliament has enacted the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007) (for short "Forest Rights Act") and the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Rules, 2007 made thereunder by the Ministry of Tribal Affairs, Government of India, so as "to recognise and vest the forest rights and occupation in forest land in forest dwelling Scheduled Tribes and other traditional forest dwellers who have been residing in such forest for generations but whose rights could not be recorded and also to provide for a framework for recording the forest rights so vested and the nature of evidence required for such recognition and vesting in respect of forest land".

Constitutional Provisions

Directive Principles obligate the State to take certain directions to promote the welfare of the people and achieve economic democracy as well as give directions to the Legislature and Executive to exercise their power. In the Constituent Assembly, "Dr. Ambedkar had said that a party which failed to implement these principles would stand to lose in the next elections." As a part of such Directive Principles, Art. 40 of the Constitution of India provides that the State shall take steps to organise village panchayats and endow them with such powers and authority as may be necessary to enable them to function as units of self-government. "The expression 'village' connotes ordinarily an area occupied by a body of men mainly dependant upon agriculture or occupation subservient thereto". Article 40 of the Constitution requires the State to take steps to organise village panchayats and to confer on them powers and authority as may be necessary to enable them to function as units of self-government. Article 40 does not give guidelines for organising village panchayats. The village panchayats however organised have to be equipped with such powers and authority as may be necessary to enable them to function as units of self-government.

To provide effective legal instruments so that to develop and uplift the tribal, the Government of India had appointed a number of Committees to survey thoroughly. Amongst them the Balwant Rai Mehta Committee was appointed in January 1957, and the said Committee has recommended to establish the scheme of 'democratic decentralisation', which ultimately came to be known as Panchayat Raj. subsequently, the National Development Council in January 1958 Ashok Mehta Committee, G V K Rao Committee, L M Singhvi Committee, Thungon Committee and Gadgil Committee, appointed, time to time. The Rajiv Gandhi Government introduced the 64th Constitutional Amendment Bill in Lok Sabha in July 1989 but Rajya Sabha was not approved. Then V P Singh Government introduced the Bill in Lok Sabha in September 1990, but it lapsed. Thereafter, Narasimha Rao Government introduced it in Lok Sabha in September 1991 and finally it was passed as the 73rd Constitutional Amendment Act, 1992, which come into force on the 24th April 1993.

To give effect to the said Article 40, the Parliament has enacted the Constitution (Seventy-third Amendment) Act, 1992, after ratification by the State Legislatures as required by Art. 368 and by that amendment, a new Part

IX has been added to the Constitution consisting of Arts. 243 to 243-O as well as Eleventh Schedule have also been added thereof. The said 73rd Amendment has introduced a panchayat system at the grass roots level. Such a panchayat system had been based on State Legislation so as to strengthen the panchayat system up to grass root level by giving it a constitutional base.

To facilitate the safety of the interest of the vast tribal population in India, a high level committee was constituted under the chairmanship of Shri Dileep Singh Bhuria, Member of Parliament, in June 1994 and the said committee was examine certain issues regarding tribal societies, their own customary laws, traditional practices, community culture, political and administrative systems and submitted its report in January 1995.

On the basis of the Bhuria Committee Report, the provisions of such Part IX of the Constitution relating to the panchayats to the Scheduled Areas has been further extended by the enactment of the Provisions of the Panchayats (Extension to the Scheduled Areas) Act, 1996 (Act 40 of 1996) (hereinafter referred to as "the PESA Act"). The term of the Scheduled Areas has been defined in Art. 244(1) which inter alia provides that the provisions of the Fifth Schedule shall apply to the administration and control of the Scheduled Areas and Scheduled Tribes in the State. Art. 243-G provides inter alia that a State may, by law, endow panchayat with such powers and authority to function as institutions of self-government and for the devolution of powers and responsibilities upon panchayat. Eleventh Schedule has provided the subject matters, such as agriculture, land development, minor irrigation, animal husbandry, fisheries, social forestry and farm forestry, minor forest produce, small scale industries, khadi and cottage industries, housing, drinking water, fuel and fodder, roads, waterways, electrification, non-conventional energy sources, poverty alleviation programme, education, libraries, cultural activities, markets and fairs, health and sanitation, family welfare, women and child development, social welfare, welfare of weaker section, public distribution system, maintenance of community assets, etc., which prepare plans for economic development and social justice and also to implement various schemes. The Governor shall annually make a report to the President of India regarding the administration of the Scheduled Area of the State. The President of India has in exercise of powers conferred by clause 6 of the Fifth Schedule to the Constitution, by order, rescinds the Scheduled Areas (Part A States), 1950 and the Scheduled Areas (Part B States) Order, 1950 and in consultation with the Governor of Maharashtra, published in Gazette of India, Extraordinary, PART II- Section 3-sub-section (1), dated the 2nd December 1985, at page 8, published Government Notification, Ministry of Law and Justice (Legislative Department), vide G.S.R. 876(E), declaring that the Scheduled Areas (Maharashtra) Order, 1985. District Thane, Palghar, Nashik, Gondia, Dhule, Ahmadnagar, Pune, Nanded, Nandurbar, Raigarh, Amravati, Yavatmal, Gadchiroli and Chandrapur of the State of Maharashtra to be the Schedule Area for the purpose of the provisions of the PESA Act.

Historical Background

The British had imposed restrictions on local forest dwelling communities declaring that the forest is a national property. They controlled forests for commerce and national development. They had nothing to do with conservation as well as community development. The Indian Forest Act, 1878 and other related laws were general enactments regulating the forests during the British India regime. To consolidate these laws relating to forests, transit of forest produce and duty leviable on timber and other incidental provisions relating thereto, the Indian Forest Act, 1927 (16 of 1927) has been enacted and come into force with effect from the 21st September 1927. Thereafter, the Government of India has enacted the Forest (Conservation) Act, 1980 (69 of 1980) with effect from the 27th December 1980, with a view to prevent the deforestation which causes ecological imbalance and leads to environmental deterioration. In T.N. Godavarman Thirumulpad vs. Union of India, W.P. (C) No. 202 of 1995, the Supreme Court in its order dated the 3th October 2002, observed that, "a Compensatory Afforestation Fund may be created in which all monies received from the user agencies shall be deposited." The Court directed that the "Fund shall be utilised for plantations, protection of forests, wildlife protection and other related activities". With a view to comply with the directives of the Hon'ble Supreme Court, the Government of India has enacted the Compensatory Afforestation Fund Act, 2016 (38 of 2016) and the Compensatory Afforestation Fund Rules, 2018 made thereunder.

Forest Rights

Sub-section (1) of section 3 of the Forest Right Act have been provides, inter alia, the following forest rights to,-

- (a) hold and live in the forest land;
- (b) community rights;
- (c) ownership access to collect, use and dispose of minor forest produce;

- (d) other community rights, such as fishing, traditional seasonal resources, etc.;
- (e) community tenures of habitat and habitation;
- (f) on disputed lands of any nomenclature;
- (g) convert of patta or leases or grants on forest lands to titles;
- (h) settlement and conversion of all forest villages, old habitation, surveyed villages and other villages in forests;
- (i) protect, regenerate or conserve or manage any community forest resource;
- (j) recognised by any traditional or customary law;
- (k) access to bio-diversity and community right to intellectual property and traditional knowledge related to bio-diversity and cultural diversity;
- (l) any other customary or traditional rights excluding hunting or trapping or extracting a part of body of any species of wild animal;
- (m) rehabilitation including alternative land.

Sub-section (2) of the said section has imposed the duties on the Government to provide schools, dispensary or hospital, anganwadis, fair price shops, electric and telecommunication lines, tanks and other minor water bodies, drinking water supply and water pipelines, water or rain water harvesting structures, minor irrigation canals, non-conventional source of energy, skill upgradation vocational training centres, roads and community centres.

The Governor of Maharashtra has by issuing notification in pursuance of his legislative powers conferred by sub-paragraph (1) of Paragraph 5 of the Schedule Vth of the Constitution, and accordingly modifies the provisions of the Forest Rights Act, in its application to the State of Maharashtra, providing that “to enable tribal and other traditional forest dwelling families to build houses in the neighbourhood forest area”. This provision was inserted with a view to prevent the migration of forest-dwelling families outside their native villages and to provide them housing by extending the village site into forest land in their neighbourhood.

Guidelines on Forest Rights Act

The Government of India, Ministry of Tribal Affairs, vide No. 23011/32/2010-FRA [Vol.II (Pt.)], dated the 12th July 2012 has issued the Guidelines on the implementation of the Forest Rights Act, with a view to ensure effective implementation the provisions of the Act and rules made thereunder and for the purpose issued in this regards, the following guidelines,-

- (1) Process of Recognition of Rights.- Officials of Revenue and Forest Department should remain present when the Forest Rights Committee visit site for verification of claims; in case of rejection or modification of claim by the Gram Sabha or Sub-Divisional Level Committee or District Level Committee, communicate the aggrieved person so that he should be able to file petition before the appropriate Committee within sixty days; Sub-Divisional Level Committee or District Level Committee should remand such rejected or modified claim for reconsideration, etc.;
- (2) Minor Forest Produce.- All non-timber produce of plant origin, including bamboo, brush wood, stumps, cane, tussar, cocoons, honey, wax, lac, tendu or kendu leaves, medicinal plants and herbs, roots, tubers, etc. of the Minor Forest Produce should be provide market, remuneration, transport, processing by the State Government;
- (3) Community Rights.- State Government may convert all forest villages, unrecorded settlements and old habitations into revenue villages, and also provide land for schools, health facilities, public spaces, etc., and to maintain its records;
- (4) Protection against Eviction, Diversion of Forest Lands and Forced Relocation.- Ministry of Environment & Forest, vide letter No.11-9/1998-FC(pt), dated the 30th July 2009, directed State Government to complete the process of settlement of rights under the Forest Rights Act relating to the diversions of forest land for non-forest purposes under the Forest (Conservation) Act, 1980;
- (5) Awareness-Raising, Monitoring and Grievance Redressal.- State Nodal Agency should plans to conduct trainings for revenue, forest, tribal welfare department’s field staff, officials, Forest Rights Committees,

panchayat representatives, etc., so that the awareness about various provisions of the Act and rules should be spread at village levels.

District-wise Analysis

As per the citizens report the performance of the claims received, pending, approved and rejected at various levels in the Gadchiroli District has implementing above 60 percent of its minimum potential, only two district with above 33 percent implementation, nine district with less than 30 percent implementation and 21 districts with zero or near zero implementation, which includes Ahmednagar, Chandrapur, Dhule, Gondia, Kolhapur, Nashik, Pune, Raigad, Satara, Thane and Yavatmal. The Tribal Commissionerate of Maharashtra has up to November 2016, received a total 6264 claims that were approved at the DLC level, 5741 titles have been distributed with 523 titles yet to be distributed. Districts like Yavatmal and Thane have more than 60 percent of the titles which are yet to be distributed.

Hurdles for Implementation

The second Administrative Reforms Commission has stressed on the effective implementation of the PESA. Moreover, international organizations too had stressed the right to self-determination for these groups. For that purpose, it is necessary to make the State legislations in consonance with customary laws, social and religious practices as well as traditional management practices of community resources of the tribal. Therefore, it is important to examine the various provisions of the Maharashtra Land Improvement Schemes Act (XXVIII of 1942); the Bombay Money-lenders Act, 1947 (Bom. XXXI of 1947); the Maharashtra Prohibition Act (XXV of 1949); the Maharashtra Police Act (XXII of 1951); the Maharashtra Village Panchayats Act (III of 1959); the Maharashtra Fisheries Act, 1961 (Mah.I of 1961); the Maharashtra Industrial Development Act, 1961 (Mah. III of 1962); the Maharashtra Zilla Parishads and Panchayat Samitis Act, 1961 (Mah. V of 1962); the Maharashtra Land Revenue Code, 1966 (Mah. XLI of 1966); the Maharashtra Forest Produce (Regulation of Trade) Act, 1969 (Mah. LVII of 1969); the Maharashtra Housing and Area Development Act, 1976 (Mah. XXVIII of 1977); the Maharashtra Irrigation Act, 1976 (Mah. XXXVIII of 1976); the Maharashtra Forest Development (Tax on Sale of (Forest-produced by Government or Forest Development Corporation) (Continuance) Act, 1983 (Mah. XXII of 1983); the Maharashtra Transfer of Ownership of Minor Forest Produce in the Scheduled Areas, and the Maharashtra Minor Forest Produce (Regulation of Trade)(Amendment) Act. 1997 (Mah. XLV of 1997), as these State Acts have been correlated with the implementation and administration in the PESA area.

The trends have emerged particularly in areas where CFR rights have been claimed and Gram Sabhas have started asserting these rights toward governance and management of CFR forest. The management of conservation of forest with local and sustainable governance, CFR management strategies and plans, implementation of plans through District Convergence Committees, assertion of rights over non timber forest produce, issues of the particularly vulnerable Tribal Groups (PVTGs) and habitat rights of the media gonds, reviewing and correcting faulty CFR titles, reclaiming the resource of water bodies as CFR in control of Gram Sabhas, engendering forest governance through FRA are the hurdles while implementing the provisions of FRA.

CHALLENGES

There is a lack of awareness about the CFRs particularly in the PESA areas. There is a lack of dedicated staff at the State and District level committees. Lack of trust between Gram Sabhas and Forest Department. There is a very high rate of rejection of claims, discrepancies in the titles and title corrections, conversion of forest villages into revenue villages, etc. The Compensatory Afforestation Fund Act, 2016 has released around 42000 crore rupees to the State for carrying out compensatory afforestation, primarily in lieu of diversion of customary forests of tribal lands.

Implementation

The Office of the Secretary to the Governor of Maharashtra has to provide housing area to the tribal so that to stop migration of the Forest Dwelling Scheduled Tribe families and other traditional Forest Dwelling families outside the native habitats and to provide stability in tribal lives, modified suitably the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (2 of 2007) by issuing Notification, dated the 23 September 2020, in this regard.

The Supreme Court in *Samatha V/s State of Andhra Pradesh* has struck down the mining leases so granted, and held that the Government lands, forest lands and tribal lands in Scheduled Area cannot be leased out to non tribal or to private industries. In *Nandini Sundar V/s State of Chhattisgarh*, has struck down the recruitment of Special Police Officers, held that the human rights of local population and human rights activists cannot be violated on the pretext of counter-insurgency. In *Orissa Mineral Corporation Limited V/s Ministry of*

Environment and Forests, SC held that the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, are protecting the tribal autonomy, cultures and economic empowerment, to attain social, political and economic justice, and good governance for all. An issue involved in Biological Diversity Act, 2002 and Regulations 2014 require Indian entities, and not only those with a foreign element, to pay a fee for fair and equitable benefit sharing with tribal communities for the use and development of bio-products constituting their traditional knowledge.

Review Meeting

Minutes of the Review Meeting held between 7th June 2021 to 14th June 2021, under the Chairmanship of Secretary, Tribal Affairs, Government of India, has been communicated vide F.No.11015/02/2019-Grants, Ministry of Tribal Affairs (Grants Division), on the 7th July 2021. In the said meeting, on behalf of the State of Maharashtra Shri Anup Kumar Yadhav, Secretary of the Rural Development Department, had represented. In the said meeting discussed various issues under the schemes of the Ministry, such as, Sharing of Best Practices which can be adopted, Status of submission of proposals for 2021-22 financial year after due approval of Empowered Committee, Uploading data on Diagrams (www.grants.tribal.gov.in), EMRS (www.emrs.tribal.gov.in) and Scholarship Portal, Identification of land for EMRS sanctioned between 2018-19 and 2020-21 and to be sanctioned during 2021-2022, Progress of construction of EMRSs under State Board, Adoption of RR framed by NESTS to be adopted by State Societies, Scholarships, Initiatives taken in tribal areas in view of Covid 19 crisis, Invitation to National and International achievers/celebrities as “Special invited Guests” to the Republic Day Parade, 2022, Integrated village development scheme, FRA, NCST Annual Reports Compliances, Status of National Tribal Policy and Xaxa (HLC) Committee, Monitoring of State TSP, etc.

Agenda 9 on FRA directs all the States that the petition in Supreme Court still is pending, therefore, requested to all State Governments “to ensure that the contents of their respective affidavits filed in the Court be adhered and also keep in mind the timelines that have been submitted to the Court” and also discussed on the “data on rejection of cases should be thoroughly examined and reasons for rejection should be documented for each case”.

The “State Government of Maharashtra has been uploading the implementation of FRA in FRA Portal. However, discrepancies [declining titles/land figure (CFR) in MPR found after May, 2020 to April 2021. The State Government was, therefore, advised to send correct MPRS for the said period”.

In respect of review of rejected claims, the State Government was advised to ensure that due process of law (communication of reasons for rejection at each level, etc.) has been followed in the process to be prepared before the Supreme Court hearing. 1752 cases under FRA were reported to be pending in the State. Success stories of bamboo plantation/fishing on FRA land Community Forest Management success stories were brought out and the State was requested to formally share these stories with FRA Division of MOTA”.

CONCLUSION

The implementation of the provisions of the CFR rights in Maharashtra are quite satisfactory insofar as the Gadchiroli District is concerned. But, the rest of Maharashtra needs to implement the CFR rights more effectively with the help of Gram Sabhas, Adivasi Movements, Civil Society Groups, Tribal Development Department, Governor’s office, Block and District administration. Needs to spread the awareness programme throughout Maharashtra at all levels, so that every Tribe must know its provisions and importance. Needs to provide livelihood, food and water security together with socio-cultural integrity. To provide information relating to convention on Biological Diversity and climate change. The Government institutions are crucial to provide good governance, mobilization and resource management. Necessary to stop the conflicting policies of notification on Village Forest Rules, leasing out forest lands to FDMC without Gram Sabha’s consent, supporting JFM committee in recognised CFR villages and diversions of forests for non-forest purposes against the wish of the affected Gram Sabha’s consent, etc. The Tribal Development Department of the Government of Maharashtra is a nodal agency, and therefore, this nodal agency implements its policies effectively, in the interest of the Tribal.

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An Analytical Study of Influence of HR Audit on Performance of Employees of Selected it Sector Companies of Gujarat

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ABSTRACT

Purpose: To study the interaction between HR audit & Employee Performance, to examine the influence of HR Audit, to recognize relation among Systems of Performance Appraisals & Employee Morale to implement it with HR Audit.

Research Methodology: During the research, calculation of Cronbach's Alpha, Frequency analysis and weighted average ranking method were applied; 50 skilled employees and 50 Managers working for organizations that launched and implemented an HR audit were surveyed; questionnaire method (via google form) was used (15 companies) as this research was divided into 2 unit of sample.

Findings: From the various factors regarding Human resource audit, the skilled employees are highly satisfied with the job performance (Factors affecting job performance are—on the basis of work, I set appropriate priorities at work, I arrive for work on time. ((Punctuality), I fulfil all the targets all the time, I take appropriate actions on problems as necessary, I adhere to all work-related deadlines). 52% Managers agree with this: Human Resource Audit give a sense of confidence in the human resource department that it is well managed and prepared to meet potential challenges and opportunities.

Implementation: With the increasing effect of globalization and technology, organization have started to use audit system in various functions and departments in the last decades. HR audit systems support activities such as identifying potential employees, maintaining complete records of existing employees and creating programs to develop employees' talents and skills. HR audit systems help senior management to identify the manpower requirements in order to meet the organization's long term business plans and strategic goals. Middle management used human resources audit systems to monitor and analyse the recruitment, allocation and compensation of employees. In this research, HR Audit System perception and HR Audit System satisfaction questionnaires were applied to the employees of IT industries in order to assess the opinion, effectiveness and use of the HR Audit System in organizations.

Keywords: Human Resource, Audit, HR Audit, Employees, Influence, Organization

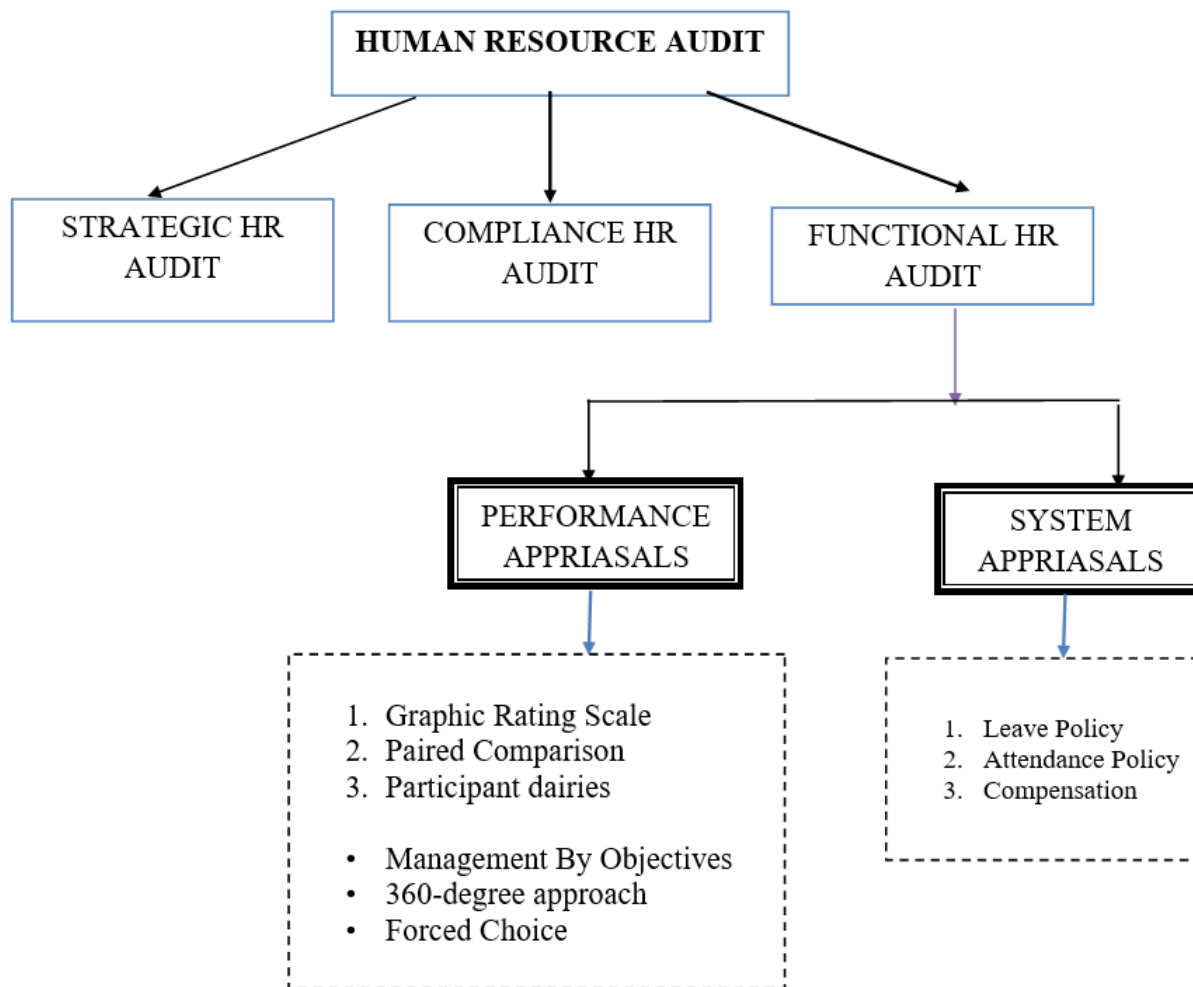
1. INTRODUCTION

Auditing has been a usual practice in the field of finance, particularly because it is a constitutional obligation. However, in case of Human Resource, there is no legal binding to implement auditing. Some of the companies favor the process of Human Resource Audits. Human resource audit is a tool which appraises effectiveness of function of an organization. The audit of the HR Department is an integration of both the HR function and HR competencies. It also involves a more numeric analysis of the HR department in terms of the ratio analysis, the cost and expenditures associated with HR. Take care of your people and they will take care of your business. This is the motto of many successful organizations. In this, context, it becomes imperative to ensure that the entire HR process is well managed and the organization is able to recruit, motivate and retain good talent. The best tool to ensure that HR process is running well is HR audit. Effective audits pinpoint the gaps between "what is" and "what should be." Or "what could be." By removing or reducing the size of the gaps, an organization can increase legal compliance, ensure conformance to established professional standards and/or contribute to the quality improvement process. HR Audit as a strategic tool for evaluation of organizational people processes in order to understand its implication on the business strategy. In this fast-moving competitive environment, HR Audit significance cannot be compromised because Human Resource Management (HRM) is considered the backbone of the organization. HR Audit is a process for continuous improvement and very useful when applied to the whole organization.

2. CONCEPTUAL FRAMEWORK

With the increasing effect of globalization and technology, organizations have started to use audit systems in various functions and departments in the last decades. Human resources management is one of the departments that mostly use audit systems. HR audit systems support activities such as identifying potential employees,

maintaining complete records of existing employees and creating programs to develop employees' talents and skills. HR audit systems help senior management to identify the manpower requirements in order to meet the organization's long term business plans and strategic goals.



Basically, when we talk about HR Audit, Human Resource Audit is a very generic concept. It basically focuses on 3 aspects—

1. Strategic human resource audit
2. Compliance human resource audit
3. Functional human resources audit

1. Strategic Human Resource Audit: The strategic audit process identifies individuals who need training or increase knowledge, make recommendation on them and work to improve the quality of their customs performance. According to the strategy, they can prepare HR policy for 20 years when you have to focus on strategy to correct or change strategy for HR policy, that is called as strategy HRA. Those organization who are already existent since last 30-40 years, are implement Strategic HRA. Because they have the data like which type of problem in strategy they faced in past and currently what is it actually? So, according to my study, this is out of question as we can't do strategical changes in HR policy because top management knows everything.

2. Compliance Human Resource Audit: While conducting a Compliance HR Audit, the HR department goes into an investigation and break down of a business' operations to figure out if it is in line with federal mandates and guidelines while at the same time adhering the needs of the workers. In short, those audits which are compulsory by law under HR. Like proper focus on provident fund (as per norms), minimum wages, section of payment of wages are properly maintaining or not? Are you following proper equal remuneration or not? These all are compliance audit. We can't do research on compliance audit because

these all data are very sensitive. No one can share. So, we can't able to focus on compliance HR Audit. So, what can we focuses on? The 3rd aspect of HRA –Functional HRA.

- 3. Functional Human Resource Audit:** Functional HR Audits are not only about compliance. They involve analyzing how various HR systems across the employee lifecycle function. It includes getting familiar with the approach, ascertaining the current capabilities, gauging the effectiveness, identifying improvement areas, your current recruitment and selection, your current HRD Program, Training & Development. These all activities are doing on a routine basis. These are so many things but we will focus on 2 things- system Appraisals audit and Performance Appraisals technique of a company and how does it effect on the performance of your overall employee. Because ideally It should have positive impact on your employees.
- Nature of this research is—in knowing, whether the organization is adopting a proper policy of HRA or not? If they are adopting HRA—then does it have an impact on performance of your employees or not? I also want to check how many deviations happen & if deviations happen—what is the reason behind that... This is my entire focus....

In the current competitive business climate, the companies in various industries try to enhance their competence level to survive in the market. To achieve their goals, they have to comply with the dynamic pressures such as technology changes increased competition etc. The performance of an organization can be improved only through improved employee performance. Recruitment, training, compensation, conflict management and motivation all these are common functions of Human resource management. All these functions/activities have to be reviewed and evaluated in order to ensure the efficient HR policies and management system, -- An HR audit is dreaded by many a human resources department head, but for the skilled HR representatives, it is a valuable tool that points to areas in need of employee development. In some cases, an HR audit may even help a company find areas where savings could be realized with the help of job cuts and the funds may then be allocated to different departments in an effort to either streamline productivity or launch a new program or product line by either moving personnel there or hiring additional staff. Learning how to define an HR audit is not hard, and when you follow these simple steps, you are well on your way to drafting a hard-hitting audit that provides an abundance of facts with respect to educational standards being met as well as indicators where training improvement is needed the most.

The main function of HR Audit System facilitates to take specific actions that will help in minimizing employee turnover, effective orientation and training, better working condition, remuneration, benefits and opportunities for future advancement. The audit is an overall quality control check on human resource activities in a division of company and an evaluation of how their activities support the organization strategy. Thus, this paper focuses on human resource audit practices on the performance of employees in selected IT industries in Gujarat.

Hence an attempt is made in this study about the HR Audit System in IT industries in GUJARAT. The HR Audit System is very much helpful to face the challenges, to increase the potentiality of the employees in the organization and to analyze the impact on employees' performance.

3. LITERATURE REVIEW

1. **Mahalingam S (2014), Impact of HR Audit System in Industries in Tamilnadu in order to gain insight into the present scenario, International Journal of Management and Social Science Research Review, Vol.1, issue.3, pp. 76-83** found in his research that The main function of HR Audit System facilitates to take specific actions that will help in minimizing employee turnover, effective orientation and training, better working condition, remuneration, benefits and opportunities for future advancement. Hence an attempt is made in this study about the HR Audit System in IT industries Tamilnadu. The HR Audit System is very much helpful to face the challenges and to increase the potentiality of the employees in the organization.
2. **Poonguzhali, P., Chandramohan, A. (2015). Human resource audit practices on the performance of employees with reference to i.t. industries in Chennai. Abhinav International Monthly Referred Journal of Research in Management & Technology, 4, 33-40** found that Human beings are the most precious part of the organization. Effective utilization of human resources depends upon the human resource audit practices of an organization. A human resource audit is a tool for evaluating the personnel activities of an organization. The audit includes one division or an entire company. It gives feedback about the human resources function to operating managers human resource department. It also provides feedback about how well managers are meeting the human resource duties. In short, the audit is an overall quality control check on human resource activities in a division of company and an evaluation of how their activities support the organization strategy. Thus, this paper focuses on human resource audit practices on the performance of

employees in selected IT industries in Chennai. It also focuses on Human Resource Audit Approaches and Human Resources Benefits with reference to IT Industries.

4. METHODOLOGY

4.1 Statement of Problem

A Study on Human Resource Audit and Its Impact On
Performance of Employees' Of Selected It Sector Companies

4.2 Scope of Study

The scope of the present study is limited to IT companies operating in Gujarat and **the 5 regions of North, South, Central, Kutch and Saurashtra**. The IT companies in the study included both public limited companies and private limited companies. The activities of the companies in the sample are spread across all sectors and verticals of IT and ITES services. Survey staff include age groups, experience groups, working at different levels of management. In addition, equal opportunity is given to all qualified employees and managers by submitting a structured digital survey questionnaire to express their views on the topic and aspects. Its different effects. The findings of the study are applicable to companies operating elsewhere in the same domestic environment.

4.3 Research Gap

- A research gap is defined as a topic or area for which missing or insufficient information limits the ability to reach a conclusion for a question.
- Most of the studies have examined HR audit Practice, methods, process, issues, success factors, benefits and limitations in sectors like Healthcare, Banking, Railway, Steel, Textile, Petroleum etc for Doctorate course but no significant research has taken place in this ever-growing industry and especially impact of HR Audit on employees' performance in IT sector is not measured in Indian context.
- Majority of the past studies were carried out in various other industries, while there were a few studies in IT industry in India but there is no study so far conducted specifically in this sector in Gujarat which covered a host of dependent and independent variables such as **Performance Appraisals, Critical Evaluation Component (CEC) – observation, Job Performance, Loyalty, Career Perspective**. These have been proved to be decisive ones having a positive influence on HR Audit.
- Hence, the current study is relevant and contemporary for the study. The study is titled as **A STUDY ON HUMAN RESOURCE AUDIT AND ITS IMPACT ON PERFORMANCE OF EMPLOYEES' OF SELECTED IT SECTOR COMPANIES**.

4.4 OBJECTIVES OF RESEARCH

- **Primary Objectives**
 - ✓ To study the interaction between HR audit & Employee Performance.
 - ✓ To examine the influence of HR Audit.
 - ✓ To recognize relation among Systems of Performance Appraisals & Employee Morale.
- **Secondary Objectives**
 - ✓ To measure the impact of Organizational variables (management attitude, frequency of audit, focused area in HR) on the Performance of the IT Professionals in the selected companies.
 - ✓ To propose appropriate management strategies to improve the HR Audit practices and climate among the IT firms.
 - ✓ To find out the efficiency of performance of HR Department.

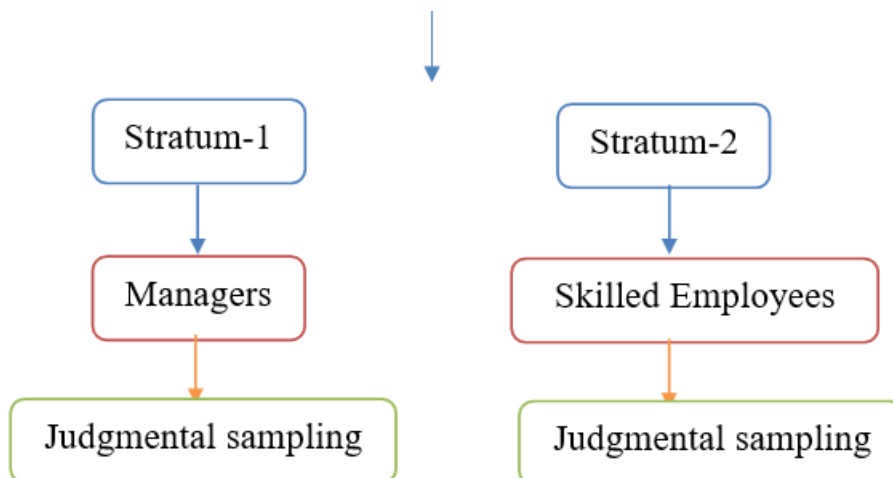
4.5 SAMPLING PLAN:

- **Unit of Sample**
 1. Managers
 2. Skilled Employees

• **Types of Population**

Finite

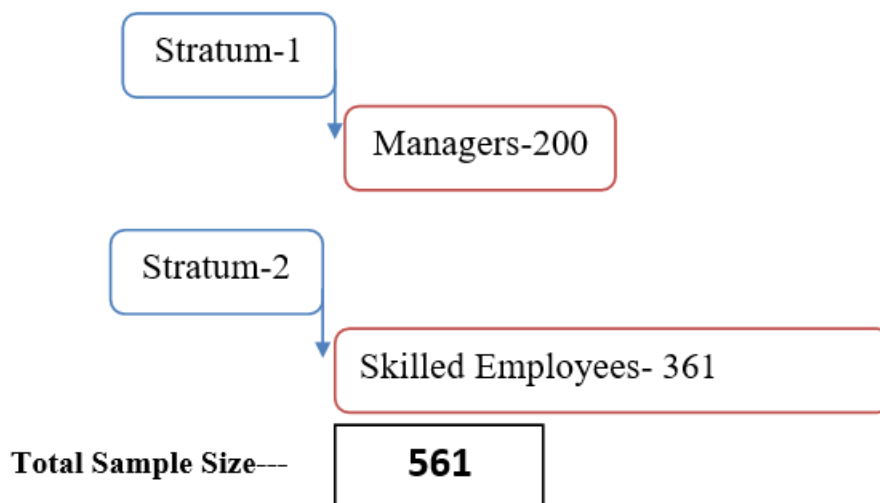
• **Sampling Method:** Non-Probability Convenient sampling



• **Sample Size**

$$\text{Sample size} = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p(1-p)}{e^2 N}\right)}$$

According to this formula, keeping the confidence level at 95% and confidence interval at 5 %..... The sample size comes to

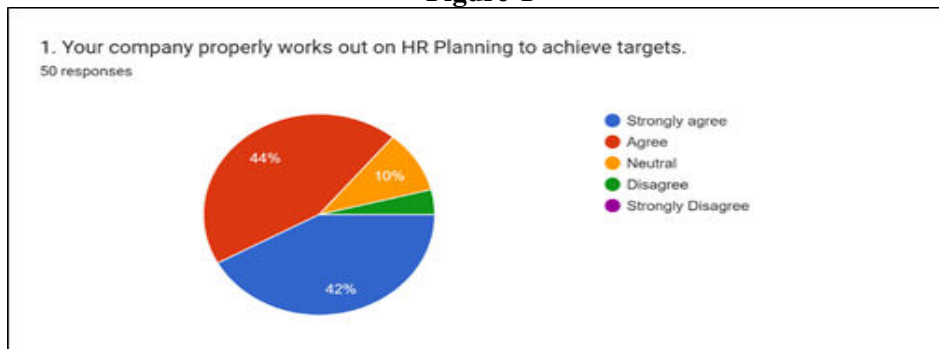


(Note: As a part of study, Sample of 50 employees and 50 managers are to be tested.)

- **Data Collection Method:** Primary data collection method
- **Data Collection Tool:** Structured Questionnaire

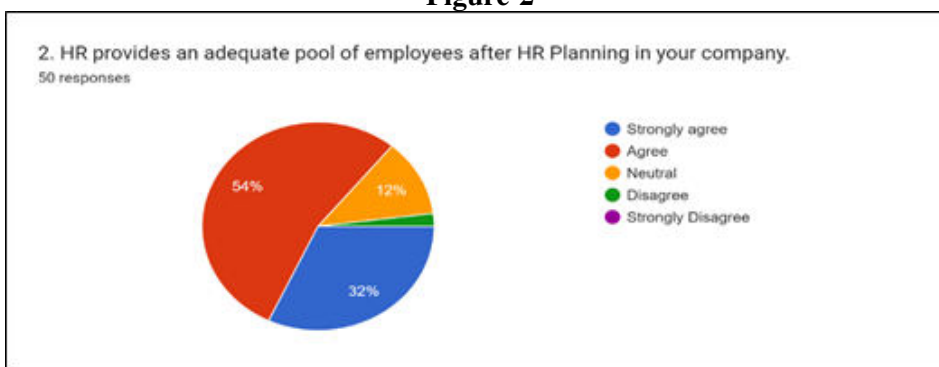
5. Analysis and Interpretation:

Figure-1



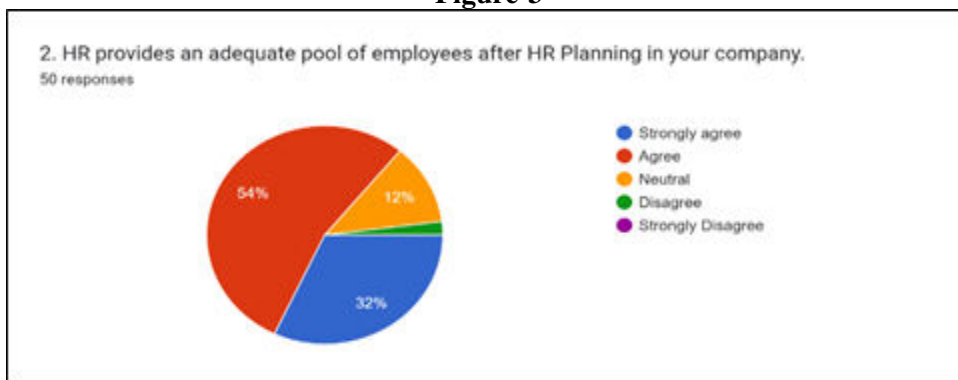
This graphics depicts that 44% Managers are agree with statement that our company properly works out oh HR Planning to achieve targets.

Figure-2



54% Managers agree with the line that HR Provides an adequate pool of employees after HR Planning in our company.

Figure-3



From the above chart, it is cleared that 54% Managers are agree that HR provides an adequate pool of employees after HR Planning in your company.

Figure-4



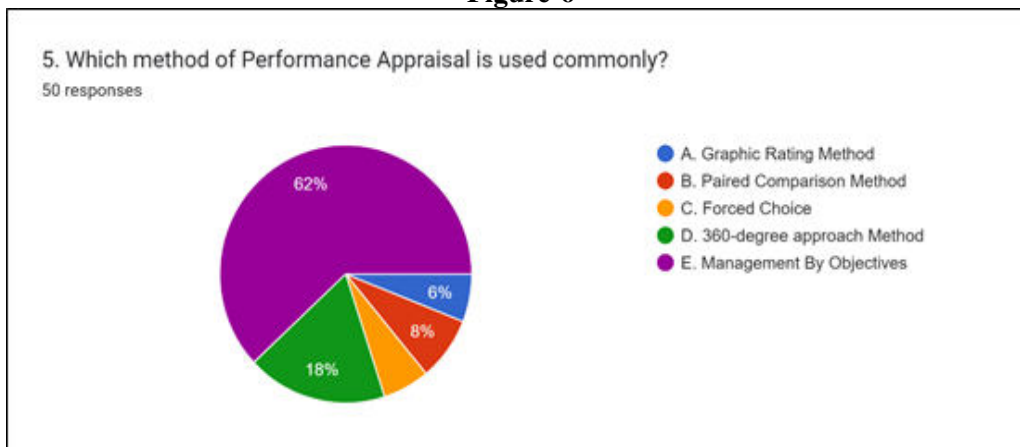
An analysis from the above presentation is – 46% Managers are strongly agree with this statement—our company has career planning, raining & Appraisal system to identify individual skills, interest and which contributes in productivity/development assistance.

Figure—5



Managers responded that Human resource Audit give a sense of confidence in the human resource department that it is well managed and prepared to meet potential challenges and opportunities.

Figure-6



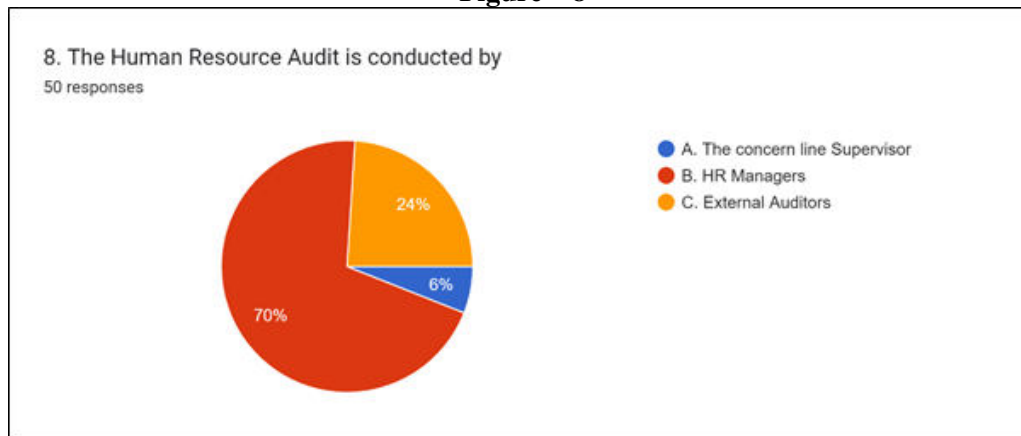
Out of 50 responses, Managers suggested that according to our knowledge, Management by Objectives-is used commonly under the method of Performance Appraisal.

Figure—7



Performance Appraisals happen annually in their organization, according to the respective Managers of respective companies.

Figure—8



In General, the human Resource Audit is conducted by HR Managers.

5.1 HYPOTHESIS TESTING

Validation & Scale Reliability

After identifying the dimension underlying a factor, a researcher may prepare a scale of those dimensions to measure the factor. Such a scale has to be tested for validity and reliability. Proper validity and reliability testing can be done using CFA. However, researcher commonly uses the Cronbach alpha coefficient for establishing scale reliability. The Cronbach alpha coefficient suggests that the item that make up the scale “hang together” and measure the same underlying construct. A value of Cronbach alpha above 0.07 can be used as a reasonable test of scale reliability.

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum V_i}{V_t} \right)$$

= Sum of all respondent variances

= Sum of all question variances

K= No. of Questions

- **For Managers:**

$$\begin{aligned} \alpha &= \frac{k}{k-1} \left(1 - \frac{\sum V_i}{V_t} \right) \\ &= \left[\frac{10}{9} \right] \left[1 - \frac{13.2968}{87.5076} \right] \\ &= \left[1.11 \right] \left[1 - 0.152 \right] \\ &= \left[1.11 \right] \left[0.848 \right] \end{aligned}$$

• For Skilled Employees

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum V_i}{V_t} \right)$$

$$= \left[\frac{15}{14} \right] \left[1 - \frac{13.24}{106.8916} \right]$$

$$= \left[1.071 \right] \left[1 - 0.124 \right]$$

$$\left[1.071 \right] \left[0.876 \right]$$

= 0.938

	Cronbach's Alpha
For Managers	0.942
For Skilled Employees	0.938

Tab: 1.2 calculation of Cronbach's Alpha

The alpha values are calculated to assess the internal consistency reliabilities of the variables.

For scale, variables, the value of .942 and .938 indicated adequate reliability.

Cronbach's α (alpha) is a statistic used in this study. It is commonly used as a measure of the internal consistency or reliability of a psychometric test score for a sample of examinees. Cronbach's alpha will generally increase as the intercorrelations among test items increase and is thus known as an internal consistency estimate of reliability of test scores, because intercorrelations among test items are maximized when all items measure the same construct, Cronbach's alpha is widely believed to indirectly indicate the degree to which a set of items measure a single unidimensional latent construct

Frequency Analysis

Demographic Variables	Categories	Number of Respondents
For Managers		
Your company properly works out on HR Planning to achieve targets.	Strongly Agree	21
	Agree	22
	Neutral	5
	Disagree	2
	Strongly Disagree	0
HR provides an adequate pool of employees after HR Planning in your company.	Strongly Agree	16
	Agree	27
	Neutral	6
	Disagree	1
	Strongly Disagree	0
Your company has Career Planning, Training, & Appraisal system to identify individual skills, interests and needs & which contributes in productivity /	Strongly Agree	23
	Agree	20
	Neutral	6

development assistance.	Disagree	1
	Strongly Disagree	0
Human Resource Audit give a sense of confidence in the human resource department that it is well managed and prepared to meet potential challenges and opportunities.	Strongly Agree	16
	Agree	26
	Neutral	7
	Disagree	1
	Strongly Disagree	0
1. Rate the following statements:		
2. (i) I believe the Performance Appraisal system is measuring what it is supposed to measure.	Strongly Agree	22
	Agree	23
	Neutral	5
	Disagree	0
	Strongly Disagree	0
3. (ii) I feel the system is fair and transparent.	Strongly Agree	18
	Agree	25
	Neutral	5
	Disagree	2
	Strongly Disagree	0
(iii) The system Human Resource Audit is according to the business strategy.	Strongly Agree	20
	Agree	21
	Neutral	8
	Disagree	1
	Strongly Disagree	0
(iv) The Recruitment and Selection policy are according to the business strategy.	Strongly Agree	17
	Agree	27
	Neutral	6
	Disagree	0
	Strongly Disagree	0
(v) The leave policy is fair and transparent.	Strongly Agree	29
	Agree	19
	Neutral	2
	Disagree	0
	Strongly Disagree	0
(vi) These are regular policy audit being conducted.	Strongly Agree	24
	Agree	17
	Neutral	9
	Disagree	0
	Strongly Disagree	0
Demographic Variables	Categories	Number of Respondents
For Skilled Employees		
1. Age:	25-30	28
	30-40	19
	40-45	12
	45- above	5
2. Rate the following statements regarding job performance :		
3. (i) On the basis of work, I set appropriate priorities at work.	Strongly Agree	15
	Agree	34
	Neutral	1
	Disagree	0
	Strongly Disagree	0
(ii) I arrive for work on time. (Punctuality)	Strongly Agree	32
	Agree	17

	Neutral	1
	Disagree	0
	Strongly Disagree	0
(iii) I fulfill all the targets all the time.	Strongly Agree	23
	Agree	21
	Neutral	4
	Disagree	1
	Strongly Disagree	1
(iv) I take appropriate actions on problems as necessary.	Strongly Agree	31
	Agree	18
	Neutral	1
	Disagree	0
	Strongly Disagree	0
(v) I adhere to all work-related deadlines.	Strongly Agree	26
	Agree	22
	Neutral	1
	Disagree	1
	Strongly Disagree	0
Rate the following statements regarding <i>loyalty</i>:		
(i) I feel my needs are met by working with this organization.	Strongly Agree	23
	Agree	23
	Neutral	4
	Disagree	0
	Strongly Disagree	0
(ii) I like the work that I am doing.	Strongly Agree	26
	Agree	22
	Neutral	1
	Disagree	0
	Strongly Disagree	0
(iii) I might not leave this organization for short term benefits.	Strongly Agree	24
	Agree	25
	Neutral	1
	Disagree	0
	Strongly Disagree	0
(iv) I consider this organization is as family.	Strongly Agree	26
	Agree	21
	Neutral	2
	Disagree	1
	Strongly Disagree	0
(v) I feel that this organization takes all around care of my needs.	Strongly Agree	24
	Agree	21
	Neutral	5
	Disagree	0
	Strongly Disagree	0
Rate the following statements regarding <i>career perspective</i>:		
(i) This organization runs regular career development programmes.	Strongly Agree	18
	Agree	25
	Neutral	7
	Disagree	0
	Strongly Disagree	0
(ii) I have taken promotions in this organization.	Strongly Agree	25
	Agree	20
	Neutral	4

	Disagree	0
	Strongly Disagree	1
(iii) I am pleased with career advancement opportunities available to me by this organization.	Strongly Agree	19
	Agree	25
	Neutral	6
	Disagree	0
	Strongly Disagree	0
(iv) I continually set myself practical, specific career development objectives with measurable outcome and defined timescales.	Strongly Agree	21
	Agree	25
	Neutral	3
	Disagree	1
	Strongly Disagree	0
(v) I am satisfied with career development opportunities for professional growth given by this organization.	Strongly Agree	26
	Agree	20
	Neutral	3
	Disagree	1
	Strongly Disagree	0

Weighted Average Ranking Method

Employee's Opinion towards Job performance, Loyalty and career perspective.

S. No	Factors	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Total	Average
1.	Job performance*	635	448	8	4	3	1098	10.98
2.	Loyalty**	615	448	13	2	-	1078	10.78
3.	Career perspective***	545	460	23	4	3	1035	10.35

*Factors affecting job performance are – on the basis of work, I set appropriate priorities at work, I arrive for work on time. (Punctuality), I fulfil all the targets all the time, I take appropriate actions on problems as necessary, I adhere to all work-related deadlines.

** Factors affecting loyalty are – I feel my needs are met by working with this organization, I like the work that I am doing, I might not leave this organization for short term benefits, I consider this organization is as family, I feel that this organization takes all around care of my needs.

***Factors affecting career perspective are – This organization runs regular career development programmes; I have taken promotions in this organization; I am pleased with career advancement opportunities available to me by this organization, I continually set myself practical, specific career development objectives with measurable outcome and defined timescales, I am satisfied with career development opportunities for professional growth given by this organization.

Formula:

5

$\text{Total} = \sum \text{value} * \text{weightage}$

$i=0$

$\text{Average} = \text{Total} / \text{Total no. of Respondents}$

Inference

From among the various factors regarding Human resource audit, the respondents are highly satisfied with the job performance.

6. FINDINGS

- 44% Managers agree with statement that our company properly works out on HR Planning to achieve targets.

- 54% Managers agree with statement that HR Provides an adequate pool of employees after HR Planning in our company.
- 46% Managers stated that we are strongly agree that our company has career planning, Training & Appraisal system to identify individual skills, interest and needs and which contribute in productivity / development assistance.
- 52% Managers agree with this: Human Resource Audit give a sense of confidence in the human resource department that it is well managed and prepared to meet potential challenges and opportunities.
- From the various factors regarding Human resource audit, the skilled employees are highly satisfied with the job performance (Factors affecting job performance are—on the basis of work, I set appropriate priorities at work, I arrive for work on time. ((Punctuality), I fulfil all the targets all the time, I take appropriate actions on problems as necessary, I adhere to all work-related deadlines)

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APPENDICE-1 QUESTIONNAIRE:

Questionnaire for Managers

4. Your company properly works out on HR Planning to achieve targets.

A. Strongly Agree

B. Agree

C. Neutral

- D. Disagree
E. Strongly Disagree
5. HR provides an adequate pool of employees after HR Planning in your company.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree
6. Your company has Career Planning, Training, & Appraisal system to identify individual skills, interests and needs & which contributes in productivity / development assistance.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree
7. Human Resource Audit give a sense of confidence in the human resource department that it is well managed and prepared to meet potential challenges and opportunities.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree
8. Which method of Performance Appraisal is used commonly?
A. Graphic Rating
B. Paired Comparison
C. Forced Choice
D. 360-degree approach
E. Management By Objectives
9. How often does Performance Appraisals happen in your organization?
A. Quarterly
B. Bi-Annually
C. Annually

10. Rate the following statements:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(i) I believe the Performance Appraisal system is measuring what it is supposed to measure.					
(ii) I feel the system is fair and transparent.					
(iii) The system Human					

Resource Audit is according to the business strategy.					
(iv) The Recruitment and Selection policy are according to the business strategy.					
(v) The leave policy is fair and transparent.					
(vi) These are regular policy audit being conducted.					

11. The Human Resource Audit is conducted by

- A. The concern line Supervisor
- B. HR Managers
- C. External Auditors

https://docs.google.com/forms/d/1eBGAcD5pilwPeVhJs9fJ7dUDHcrH7M16er16F8H_Njw/edit#responses

Questionnaire for Skilled Employees

1. Name:

2. Age:

- A. 25-30
- B. 30-40
- C. 40-45
- D. 45- above

3. Department:

4. Rate the following statements regarding job performance:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(i) On the basis of work, I set appropriate priorities at work.					
(ii) I arrive for work on time. (Punctuality)					
(iii) I fulfill all the targets all the time.					
(iv) I take appropriate actions on problems as necessary.					
(v) I adhere to all work-related deadlines.					

5. Rate the following statements regarding loyalty:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(i) I feel my needs are met by working with this organization.					
(ii) I like the work that I am doing.					

(iii) I might not leave this organization for short term benefits.					
(iv) I consider this organization is as family.					
(v) I feel that this organization takes all around care of my needs.					

6. Rate the following statements regarding career perspective:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
(i) This organization runs regular career development programmes.					
(ii) I have taken promotions in this organization.					
(iii) I am pleased with career advancement opportunities available to me by this organization.					
(iv) I continually set myself practical, specific career development objectives with measurable outcome and defined timescales.					
(v) I am satisfied with career development opportunities for professional growth given by this organization.					

https://docs.google.com/forms/d/16U8AYLakzIq4W-icWV63cb2gRGtCv1yRb-EaCAj_dFQ/edit#responses

Appendice-2cronbach Alpha Calculation Sheet

Respondents (Managers)	Q1	Q2	Q3	Q4	Q7-i	ii	iii	iv	v	vi	Total
1	4	4	4	4	4	4	0	4	4	4	36
2	2	2	2	2	1	2	1	1	4	1	18
3	1	4	1	4	1	2	4	4	4	4	29
4	4	4	4	4	4	4	4	4	4	4	40
5	1	1	1	1	1	1	1	1	4	1	13
6	5	4	5	1	5	4	4	4	5	5	42
7	5	5	5	4	4	4	4	4	5	5	45
8	4	1	4	5	5	4	5	4	5	4	41
9	4	4	4	5	5	4	1	1	5	1	34
10	4	5	5	5	5	5	5	5	5	5	49
11	5	5	5	5	4	4	5	5	5	5	48
12	4	4	4	4	5	5	4	4	4	4	42
13	4	4	5	5	5	5	4	4	4	4	44
14	5	5	5	4	5	5	5	4	5	5	48
15	4	4	4	4	4	4	4	4	4	4	40
16	2	1	1	1	1	1	1	4	1	1	14

17	5	5	4	5	4	1	4	1	4	4	37
18	5	5	5	4	5	5	5	4	4	4	46
19	4	5	5	5	5	5	5	4	5	5	48
20	4	4	4	4	4	4	4	5	5	5	43
21	1	1	1	4	1	4	1	4	1	1	19
22	5	4	4	4	4	5	4	5	4	4	43
23	5	4	5	5	5	4	5	5	4	4	46
24	4	4	4	4	5	5	5	5	5	5	46
25	4	1	4	1	4	1	2	4	4	1	26
26	5	4	5	4	4	1	1	1	4	1	30
27	5	4	1	1	4	4	5	5	5	1	35
28	5	5	5	5	5	5	5	5	5	5	50
29	4	4	4	4	4	4	4	4	5	5	42
30	5	4	5	4	4	5	5	4	5	5	46
31	1	4	4	4	5	4	5	5	5	5	42
32	4	4	4	4	4	5	4	4	5	5	43
33	4	5	5	4	5	5	4	4	5	5	46
34	5	5	5	5	5	5	5	5	5	5	50
35	4	4	4	4	4	4	4	5	5	5	43
36	5	4	5	4	5	4	5	4	5	4	45
37	4	4	4	4	5	4	4	5	4	5	43
38	1	1	1	1	5	4	1	1	4	4	23
39	5	5	5	5	4	4	5	5	5	5	48
40	4	4	4	4	4	5	4	4	4	4	41
41	5	5	5	5	5	5	4	4	5	5	48
42	4	5	5	4	4	4	5	5	5	5	46
43	4	4	4	5	4	4	4	4	5	5	43
44	5	4	4	4	4	4	5	5	5	5	45
45	5	4	5	5	4	5	5	4	4	4	45
46	4	4	5	1	4	4	1	4	5	1	33
47	5	5	5	5	5	5	4	4	5	5	48
48	4	5	5	4	5	4	5	5	5	4	46
49	5	5	5	5	5	5	5	5	5	5	50
50	5	4	4	4	4	4	4	4	4	4	41

Variance	1.4784	1.4736	1.6164	1.6404	1.3204	1.42	2.2	1.42	0.728

Sum (Var)- 13.2968

Vt- 87.5076

a- 0.9423

Respondents (Employees)	Q1-I	ii	iii	iv	v	Q2-i	ii	iii	iv	v	Q3-i	ii	iii	iv	v	Total
51	4	4	5	4	5	4	3	5	2	5	4	1	4	4	5	59
52	4	4	4	4	4	5	5	5	5	5	4	1	4	4	5	66
53	5	5	5	5	5	1	5	5	5	4	5	3	4	4	5	66
54	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
55	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	60
56	4	5	1	5	4	1	4	4	4	4	1	1	1	4	5	45
57	4	4	1	5	4	4	5	4	5	4	1	4	4	4	4	57
58	4	4	1	4	4	4	4	4	4	1	1	4	4	4	4	51

59	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
60	4	5	5	5	5	5	5	5	5	5	4	5	5	5	73
61	4	4	4	5	5	5	5	5	5	5	4	5	5	5	71
62	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
63	4	4	4	4	4	4	4	4	4	4	4	4	4	4	60
64	4	5	5	5	5	5	5	5	4	4	4	5	4	5	70
65	4	4	4	4	4	5	5	5	5	5	5	5	5	5	70
66	4	5	4	5	5	4	5	4	4	4	1	4	1	4	58
67	4	5	4	5	5	4	5	4	5	5	5	4	4	4	67
68	4	5	5	4	4	5	4	4	5	5	4	5	4	5	68
69	4	4	5	5	4	5	5	4	5	5	4	4	4	4	67
70	5	5	4	4	5	5	5	4	4	5	5	5	4	4	69
71	4	4	4	4	4	5	5	5	5	5	4	4	4	4	65
72	5	5	5	5	5	5	5	5	5	5	5	5	5	5	70
73	1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
74	4	5	4	5	5	5	4	4	5	5	4	5	4	5	69
75	4	4	3	5	4	5	4	5	5	5	1	4	1	5	60
76	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
77	4	5	5	4	5	1	4	4	4	4	4	4	4	4	60
78	5	5	4	5	4	4	4	5	4	1	4	4	1	2	54
79	4	5	4	5	4	5	4	5	4	5	5	5	5	5	70
80	4	4	4	4	4	4	4	4	4	4	4	4	4	4	60
81	5	5	5	5	5	4	4	4	4	4	5	5	5	5	70
82	4	4	4	4	4	4	4	4	4	4	4	4	4	4	60
83	4	5	5	5	5	5	5	4	4	4	4	4	4	4	66
84	4	5	5	5	5	5	5	5	5	5	4	5	5	5	73
85	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
86	4	5	4	5	4	4	5	5	5	4	4	5	4	4	66
87	5	5	4	5	5	4	5	5	5	4	4	5	5	4	69
88	4	4	2	4	2	4	4	5	4	1	4	5	5	1	54
89	5	4	4	5	4	4	5	4	1	4	1	1	1	1	45
90	4	5	5	5	5	4	4	4	4	4	5	5	5	5	69
91	4	4	4	4	4	4	4	4	4	4	4	4	4	4	60
92	4	5	5	5	5	4	4	4	4	4	5	5	5	5	69
93	4	5	5	4	4	4	4	4	5	5	4	4	4	4	64
94	5	5	5	4	4	4	4	4	4	4	5	5	5	5	68
95	4	5	4	4	4	5	4	4	5	4	5	4	4	4	64
96	4	5	4	4	4	4	4	5	5	4	4	4	4	4	63
97	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75
98	4	4	4	5	5	4	4	4	4	5	4	4	4	4	63
99	4	5	5	5	5	4	5	4	4	4	4	4	4	4	65
100	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75

Variance	0.4 224	0.48 36	1. 25 44	0.48 64	0.6 04	1.1 32	0.5 26	0. 25	0.8 39	1.3 48	1.6 16	1.1 82	1. 46	08 07	0.8 36

Sum (Var) - 13.24

Vt- 106.8916

a- 0.938717355

Role of Self Employed Women in Investment Decision Making in the Family

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ABSTRACT

Role of women in every family decision is increasing day by day. Especially when women are self dependent, earning their own money and being financially helpful to their family. Those days had been gone when important investment decisions were taken only by male members of the family and women had no right to interfere in that. Now women also know what is good and what is bad for their future so they are also taking interest in those decisions. Here in this research paper attempt is made to highlight the role of self employed women in investment decision making in their family and also tried to know women's dependence on male members in particular decisions. The main objectives of the study were to examine behavior of women while taking investment decisions and also to know which types of investment decisions are affected by their husband and up to which extent. For this purpose the sample size of 100 self employed married women of Porbandar district was taken and data was collected through structured questionnaire. It was found that women are becoming independent in investment decisions but when it comes to decision like real estate, shares or debentures they are strongly influenced by their husband.

Keywords: family, investment decision making, financial planning, role of women, self employed women

INTRODUCTION

In today's era women are playing very crucial and active role in family, business as well as society. In every field they are competing with men. They are not doing just job for earning purpose but also starting their venture, becoming successful entrepreneur and also providing job to other people. If we see in financial terms then those days are gone when they used to give full salary or earning to their husband and not interfering or even not trying to know what their husband are doing with these money. Now they are not just bread winners but also decision maker of their family. With increase in education, vast use of social media, various online sessions and their interest to become more aware about market as well as saving for future, they are also taking active participation in family investment decision making and sometime taking decision solely. Thus role of women in home as well as in business cannot be under estimated. Full participation of both men and women is important for development.

It is believed that women are more risk averse compare to men. They have less confidence, less financial and market knowledge as well as dependent on men when it comes to take investment decision. Husband play important role in married women's investment decisions. This research attempts to highlight role of women in investment decision making in the family. A questionnaire was used to collect the data from 100 respondents to have better idea of how the spouse influences the investment decision of self employed women for different investment avenues.

CONCEPT OF INVESTMENT

Saving & investment activities play vital role for any country's economy. There is a need for saving mobilization it means advocating the need for more and more savings to improve the economic policies

Fromm past many decades saving is a habit of women even when they were not earning their own income and depended on their husband's income. They used to save to meet emergencies as well as for future security. In this competitive era it has become compulsory to secure financial future. That's why Today women give due importance to the need of investing and starting investing at early age to reap the benefits of long term investments in the form of higher returns.

Investment meaning is primarily to obtain an additional source of income or gain profit from the investment over a specific period of time. So it's the commitment of current financial resources in order to achieve higher gains in the future.

There are number of factors affecting investment decision like income, interest rate, risk taking ability, return, duration of investment, inflation, government policy, confidence, expectations, liquidity, tax benefits etc. one has to consider all the related factors whenever taking investment decision.

It has been observed that financial behavior of men & women is different. It was believed that women are risk averse than men, they invest conservatively and have low self confidence regarding their financial behavior. Many studies have been conducted to analyze investor's behavior but very few studies have been conducted with reference to women. That type of study is required have idea about women's perspective and to update their knowledge.

REVIEW OF LITERATURE

CA Anupama Sharma and Dr. Bhavesh Joshi (2015) conducted study on Financial Literacy of Women and its Effect on Their Investment Choice Decision. The main objective was to evaluate the financial literacy of working and financially independent women and its impact on their investment decisions. Primary data was collected through questionnaire from 85 women respondents working in educational sector. Conclusion of the study was financial confidence of women is based on the knowledge and education. It was also concluded that women who do not have financial knowledge are less inclined towards investment.

Inderbir Kaur and Rajni Saluja (2017) in their study, "women power in financial decision-making: a study of Punjab" collected data from 300 men and 300 women respondents of Punjab. The study was done to know various relationship of financial autonomy of women with education and other demographics. Result of the study suggested that women display much lower levels of financial literacy than the older population as whole. Besides that women who are less financially literate are also less likely to plan for retirement and be successful planners.

Sharma & Douglas (2017) in their paper discussed about factors influencing women's preference in investment decision making. According to study investment decision is being affected by various factors like psychographic and demographic factors. Investors can be same in all aspects but their perception can be dissimilar towards different investment plans.

Manish Sharma, Hima Bindu Kota (2019) in their research "The Role of Working Women in Investment Decision Making in the Family in India" conducted study on 84 women with the main objective of to examine the behavior of working women while taking investment decisions and to identify the extent to which the investment decisions of the working women are influenced by the spouse/husband. The main findings were some investment products like bank deposits, 5 year tax saving FDs, precious metals, PPF, post office saving schemes, life insurance etc are strongly influenced by women wile investment products like real estate, debenture or bonds, pension schemes, equity shares and derivatives are highly influenced by men.

Nadia Asandimitra, Achmad Kautsar and Tony Seno Aji (2019) conducted study on Financial Behavior of Working Women in Investment Decision-Making. The main objective of the study was to measure the level of financial literacy of working women, to describe asset allocation, as well as the time & profit in investment. Study was conducted on 100 working women of Indonesia by using random sampling technique. Based on the study's results it showed that working women have high financial literacy. It is indicated by the discipline of investing the excess money, to have control over their finances and have the confidence to earn investment profits, and they must perform financial planning.

Pooja Chaturvedi Sharma and Riya Goel (2019) conducted study on factors affecting investment decision of working women in Delhi – NCR. Main objectives of the study were to analyze women investors' awareness and perception regarding various investment avenues and to identify factors affecting investment decisions of working women. Data was collected from 100 working educated women investors through personal interview with structured questionnaire. The result highlighted that certain factors like attachment, source of information, risk, quality of life and independent decision make significant impact while deciding the investment avenues.

Dr. Runali Goswami (2021) in her research, role of women in decision making in the family, concluded that Education, employment and differential association made working women conscious about her right and economic potentiality. With the achieved status, the women play a major part in economic agenda of the household. The main objective of the study was to examine the involvement of women in the decision-making process related to economic activities of the household and thereby the role played by the women in controlling the family purse. Primary and secondary both data were used for study and then percentage analysis was done. 10 municipal wards and 30 numbers of households per ward were considered for the study.

RESEARCH METHODOLOGY

The present study highlights financial behavior of self employed women and in which investment decisions they require help of their husband. Here, 100 married self employed women of Porbandar district were considered as respondents. For collecting primary data structured questionnaire was used in which personal information of respondents like age, education, field of their business activity and monthly family income was considered. While for the purpose of knowing various financial and investment activities multiple choice questions were asked.

OBJECTIVES

The main objectives of the study are:

- 1) To examine behavior of women while taking investment decisions like taking advice or suggestion, main reason for investment & most preferred Investment Avenue.
- 2) To know how much influence of respondent's husband on various investment decisions
- 3) To know whether women's demographic characteristic i.e. age, education qualification & nature of business affects their involvement in decision making or not?

HYPOTHESIS

1. Ho: There is no significant relationship between age & involvement in investment decision making of the respondents

H1: There is significant relationship between age & involvement in investment decision making of the respondents

2. Ho: There is no significant relationship between educational qualification & involvement in investment decision making of the respondents

Ho: There is no significant relationship between educational qualification & involvement in investment decision making of the respondents

3. Ho: There is no significant relationship between nature of business & involvement in investment decision making of the respondents

Ho: There is no significant relationship between nature of business & involvement in investment decision making of the respondents

DATA ANALYSIS & INTERPRETATION

Demographic profile of the Respondents

100 women respondents were taken from Porbandar district. The minimum age of the respondent is 21 years and they must be completed graduation and involved in any business activity as well as financial decision making process in their family.

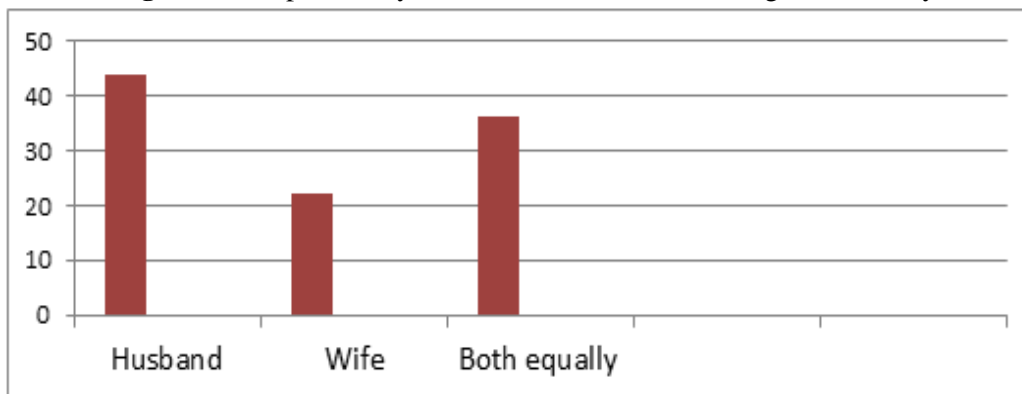
Table 1 Demographic profile of the respondents

Demographic characteristics	Class	Frequency	Percentage
Age group (Years)	21 to 30	21	21
	31 to 40	32	32
	41 to 50	28	28
	51 to 60	19	19
	Total	100	100
Highest Educational Qualification	Graduation	38	38
	Post graduation	47	47
	Professional	15	15
	Total	100	100
Nature of business or activity	Academic	25	25
	Manufacturing or self making	21	21
	Retail selling	28	28
	Other work	26	26
	Total	100	100
Monthly family income (Rs. In	Up to 20,000	16	16
	21,000 to 40,000	40	40

thousands)	41,000 to 60,000	32	32
	Above 60,000	12	12
	Total	100	100

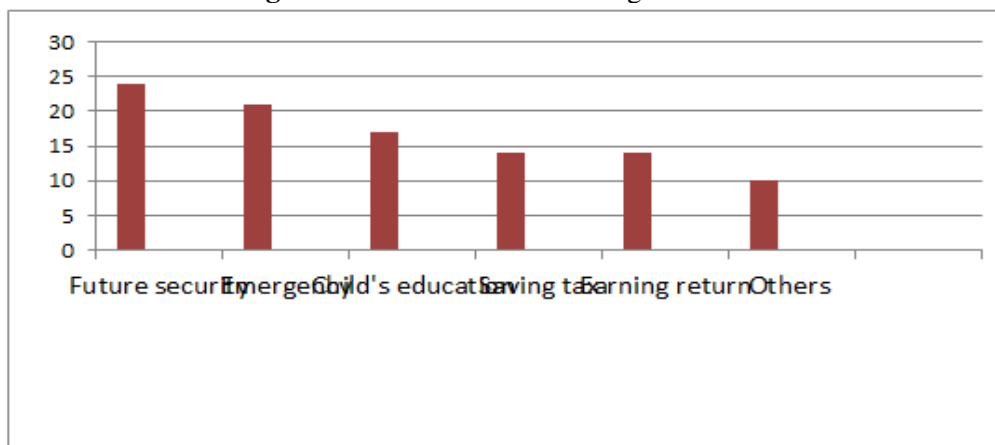
Demographic characteristics in above table reveal that as per age group in 31 to 40 years there are more respondents. Educational qualification wise more respondents have done post graduation. As per nature of activity or business the distribution is more or less equal in each type. While considering monthly family income more respondents are in 21,000 to 40,000 scales.

Figure 1. Responsibility of investment decision making in the family



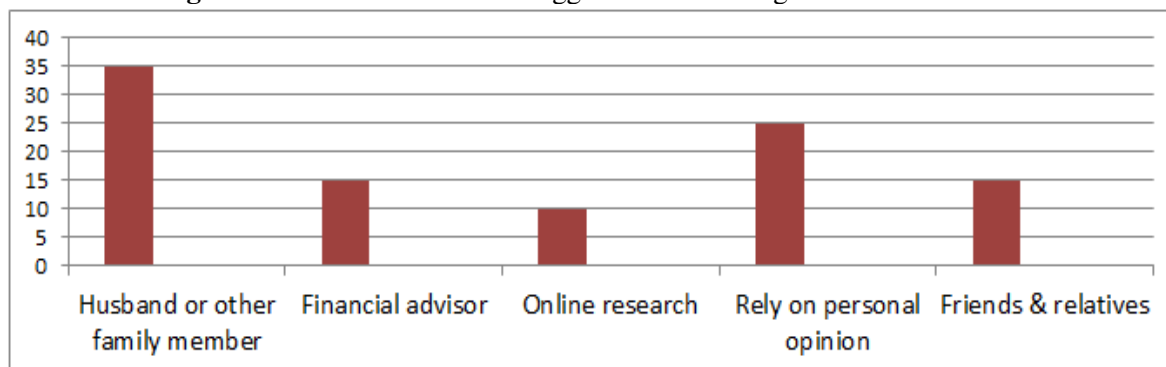
In above table it can be seen that, 44% respondents said that husband is responsible for making investment decision, 22% said that wife is responsible while 34% said that both are equally responsible.

Figure 2. Main reason for making investment



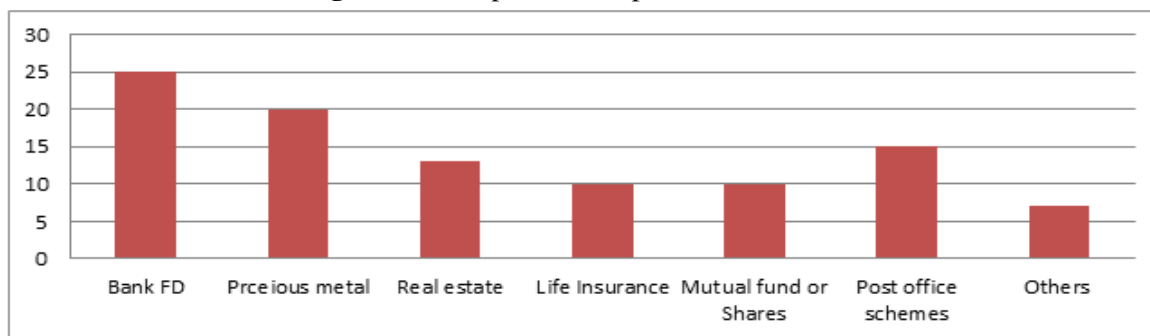
24% women making investment for future security, 21% for handling any emergency situation, 17% for child's education, 14% for saving tax, 14% for earning return and 10% for other purposes like child's marriage, buying home, improve lifestyle etc. There may be more than one reason for making investment but they here they selected top most one only.

Figure 3. Source for advice or suggestion for making investment decision



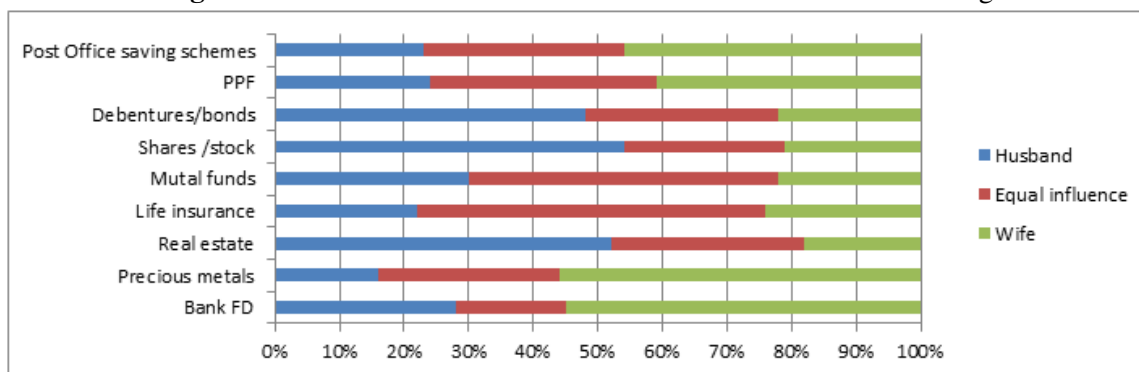
When it comes to take advise or suggestions 35% respondents take help from their husband or other family member, for financial advisor and friends & relatives it is equal i.e.15%, 10% rely on online research while 25% rely on their personal opinion.

Figure 4. Most preferable option for investment



Among all options provided, Bank FD is most popular as 25% selected that option while least popular is Life insurance & mutual fund or shares. Other options include PPF, company deposit, debentures etc.

Figure 5. Influence of wife & husband on investment decision making

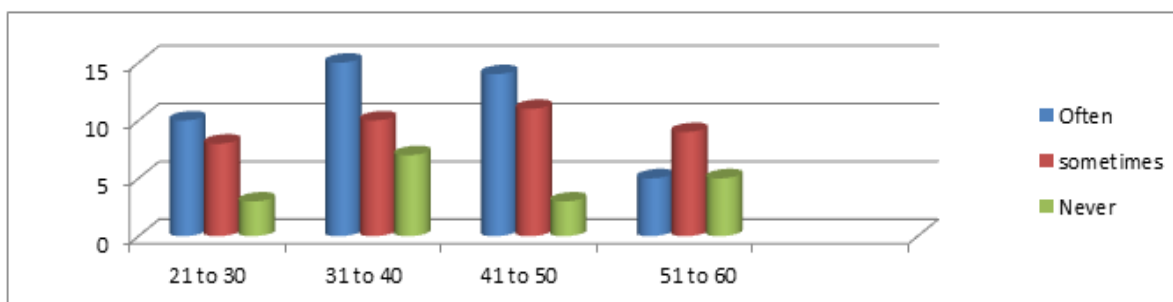


When it comes to take investment decision, women share responsibility. When respondents were asked to tell who influence the investment decisions in the family for various avenues, it was found that products like Bank FD, precious metal like gold, silver, diamond etc, PPF and post office saving schemes, the influence of women is more while in products like real estate, shares/stock and debentures/bond, the influence of men is more. In mutual fund, life insurance it's almost equal & shares.

Table 2 Involvement in investment decision making & age

Age	Often	sometimes	Never	Karl pearson chi-square test Calculated value=4.52 Table value=12.59 Df=6
21 to 30	10	8	3	
31 to 40	15	10	7	
41 to 50	14	11	3	
51 to 60	5	9	5	

Figure 6. Involvement in investment decision making & age

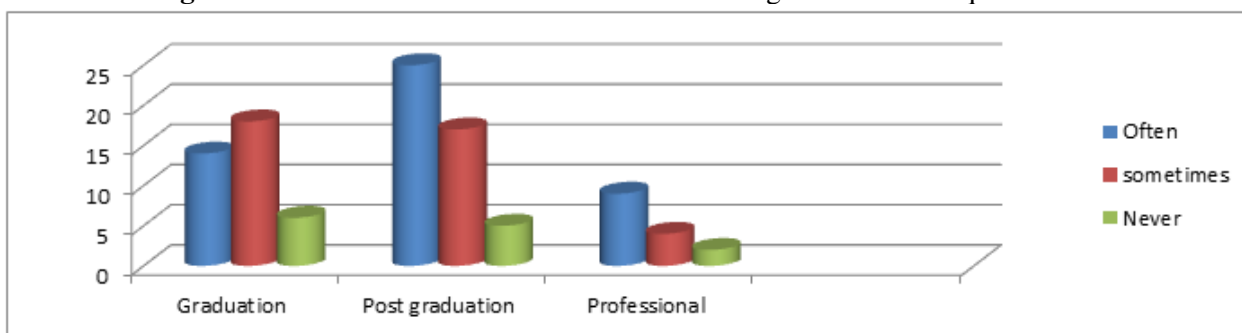


Here it can be observed from the above chart that most of respondents below from the age group 31-40. When it comes to involvement in investment decision making in age group 21 – 30 women’s involvement often is more, in age group 31-40 also women’s involvement often is more, in age group 41-50 same situation is there but in age group 51 – 60 the option sometimes is more. Here Chi square test revealed that age does not influence women’s involvement in decision making.

Table 3 Involvement in investment decision making & educational qualification

Highest educational qualification	Often	sometimes	Never	Karl pearson chi-square test
Graduation	14	18	6	Calculated value=3.49 Table value=9.49 Df=4
Post graduation	25	17	5	
Professional	9	4	2	

Figure 7 Involvement in investment decision making & educational qualification

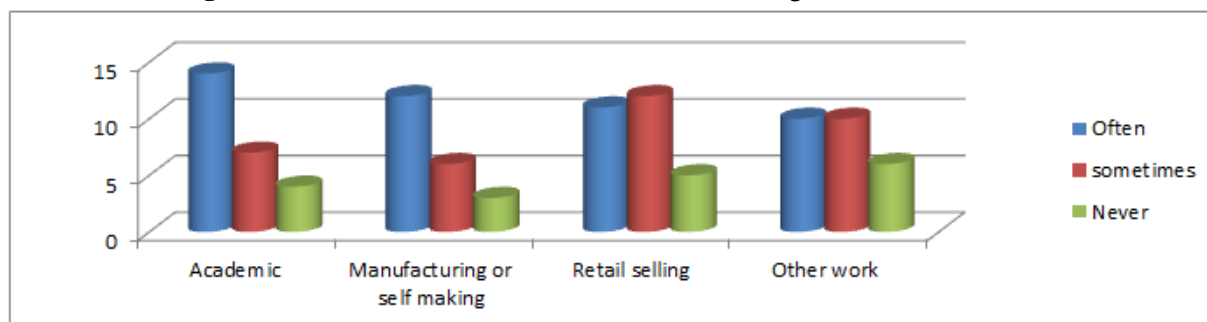


Here it can be observed from the above chart that most of respondents have post graduation as highest educational qualification. When it comes to involvement in investment decision making in graduated women involves themselves sometimes is more, but women who possess post graduation as their highest education qualification involves themselves on regular basis is more while professional women’s involvement is also more in investment decision making. Here Chi square test revealed that educational qualification does not influence women’s involvement in decision making.

Table 4 Involvement in investment decision making & nature of business

Nature of business	Often	sometimes	Never	Karl pearson chi-square test
Academic	14	7	4	Calculated value=3.42 Table value=12.59 Df=6
Manufacturing or self making	12	6	3	
Retail selling	11	12	5	
Other work	10	10	6	

Figure 8 Involvement in investment decision making & nature of business



Above chart shows that that most of respondents are involved in retail selling or academic activity. When it comes to involvement in investment decision making women’s involvement is quite good who are associated with academic activities. Women who are doing either manufacturing activity or self making product, their

involvement is also on often basis is more, same situation can be seen in other work option also. But women who are doing retail selling their involvement are more in sometimes option. Again Here Chi square test revealed that nature of business or activity does not influence women's involvement in investment decision making.

FINDINGS

- Women are taking investment decisions but still the independent decision making is somewhat lower than men.
- When it comes to main reason for investment, future security & handling any emergency situation are the main reasons.
- They are also taking suggestions from their husband.
- Influence of women is more in some investment avenues like Bank FD, precious metal like gold, silver, diamond etc, PPF and post office saving schemes but when it comes to decision like real estate, shares or debentures they are strongly influenced by their husband.
- Women are becoming aware & informed regarding investment their involvement in investment decision making is also getting increase on regular basis
- Age, educational qualification & nature of business they are doing does not affect their involvement but the main condition is that they must have interest to get information and have to develop ability to take risk sometimes

CONCLUSION

From the above data it can be concluded that in Porbandar district importance of women in decision making is increasing. Their education & earning play important role in that. In some cases their influence is more and they are getting hesitated to take final decision, it may be because of lack of knowledge or proper information about those avenues. But overall that's a good sign that they are taking interest and trying to get involved in that. Their increasing role in investment decision also increases their importance in family. If they are aware & informed about those investment options then they can take participate in financial discussion also at their workplace or at any social function, which is helpful to increase their social status also.

Government & NGO's should try to organize seminars for women which can guide them for making better investment choice considering all risk & return factors. Sometimes they want to invest but lack of right information & lack of confidence prevent them to take the step.

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Bioepoxy Resins of Karanja Oil: Synthesis and Evaluation of in VIVO Wound Healing Activity on Wistar Albino Rats

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ABSTRACT

In the present study, bioepoxy resins were synthesized from epoxidized karanja oil (EKO) and evaluated for potential wound healing activity. The karanja oil was epoxidized using H₂O₂ and acetic acid. Bioepoxy resins were prepared using citric acid (CA) and tartaric acid (TA) acting as biobased curing agents. Four bioepoxy resin films (A-D) were prepared using EKO, CA, TA and ofloxacin (OFL). Evaluation of various physicochemical parameters i.e. folding endurance, surface pH, swelling index, moisture absorption, water permeation and mechanical properties showed that the bioepoxy resins are suitable for use as wound healing dressing. Wound healing activity was studied using excision wound model on Wistar albino rats. All the animal groups treated with bioepoxy resins (A-D) showed significant improvement (p<0.05) in the percentage wound contraction rate and time of epithelisation as compared to control. Group III treated with film B (EKO + CA) demonstrated highest rate of wound contraction (25.9% to 55.5%) and shortest time for epithelization (5.66 + 0.22 days). Histopathological investigation of wound tissues samples revealed that groups treated bioepoxy resins had significant granulation, remodelling and contraction with horizontally arranged fibrous connective tissue. Thus, bioepoxy resin film dressings of prepared from epoxidized karanja oil can serve as an alternative for wound dressing films in the treatment of excision wounds.

Keywords: Karanja oil, Pongamia pinnata, Millettia pinnata, Pongamia glabra, bioepoxy resin, wound healing,

INTRODUCTION

Wound healing is a dynamic and complex process involving several inter-related biological activities for achieving tissue regeneration. These processes are divided into four different phases, (i) the coagulation and haemostasis phase (immediately after injury); (ii) the inflammatory phase, (shortly after injury to tissue) during which swelling takes place; (iii) the proliferation period, where new tissues and blood vessels are formed and (iv) the maturation phase, in which remodelling of new tissues takes place^{1,2}. When wound healing does not progress normally, it can become a major concern in case of chronic wounds such as amputations, diabetic and leg ulcers, pressure sores, and traumatic wounds where the patient immunity is low and the risk of infections and complications are high³. With technological advancement, various types of wound dressings are available such as medicated moist dressings, tissue-engineered substitutes, biomaterials-based biological dressings, biological and naturally derived dressings, medicated sutures, etc⁴⁻⁷. However, not all meet the requirements of ideal wound dressing material. Considering the limitations of the various types of wound dressing, there is a need for development of more effective as well as cost-effective dressings.

Epoxy resins are cross-linked polymers that have been widely used for adhesives, coatings, electronic materials, and lamination materials because of their outstanding mechanical properties, high adhesion strength, good heat resistance, and high electrical resistance⁸. Owing to the emergence of sustainable development, research is focused towards the development of bio-based epoxy resin as well as the curing agents derived from natural sources. Various vegetable oils such as soybean oil, castor oil, cottonseed oil, linseed oil, etc. have been used for this purpose due to their biodegradability and low toxicity^{9,10}. Epoxidation is one of the most significant reactions used for chemical modification of triglyceride present in vegetable oils. Such bio-based epoxy resins are being explored for biomedical application owing to their high and low water uptake properties, biodegradation rate and excellent mechanical properties.

Pongamia pinnata or Millettia pinnata (Fabaceae), commonly known as Karanja, is a deciduous tree native to tropical Asia. This plant is used in folk remedies for treatment of wounds, inflammations, piles, ulcers and skin infection¹¹. Oil obtained from karanja (also known as karanja oil, pongamia oil, honge oil, kanuga oil, and pungai oil) is viscous, yellow-orange to brown in colour, non-edible with 45-70% of oleic acid as the

principal unsaturated fatty acid. Several studies have reported the wound healing activity of Karanja. Bhandirge et al.¹² evaluated and demonstrated the wound healing activity of ethanolic extract of Pongamiapinnata bark on wistar albino rats. In 2016, Dwivedi et al.¹¹ studied and reported wound healing activity of the methanolic extracts of P. pinnata leaf on Wistar rats. Shukla et al.¹³ demonstrated the wound healing activity of herbal ointment containing extract of pongamia glabra on albino rats using anemic burn wound model.

The present study reports formulation of bio-based epoxy resins prepared from epoxidized karanja oil as potential wound healing dressing material. The bio-based epoxy resins were prepared using citric acid (CA) and tartaric acid (TA) acting as biobased curing agents. bioepoxy resins were then evaluated of in vivo wound healing activity on Wistar albino rats using excision wound model.

MATERIAL AND METHODS

Materials

All the chemicals and reagents were procured from SD Fine-Chem Ltd (India) And Spectrochem (India). Karanja oil was procured from Vijaya Agro Industries, Sangamner, India. Trimethylolpropane triglycidyl ether was purchased from Sigma Aldrich, Canada.

METHODS

Epoxidation of Karanja oil

Epoxidation of karanja oil was performed as per the following procedure. 24 g (0.11 mol) karanja oil, 7.68 mL toluene, 3.84 g amberlite 15-wet (strongly acidic, polymeric catalyst) and 2.26 g (0.15 mol) of glacial acetic acid were added taken into a round bottom flask. The apparatus was maintained at 80 °C in a water bath. 12.68 g (0.45 mol) of 30% H₂O₂ was added slowly with constant agitation. This precaution was taken to prevent overheating of the system due to exothermic nature of epoxidation. The reaction was continued further for desired time duration. The reaction mixture was dissolved in ethyl acetate and amberlite was filtered off. The filtrate was poured into a separatory funnel and washed repeatedly with warm water until the pH was neutral. The oil phase was further dried above anhydrous sodium sulfate and then filtered. The solvent was removed using a rotary evaporator.

Synthesis of bioepoxy resins from epoxidized karanja oil

Four bioepoxy resin films were synthesized by solution polymerization method (Figure 1) as given in table 1. 1.20 g citric acid or 1.08 g tartaric acid (epoxy equivalent weight: acid equivalent weight ratio of 1:1) and 20 mL of THF were taken in a three necked round bottom flask equipped with reflux condenser. The reaction mixture was continuously stirred to dissolve citric/tartaric acid. 10 g epoxidized karanja oil (epoxy equivalent weight 310 g/mol) was added. For film B and D, 1 g ofloxacin was added and whole mixture was stirred under nitrogen atmosphere at 60-80 °C for 30 min. After 30 min, the solution was found to become viscous. The reaction mixture was cooled to room temperature and removed from the flask. The thin films were casted pre-heated glass plates (10x10 cm²) to avoid thermal shock when the liquid resin was poured onto it. The oven temperature was maintained further at 80 °C for 6 h. The glass plates were taken out, cooled to room temperature (28 °C) and the films were peeled out from glass plates by dipping into water. Residual solvent and moisture from the films was removed by drying on a vacuum oven till constant weight¹⁴.

Table 1. Synthesis of bioepoxy resin films (A-D).

Bioepoxy resin film	Contents
A	Bioepoxy resin film (EKO + CA)
B	Bioepoxy resin film (EKO + CA + OFL)
C	Bioepoxy resin film (EKO + TA)
D	Bioepoxy resin film (EKO + TA + OFL)

Evaluation of Bioepoxy Resin Films of Karanja Oil

The synthesized bioepoxy resin wound dressing films (A-D) were evaluated for various parameters e.g. physical appearance, surface texture, thickness, folding endurance, surface pH, swelling index, moisture absorption, water permeation, mechanical properties, microscopic study and wound healing activity.

Physical Appearance and Surface Texture

The four wound dressing films were evaluated visually for their physical appearance such as colour and transparency. The surface textures of the films were evaluated by pressing the film with finger.

Thickness

Film thickness is an important property as it affects the time required to absorb the polymer into the body¹⁵. Four samples of each film were taken and the thickness was measured using screw gauge at different places. The average film thickness was computed¹⁶.

Folding Endurance

The folding endurance was measured manually. A 2 cm² strip of each film was taken and folded at the same place till it broke. The number of times a film could be folded at the same place gave the value of folding endurance. The average of three determinations was computed¹⁶.

Surface pH

The surface pH of the film was determined by allowing the film to swell by keeping them in contact with 0.5 ml of distilled water (pH 6.5±0.05) for 1 hour in a 50 ml glass beaker. The surface pH was noted by bringing a combined glass electrode near the surface of the film for 1 min using pH meter. The average of three determinations was computed¹⁷.

Swelling index

Swelling ability is a significant parameter when wound healing dressings are studied. 2 cm² strip of each film was accurately weighed by using single pan balance (W₁) and placed in a petri dish containing 50 ml distilled water. After the interval 90 min, film was removed, blotted and weighed again (W₂). The swelling index was calculated by using equation 1. W₂ is wet weight of the film and W₁ is dry weight of the film¹⁶.

$$\text{Swelling index} = \frac{W_2 - W_1}{W_1} \times 100 \quad \text{Equation 1}$$

Moisture Absorption¹⁸

Each film was cut in circular shape with a diameter 2.8 cm and weighed accurately. The films were placed in a desiccator containing silica beads at room temperature for 24 h. The films were then placed in a desiccator containing saturated potassium chloride solution (75% R.H.). After 24 h, the films were removed and weighed accurately. The percentage of moisture absorption was calculated as the difference between the initial and final weights with respect to the initial weight (equation 2)

$$\% \text{ Moisture absorption} = \frac{\text{Final weight (mg)} - \text{Initial weight (mg)}}{\text{Initial weight (mg)}} \times 100 \quad \text{Equation 2}$$

Water vapour transmission rate

The Water vapour transmission (WVT) study was carried out in accordance with the "B" method of the ASTM (American Society for Testing and Materials), guidelines E96- 66.

10.0 mL of distilled water was taken in each permeability cups (Payne permeability cup model, Belgium). The sample films (9.62 cm²) were attached on the cups appropriately. The cups were weighed at time 0, 24, 48, 72, 96 and 120 h and stored in desiccators containing silica gel in order to determine the permeated amount of water (mass loss %). Different values of mass of the cups were recorded and the rate of water vapour transmission through free films was recorded (equation 3). g represents mass loss, t time measured in hours and a the area of the film in m²¹⁹

$$\text{WVT} = \frac{g \times 2}{t \times a} \quad \text{Equation 3}$$

Mechanical properties

The films were analysed for their mechanical properties such as tensile strength, tensile strain, and % elongation (equation 4-6). Films strips (4 × 1 cm) were fixed to the upper and lower platen of tensile tester. L₀ is the initial length of the film before stretching and L is the final length of the film at the point of rupture²⁰.

$$\text{Tensile Strength} = \frac{\text{Force or load}}{\text{Min cross sectional area}} \quad \text{Equation 4}$$

$$\text{Tensile Strain} = \frac{L_0 - L}{L_0} \quad \text{Equation 5}$$

$$\% \text{ Elongation} = \text{Tensile Strain} \times 100 \quad \text{Equation 6}$$

Stability Study

The stability studies were conducted for all the films at 40°C and 75% RH to investigate the effect of temperature on different film formulations¹⁷.

Microscopic Study

The films are studied under digital microscope at 5x and 10x magnification power.

Wound healing Activity

Excision wound healing model was used to evaluate the wound healing activity of bioepoxy resins (A-D). Wistar albino rats of either sexes weighing 150-200 g were randomly divided into five groups of six animals (n = 6) each (Table 2). The rats were kept under maintained conditions (25±2 °C, relative humidity 60± 5%, 12 h light-dark cycles). The study protocol was approved by Ethics Committee of Biocyte institute of research and development sangli (Approval number: 650/02/C/CPCSEA/17) as per Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines, India.

Table 2. Evaluation of wound healing activity of bioepoxy resin films (A-D) on Wistar albino rats (group II-V) with group I serving as control.

Animal Group	Treatment
I	Control
II	Bioepoxy resin film A (EKO + CA)
III	Bioepoxy resin film B (EKO + CA + OFL)
IV	Bioepoxy resin film C (EKO + TA)
V	Bioepoxy resin film D (EKO + TA + OFL)

1. Excision Wound Model

The animals were anaesthetized by anaesthetic ether prior and during incision activity. The back of the each animal was shaved and prepared after washing with spirit. An area of about 2 × 1 cm (5 mm away from ears) was defined with a marker on the shaven back of the animals. The circular marked area was excised with its full thickness using a surgical sterile blade and scissors under ether anaesthesia. The area of wound at the time of wounding was considered as 100%. Number of days required for falling of eschar without any residual raw wound was recorded to estimate the period of epithelialization.

2. Wound Healing Assessment

The progressive changes in wound area were measured in mm at interval of every 7 days. Progressive decrease in the wound size was monitored periodically. Wound healing assessment included estimation of percentage wound contraction and time for epithelization.

• Percentage Wound Contraction

The formulated bioepoxy resin films (A-D) were applied to the wounded rats of the respective groups (II-V). Group I served as control. The wound contractions were measured as the percentage of wound reduction in the wound area for 7, 14, 21 and 28 post wound day by counting number of squares of retraced wound area on graph paper. The degree of wound healing is calculated as percent closure of the wound area from the original wound i.e. percent wound contraction (equation 7).

$$\% \text{ wound contraction} = \frac{\text{Initial wound size} - \text{Specific day wound size}}{\text{Initial wound size}} \times 100 \quad \text{Equation 7}$$

• Time for epithelisation

Number of days required for falling of eschar without any residual raw wound was recorded to estimate the period of epithelialization.

• Histopathology

At day 28, the wound area was removed from the surviving animals for histological examination and preserved in 10% buffered formalin. Thick sections (5-6 μm) were stained with haematoxylin and eosin and evaluated for several histological parameters such as cellular proliferation, formation of granulation tissue, synthesis of

collagen. All the animal groups were assessed blindly by the pathologist and results were compared with the control group.

• **Statistical analysis**

Data are expressed as mean \pm S.E.M. and were subjected to ANOVA followed by Turkey- Kramer Multiple Comparisons Test. The values of $P < 0.05$ were considered statistically significant.

RESULT AND DISCUSSION

The bioepoxy resins films of karanja oil (A-D) were prepared as potential wound dressings (Table 1). They were analyzed for various parameters physical appearance, surface texture, thickness, folding endurance, surface pH, swelling index, moisture absorption, water permeation, mechanical properties, microscopic study and wound healing activity were studied so as to evaluate their suitability as drug delivery systems and promoter of wound healing¹⁵.

Average weight, Thickness and Surface Texture

Average weight of all films ranged from 0.59-0.62 g and the average thickness of all films ranged from 0.1 to 0.12 mm (Table 3). Film thickness is an important property as it affects the time required to absorb the polymer into the body¹⁵. The films were found to be uniform in their weight and thickness. The value of weight and thickness of the films are acceptable for wound dressings. All the films were yellow in colour, opaque and flexible with rough surface texture.

Table 3. Evaluation of weight, thickness, folding endurance, surface pH, mechanical properties and moisture absorption of bioepoxy resin films (A-D).

Group	Average weight(g)	Thickness (mm)	Folding Endurance (unit)	Surface pH	Tensile Strength (MPa)	Tensile Strain	% Elongation	% Moisture absorption
A	0.59	0.10	486	5.6	22.17	0.0175	1.75	1.92
B	0.62	0.11	490	6.2	19.22	0.0025	2.5	9.25
C	0.60	0.10	512	5.6	4.89	0.0275	2.75	2.18
D	0.61	0.12	504	5.9	10.39	0.05	5	10.11

Folding Endurance

It has been reported that the ideal wound dressings should be elastic, so as to follow skin movements and possess adequate resistance to mechanical abrasion²¹. The folding endurance of all films ranged from 486-512 and was approximately similar to each other (Table 3). The bioepoxy resin film C (EKO + TA) was found to have highest folding endurance as compared to others.

Surface pH

Ideally, a wound dressing should maintain slightly acidic environment at wound surface (because the pH of normal human skin ranges between 4.0 and 6.8) and thus, it would accelerate the wound healing process as compared to neutral and alkaline environment. The surface pH of all films was found range from 5.6 to 6.2 owing to the presence of citric acid/tartaric acid (Table 3). This mildly acidic environment provided by films helps in wound healing by controlling wound infection, increasing antimicrobial activity, altering protease activity, releasing oxygen, reducing toxicity of bacterial end products, and enhancing epithelisation and angiogenesis²². Acidic environment also enhances cell proliferation and fibroblast formation²³.

Mechanical properties

The bioepoxy resin films were evaluated for their mechanical properties such as tensile strength, tensile strain, and elongation in order to analyze their strength and elasticity. Films that exhibit higher tensile strength correspond to stronger film as tensile strength of a film is the maximum stress that it can withstand being stretched before necking or cracking¹⁵. The usual range of the tensile strength of skin is reported to be 2.5–16 MPa¹⁸. The tensile strength of films A-D ranged from 4.89 to 22.17 MPa (Table 3). Film A (EKO + CA) was found to have highest tensile strength i.e. 22.17 MPa, followed by films B > D > C. All the films showed percentage elongation in the range of 2.5 to 5%, with film D (EKO + TA + OFL) having highest percentage elongation of 5% followed by films C > B > A. Films presented adequate properties for skin applications.

Moisture Absorption

The ability of a wound dressing to absorb moisture is an important factor for wound healing. Table 3 shows the percentage moisture absorption of all bioepoxy resin films after 24 h. The percentage of moisture absorption of

film B (9.25 %) and D (10.11 %) was found to be higher than that of film A (1.92 %) and C (2.18%). Thus, it can be concluded that bioepoxy resin films are suitable for treatment of light to medium suppurating wounds.

Swelling index

The swelling test helps in determining the prospect of degradation in advance, which is related to the degree of hydration of the system. It is used to verify if the material has structural stability during the period necessary for the formation of the new regeneration tissue. All bioepoxy resin films exhibited low swelling index i.e. 0 to 1.51 and the values remained unchanged more than 90 min at pH 5.5, 6.8 and 7.0 (Table 4). This showed that there was a low degradation of the films²⁴.

Table 4. Swelling indices of bioepoxy resin films (A-D) at pH 5.5, 6.8 and 7.0.

Group	Swelling Index (%) at variable pH		
	pH 5.5	pH 6.8	pH 7.0
A	0.1	0.1	0
B	1.51	0.23	0.52
C	0.46	1.49	0.25
D	0.83	1.24	1.49

Water vapour Transmission Rate

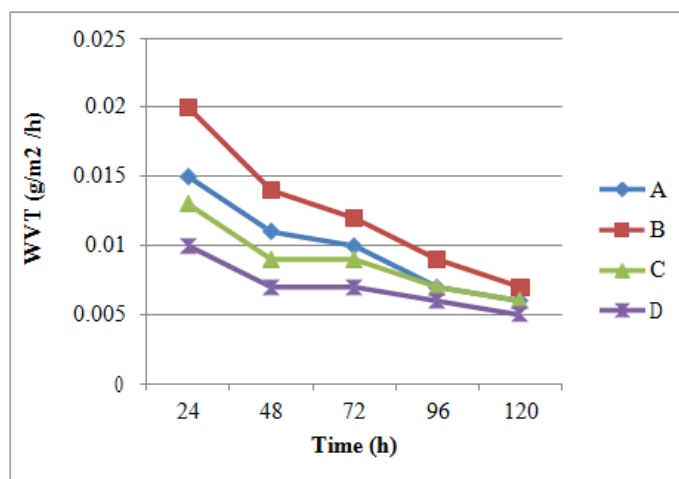


Figure 1. Comparative water vapour transmission (WVT) rates of bioepoxy resin films (A-D).

A dressing used for wound healing purpose should maintain water loss from wound surface at an optimal rate. The water vapour permeability of a wound dressing should prevent both excessive dehydration and the build-up of exudates. The high value of the water vapour loss may lead to dehydration of wound and adherence of the dressing to the wound surface. The rate of water loss at a surface temperature of 35°C from normal skin is 8.5 g/m² /h, whereas those from wounded skin can range from 11.6 to 214.1 g/m² /h¹⁸. The bioepoxy resin films showed WVT rate lower than the usual range of WVT rate in normal and wounded skin (Table 5). The comparative WVT rates show that film D (EKO + TA + OFL) has lowest WVTrate followed by C < A < B (Figure 1). These findings suggest that bioepoxy resin film is more suitable for use in a low suppurating wound.

Table 5. Water vapour transmission (WVT) rates of bioepoxy resin films (A-D) at 24, 48, 72, 96, and 120 h.

Film	Water vapour permeation rate at hour (g/m ² /h)				
	24	48	72	96	120
A	0.015	0.011	0.01	0.007	0.006
B	0.02	0.014	0.012	0.009	0.007
C	0.013	0.009	0.009	0.007	0.006
D	0.01	0.007	0.007	0.006	0.005

Stability Studies

The stability studies were conducted for all the formulations at 40°C and 75% RH. All the formulations were found to be stable with respect to the physical parameters. There are no changes in visual appearance and clarity.

Microscopic Study

The films are studied under digital microscope at 10x magnification and air droplets were observed in film with non-uniform texture of bioepoxy resin films.

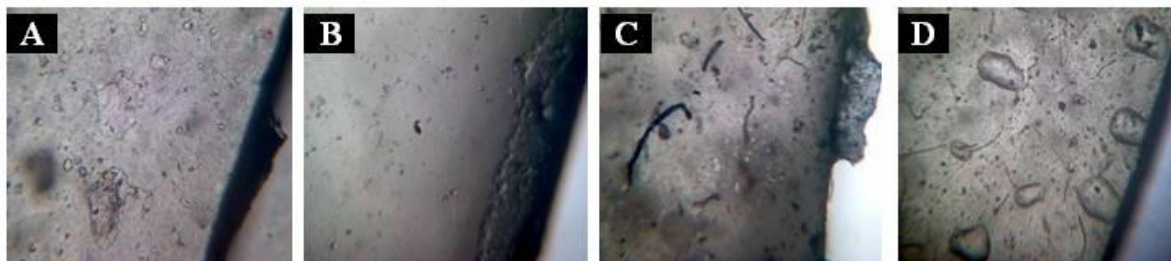


Figure 2. Bioepoxy resin films (A-D) as observed under digital microscope at 10x magnification.

Wound Healing Activity

Wound healing is a process by which a damaged tissue is restored as closely as possible to its normal state and wound contraction is the process of shrinkage of area of the wound. Quantitative measurements of wound size are routinely used to assess initial wound size before and after debridement, as well as progress toward wound closure²⁵.

Percentage Closure of Original Wound Area

A significant increase in wound healing was observed in groups treated by bioepoxy resin films (A-D) as compared to the control group. The mean percentage closure of wound area was calculated on 0, 7th, 14th, 21th, and 28th post wounding days as shown in Table 6. In comparison with control, group III treated with film B (EKO + CA) demonstrated highest rate of wound contraction (25.9% to 55.5%) from day 7 to 28 (Figure 1). Group II treated with film A (EKO + CA + OFL) closely followed Group III with increase in wound contraction from 13% to 51.8%. Per cent wound contraction in Group IV treated with film C (EKO + TA) was found to increase from 13% to 48.1% and that of Group V treated with film D (EKO + TA + OFL) from 7.4% to 42.6%. All the groups treated with bioepoxy resin films (A-D) showed higher rate of wound contraction than that shown by control group I (7.4% to 33.3%). There was only slight increase in the rate of wound contraction with the use of citric acid in films as compared to tartaric acid. There was significant improvement ($p < 0.05$) in the percent wound contraction rate in treatment groups as compared to the control group. These observations indicate that epoxidized karanja oil film have potential to improve woundhealing rate.

Table 6. Effect of bioepoxy resin films (A-D) on percentage wound contraction by excision wound model.

Animal Group	Treatment	Wound area (mm ²) (mean ± S.E.) and percentage of wound contraction on post wounding day					Time for epithelisation in days (Mean ± S.E.)
		0	7	14	21	28	
I (Control)	–	18 ± 0.00	16.33 ± 0.33 (7.4%)	15.33 ± 0.33 (14.8%)	13.33 ± 0.33 (25.9%)	12 ± 0.66 (33.3%)	12.33 ± 0.33
II	A	18 ± 0.00	15.66 ± 0.88 (13%)	13.33 ± 0.88 (25.9%)	10 ± 0.57 (44.4%)	8.66 ± 0.66 (51.8%)	6.66 ± 0.22
III	B	18 ± 0.00	13.33 ± 0.88 (25.9%)	12.33 ± 1.20 (31.5%)	11 ± 1.15 (38.88%)	8 ± 0.57 (55.5%)	5.66 ± 0.22
IV	C	18 ± 0.00	15.66 ± 0.88 (13%)	14 ± 0.57 (22.2%)	11.33 ± 1.15 (37%)	9.33 ± 0.57 (48.1%)	11.00 ± 0.22
V	D	18 ± 0.00	16.66 ± 0.33 (7.4%)	14 ± 0.57 (22.2%)	12 ± 1.15 (33.3%)	10.33 ± 0.33 (42.6%)	11.66 ± 0.22

$p < 0.05$. Statistically significant difference in comparison with control group.

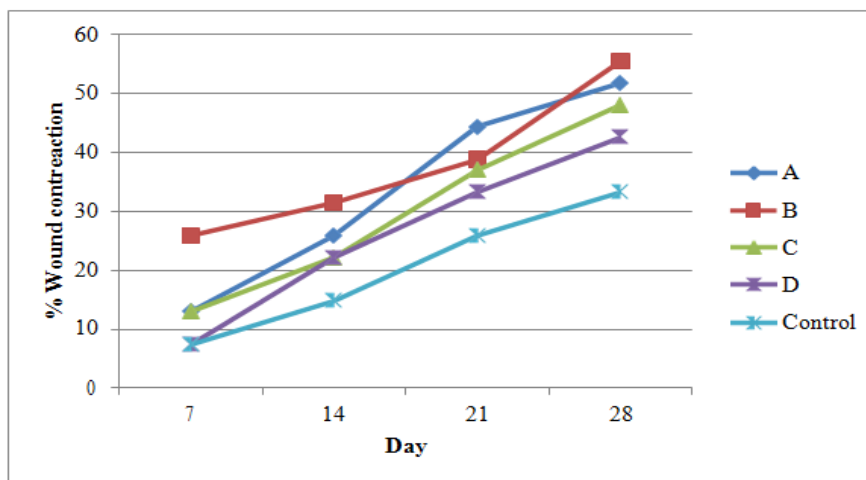


Figure 3. Comparison of wound contraction rates of bioepoxy resin films (A-D) with control.

Time for Epithelization

Group III treated with film B showed epithelization in shortest period ($5.66 + 0.22$ days) as compared to $12.33 + 0.33$ days shown by control i.e. approximately six days faster (Table 6). It was followed by Group II, IV and V which showed epithelization in $6.66 + 0.22$, $11 + 0.22$, $11.66 + 0.22$ days respectively. All the groups treated with bioepoxy resin films (A-D) showed significant decrease in epithelization time ($p < 0.05$) as compared to that shown by the control group (Table 6).

Histopathology

The wound tissues samples of Group I-V were evaluated for the cellular proliferation, formation of granulation tissue, synthesis of collagen (Figure 4). The normal wound healing contains three successive but overlapping phases: hemostasis/inflammatory, proliferative, and remodeling phases²⁶. Regular growth of granulation tissue during wound healing is one of the indicative of wound healing²⁷. Early in wound healing, the collagen is relatively thin and oriented parallel to the skin; over time, the initial collagen fibrils are resorbed and replaced with thicker fibrils aligned with stress lines²⁸.

In control group animals (Group I), poorly formed granulation tissue with abundant mononuclear inflammatory cells can be observed (Figure 4). Whereas, in groups treated with bioepoxy resin films (II-V), granulation, remodelling and contraction with horizontally arranged fibrous connective tissue was observed, all of which is indicative of wound healing. The presence of collagen fibres was found to be less in all groups, however, they were least observed in Group II (film A) as compared to other groups. These observations indicate that

bioepoxy resin films (A-D) promote significant wound healing activity by increasing cellular proliferation, formation of granulation tissue, synthesis of collagen and by increase in the rate of wound contraction as compared to the control animals.

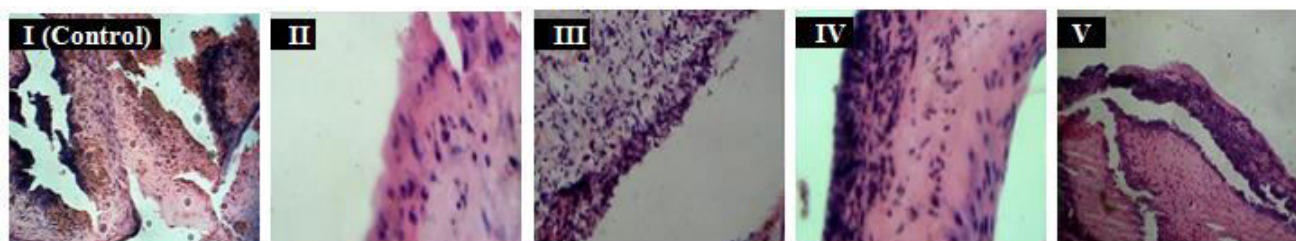


Figure 4. Histological sections of hematoxylin and eosin stained cutaneous wound site tissue of Group I-V on day 28 post wounding. **Group I (Control)** shows abundant mononuclear inflammatory cells. **Group II-V:** granulation and remodeling, contraction with horizontally arranged fibrous connective tissue and lesser collagen fibres.

CONCLUSION

Bioepoxy resins were successfully synthesized from epoxidized karanja oil (EKO) and evaluated for their use as potential wound dressing films. Four different bioepoxy resin films (A-D) were prepared using EKO, CA, TA and ofloxacin (OFL) and evaluated for its physicochemical parameters and wound healing activity. The folding endurance, surface pH, swelling index, moisture absorption, water permeation and mechanical properties were analyzed and bioepoxy resins films were found to exhibit the desired wound dressing properties. Wound

healing activity was studied in vivo using excision wound model on Wistar albino rats. All the animal groups treated with bioepoxy resins (A-D) showed significant improvement ($p < 0.05$) in the percentage wound contraction rate and time of epithelization as compared to control. Histopathological investigation revealed that bioepoxy resins have beneficial influence on the various phases of wound healing like fibroplasia, collagen synthesis and contraction resulting in faster healing. Thus, it can be concluded that bioepoxy resin film dressings formulated from epoxidized Karanja oil possess significant wound healing activity and can be used as alternative in the treatment of excision wounds.

CONFLICTS OF INTEREST

The author has declared no conflicts of interest.

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Synthesis and Crystal Field Parameter Study of Hydrazone and Benzamide Metal Complexes

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ABSTRACT

A number of organic molecules and their Zn(II), Cd(II), and Hg(II) metal complexes have been generated and described using elemental analysis, Mass, IR, and NMR data. The crystal field parameters have been explored with the ligands.

Keywords: Synthesis, Crsytal field theory, Metal complexes, Ligands

INTRODUCTION

Composite of transition metal ions with multidentate organic ligands have been the subject of intensive research because they not only have interesting spectral and magnetic properties, but they also possess a diverse spectrum of biological activities [1-6]. These composite often possess remarkable and unique spectroscopic, photophysical and electrochemical properties which may be exploited in sensory and diagnostic applications and there have been a number of reviews [7-12] on the utilisation of transition metal composite as ion and molecular sensors. Based on the widely diverse coordination environment of the transition metal composite, and variation in the identities of the coordinating ligands, synthesis of such composite with desired molecular geometry can be realized. It is well known that several metal chelates have been shown to inhibit tumor growth [13] and some drugs even exhibit increased activity when administered as metal composite [14-16]. Thus, the study of the coordination of transition metal ions with different types of ligands has been amplified by the recent developments in the field of bioinorganic chemistry and medicines [17]. The rich diversity of transition metal coordination chemistry, therefore, provides exciting prospects for the design of novel coordination ligands having unique structures and valuable functional characteristics [18-24] and significant efforts directed toward the design of specific architectures formed by the self-assembly processes have been carried out in a number of fields of synthetic chemistry [25-27].

While the knowledge of coordination chemistry is essential to the understanding of the structural and functional features of various biomolecules like metalloproteins, its medical application ranges from the development of MRI contrasting agents, radiopharmaceutical chemotherapeutics to the treatment of metal toxicity [17]. Studies on the complex formation of metal ions with a number of biomolecules or biologically active ligands have, in fact, attracted a lot of interest during the last few years because they act as models for the interactions of metalloenzymes [28] and other complicated proteins [29] in the biological systems. Thus, the bioinorganic chemistry of nickel is a topic of increasing interest [30, 31] because the study of the interactions of Ni(II) with nucleotides offers an unique opportunity for understanding various properties of Ni(II) composite such as the carcinogenicity of some nickel compounds [32] and the antineoplastic activity recently detected in some nickel composite [33].

Furthermore, development in the field of bioinorganic chemistry has also led to an increased interest in composite of N, O-donor ligands since it has been recognized that many of these composite may serve as models for biologically important species having N and O as bonding sites [28]. Amino acids and their derivatives are extensively studied as typical N, O-donor ligands. Aroyl hydrazones derived from amino acids and N-protected amino acids are of special interest in that they not only possess many potential donor sites but there is also possibility of keto-enol tautomerism which may lead to varied bonding and stereochemical behavior in the composite in which they act as neutral or mononegative or even as dianionic ligands depending on the aroyl substituents and the reaction conditions [34, 35]. Their chemistry has also been intensely investigated owing to their cooperative capability [36, 37], their pharmacological activity [38-40] and their use in analytical chemistry as metal extracting agents [41]. The interest in the study of these compounds arose from their tendency to form chelates with transition metals, lanthanides, and main group metals, and their interactions have served as model systems for the study of many biomolecules and metalloproteins.

MATERIAL AND METHODS

N-benzoyl glycine, 3-aminoacetophenone, 4-dimethylaminobenzaldehyde, potassium hydroxide, potassium nitrate and metal salts, $MCl_2 \cdot nH_2O$ (M = Ni, Cu and Cd) were purchased from E-Merck. The surfactants used in this study, triton x-100 (TX-100), sodium dodecyl benzene sulphonate (SDBS) and cetyltrimethylammonium

bromide (CTAB) were from Sigma-Aldrich and used as obtained without any purification. Acetonitrile, benzene, ethanol, ether, carbontetrachloride, 1,4-dioxane, N, N- dimethylformamide, dimethylsulfoxide, tetrahydrofuran and all the other chemicals used in the study were of AnalaR grade. All the solutions used in potentiometric titrations were prepared in double distilled water.

The following are the various tools, procedures, glassware, solvents, reagents, and techniques utilised in the production of transition metal complexes with N, O-ligands:

- Digital pH-meter of Eutech Cyberscan pH 1100
- Perkin-Elmer model 240C Analyzer.
- Systronic Conductivitymeter 306.
- Magnetic Susceptibility Balance, Sherwood Scientific Cambridge, UK
- Varian E-line X band ESR Spectrometer
- Shimadzu 2450 UV-Vis Spectrophotometer.
- Shimadzu Fourier Transform Infrared (FTIR) Spectrophotometer 8400S
- Jeol AL 300 FT NMR Spectrometer.
- Jeol Sx102/Da-6000 Mass Spectrometer.
- Perkin Elmer Simultaneous Thermal analyzer STA 6000.

METHODOLOGY

Preparation and Characterization of the Ligands

Preparation of 4-dimethylamino benzylidene (N-benzoyl)glycyl hydrazone (dabBzGH) : N-benzoyl glycine hydrazide was prepared as reported [42]. 4-dimethylamino benzylidene (N-benzoyl)glycyl hydrazone, dabBzGH was prepared by refluxing ethanolic solutions of N-benzoyl glycine hydrazide (0.02 M, 1.0 g, in 10 mL) and 4-dimethylamino benzaldehyde (0.02 M, 0.77 g, in 30 mL) for 4 hours. The light yellow precipitate obtained on slow cooling of the reaction mixture was filtered, washed repeatedly with ethanol, recrystallized from hot ethanol and dried at room temperature. dabBzGH is characterized by its melting point, elemental and hydrazine analysis, infrared, nuclear magnetic resonance and mass spectral data. Yield = 60 %; m. p. 210 – 213 °C; M^+ peak at $m/e = 324$ as molecular ion peak in the mass spectrum of the compound.

Preparation of N-(2-2-[1-(3-aminophenyl)ethylidene]hydrazino-2-oxoethyl)benzamide (aehb) : N-(2-2-[1-(3-aminophenyl)ethylidene]hydrazino-2-oxoethyl)benzamide, aehb was prepared by refluxing ethanolic solutions of N-benzoyl glycine hydrazide (0.02 M, 1.0 g in 30 mL) and 3-aminoacetophenone (0.02 M, 0.7 g in 10 mL) for 4 hours. The white precipitate obtained on slow cooling of the reaction mixture was filtered and washed repeatedly with ethanol. It was then recrystallized from hot ethanol and dried at room temperature. aehb is then characterized based on its melting point, elemental and hydrazine analysis, infrared, nuclear magnetic resonance and mass spectral data. yield = 60 %; mp 213-215 °C; M^+ peak at 311 as the base peak in the mass spectrum of the ligand.

Preparation of the composite

1 g of each ligand in 20 mL ethanol (3 mmol) was mixed with ethanolic solutions of the metal chloride ($MCl_2 \cdot nH_2O$) (3 mmol). The reaction mixture was then refluxed. Formation of the Cu(II) complex of dabBzGH occurred after refluxing for 4 hours in ethanolic solution. The precipitate of Cu(II) complex was separated out after cooling and filtered, washed with ethanol and dried in air. However, Ni(II) and Cd(II) composite could only be isolated after refluxing for ~ 20 hours. The precipitation was also to be initiated by adding ~20 mL of acetonitrile and THF to the concentrated reaction solution. The precipitates obtained were filtered, washed with acetonitrile and THF mixture and dried in desicator.

Preparation of Reaction Mixtures

The following sets of reaction mixtures were prepared.

Solution (i)	:	[HNO ₃ + KNO ₃]
Solution (ii)	:	[solution (i) + Ligand], and
Solution (iii)	:	[solution (ii) + MCl ₂ . nH ₂ O] [M = Ni, Cu, Cd]

For each set of reaction mixture, three separate solutions (iii) containing Ni(II), Cu(II) and Cd(II) ions were prepared. The metal to ligand ratio was kept constant at 1:2 in all the reaction mixtures. The volume of each set was made up to 25 mL with 40 % (v/v) aqueous - dioxane solution. The ionic strength of each reaction mixture was maintained at 0.1 M using standard KNO₃ solution as the background electrolyte. The reaction mixtures were then titrated individually against the standard KOH solution. All the titrations were carried out at three different temperatures (290.15, 300.15 and 310.15) K.

RESULTS AND DISCUSSION

In the current work, 4-dimethylamino benzylidene (N-benzoyl)glycyl hydrazone, dabBzGH was prepared by refluxing ethanolic solutions of N-benzoyl glycine hydrazide (0.02 M, 1.0 g, in 10 mL) and 4-dimethylamino benzaldehyde and N-(2-2-[1-(3-aminophenyl)ethylidene]hydrazino- 2-oxoethyl)benzamide, aehb was prepared by refluxing ethanolic solutions of N-benzoyl glycine hydrazide (0.02 M, 1.0 g in 30 mL) and 3-aminoacetophenone (0.02 M, 0.7 g in 10 mL) for 4 hours

1. 4-dimethylamino benzylidene (N-benzoyl)glycyl hydrazone (dabBzGH) (Fig. 1)
2. N-(2-2-[1-(3-aminophenyl)ethylidene]hydrazino- 2-oxoethyl)benzamide, (aehb) (Fig. 2)

On the basis of fundamental research, conductance, warm, attractive, infrared, electronic, and ESR phantom data, the Ni(II), Cu(II) and Cd(II) ions of these ligands have been built and generally defined. On the basis of fundamental research, conductance, warm, attractive, and infrared data, electronic data, and ghostly ESR results, the Zn(II), Cd(II), and Hg(II) structures of these Schiff base ligands have been constructed and thoroughly defined.

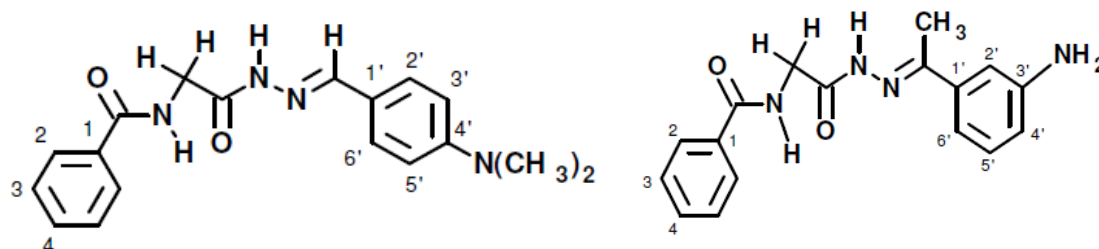


Figure 1. Structure of dabBzGH and aehb

CONCLUSION

Using various physico-substance information, the structures of Zn(II), Cd(II), and Hg(II) complexes with two different compounds have been shown. Complexes have been created by combining transition metals Zn(II), Cd(II), and Hg(II) with mixed ligands. The complexes are variously described using infrared spectroscopy, Mass spectrometry, melting point, and solubility. The crystal field parameters have been studied.

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Flood and Water Level Monitoring System Utilizing Wireless Sensor Network as a Solution for Smart Environmental Monitoring System

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ABSTRACT

Analog techniques have increasingly been employed to assess environmental or physical characteristics. Several of them are capable of recording the information on paper sheets. The earlier methods saved data at periodic times and needed people's behavior to retrieve it. Digital data recorders superseded manual data loggers a few years ago. Electronic information recorders are simpler to use and manage, as well as less expensive than older systems. Digital data recorders can additionally be utilized in conjunction with long-distance network applications to collect information from faraway locations. Though, there are certain disadvantages to using digital information recorders. Digital data acquisition solutions typically allow tracking at a single location, however, throughout many circumstances, various points must be examined. Because there isn't a standard for storing information or interacting with a data acquisition system, numerous alternative techniques are employed. A technique for flood and water level monitoring systems employing wireless sensor networks as a remedy to smart environmental monitoring systems is addressed in this study.

Keywords: Environmental Monitoring Systems, Wireless Sensor Networks, Flood and Water Level Monitoring, Sensor Nodes, Micro-electro-mechanical systems, Chemical Composition.

1. INTRODUCTION

Recent advancements in micro-electro-mechanical systems and low-power mobile network technologies have established the technological circumstances necessary for the creation of multi-functional small sensing devices that can be utilized to watch and respond to physical mechanisms in their surroundings. Wireless sensor nodes are low-power gadgets that include a CPU, memory, a power source, a transmitter, and, in certain situations, actuators. chemical, optical, thermal, and biological detectors may all be linked to wireless sensor nodes. These sensor gadgets are tiny and less expensive than traditional sensing devices.

Wireless sensor networks (WSNs) are made of sensor nodes that are geographically dispersed and detect as well as document physical and environmental parameters. WSNs have significant uses across an array of sectors, as depicted in Figure 1, encompassing farming, irrigation, environment monitoring, meteorology, pollution levels, seismic activity, wildfires, and disaster monitoring [1-4]. Wireless sensor networks are self-configuring, infrastructure-free networks that detect environmental and physical factors. WSNs may detect a variety of ambient parameters, such as temperatures, noise, vibrations, speed, gravity, movement, moisture, and biochemical or contaminant quantities, as shown in Figure 1 [5]. When used in these situations, WSNs work together to send information through the network to a centralized point or sink, so that it can be examined and

analyzed. Wireless sensor nodes can endure adverse weather conditions and function autonomously in their execution environment. Wireless sensor nodes may be set in situ (static installation) or transportable to cover broad geographic regions (dynamic deployment).

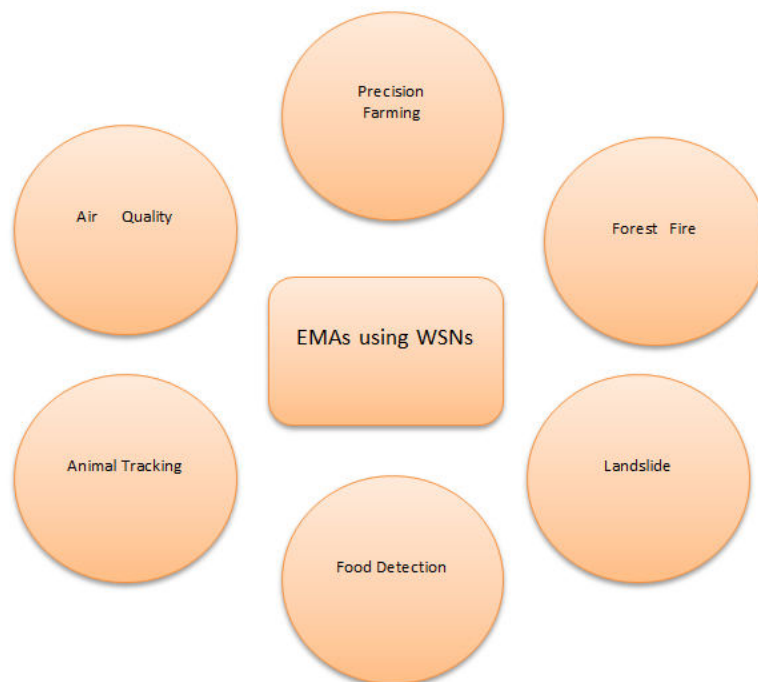


Figure 1. WSN-based Environmental Monitoring Applications

WSNs for EMAs also include methods for gathering information and power consumption parameters. When WSN information is produced from various resources, it can either be captured precisely or with some duplication. Real-time sensor information gathering allows for the precise portrayal of existing environmental situations as well as the prediction of prospective environmental circumstances and dangers. Smart farming, for instance, helps farmers to change their agricultural tactics at any moment by using real-time information provided by sensors deployed in the fields [6-10]. The ability for farmers to plan and alter land use planning actions based on smart agriculture data, instead of depending on hypothetical typical farming practices which might not occur everywhere in real-time. Information gathering in EMAs is dependent either on traffic creation or activity recognition, which may impact the quantity of power employed by every sensor node. Sensor nodes around a drain, for instance, quickly lose their energy relative to other sensors. WSNs need energy for detecting, computation, and information transmission.

When WSN designs are used for EMA implementation, they provide new possibilities and problems. For instance, adding machine learning and Internet of Things approaches in WSN for EMAs has created design issues that need different concepts in optimization techniques, affecting the networking protocol stack. As a result, investigators should be concerned with sensor nodes as well as network topologies, algorithms, and protocol design for WSNs for EMAs. It is critical to evaluate the fundamental technologies that influence how nodes are deployed (placement, coverage, and connectivity). Developing new ways to enhance the speed of the network and longevity is critical in WSNs for EMAs. As a result, it is worthwhile to examine the different WSN topologies as well as the environmental elements of EMAs in different domains of application.

Monitoring the fluctuation of external factors is critical for determining the sustainability of our surroundings. The information gathered is critical for a range of organizations and entities. Governments may make educated choices based on surveillance data regarding how the atmosphere will influence humanity and how humanity will impact the natural world. Wireless sensor networks are rapidly being a worldwide phenomenon as a consequence of the advancement of low-cost, low-power wireless communication technologies. WSN describes a system of dispersed sensors that monitor and document environmental circumstances and arrange the recorded information in a server's database. WSNs calculate environmental factors such as earthquakes, rain, intensities, pollution, flames, and winds.

WSN has a broad spectrum of applications. The bulk of environmental monitoring depends on WSNs because of the undeniable benefits they provide: cheaper costs owing to connection maintenance, flexible infrastructure

components, scalability, and require less maintenance. Wireless sensors and sensor networks have already been effectively employed in the realization of solutions in a variety of fields, such as environmental control, natural calamities prevention, current usage tracking in buildings, surveilling mechanisms for radiology operators' dosimeters in smart healthcare, location services of individuals, securities, or harmful gases, gear circumstance surveillance, and process improvement in manufacturing environments, as well as traffic congestion control.

2. WIRELESS SENSOR NETWORKS

Even though many sensors establish contact with actuators and process stations (through local area networks, for example), a growing amount of sensors send gathered data remotely to a centralized collection point. This is significant because several application programs need hundreds or thousands of nodes for sensor data, which are often installed in distant and inaccessible locations. As a result, a wireless sensor includes not just a detecting element, and also onboard computation, communications, and memory. With some of these upgrades, a sensor node is frequently accountable not just for information gathering, but additionally for in-network assessment, correlations, and fusing of its sensor information as well as information from other sensors. A wireless sensor network is formed when several sensors work together to analyze huge physical areas. Sensor nodes use wireless radios to connect not just with one another but also with a base station (BS), enabling them to send sensor information to distant computation, visualization, analytics, and memory devices.

Since connected technologies have minimal power resources, minimizing power consumption and extending network lifespan are becoming primary design objectives of next-generation wireless networks. Since wireless Sensor Networks are made up of small energy-hungry sensors, retaining the amount of energy of such nodes for an extended length of time is a difficult procedure. Wireless Sensor Networks are composed of a number of small sensors that monitor or sense information. Due to their tiny size, electricity is supplied by a small battery, which, if placed in an inaccessible location, cannot be changed or refilled on a regular basis. As a result, one of the primary constraints of wireless sensor networks is power efficiency.

Significant advances in wireless communication systems, Micro-Electro-Mechanical Systems (MEMS), and optics have created an exciting new era in contemporary civilization, inhabited by tiny, low-power, cost-effective, portable electronics known as sensor nodes that will saturate our society, altering as it is now. Sensor nodes are made up of sensing of special-purpose processing devices that are linked through wireless communication systems. When interconnected, these sensor nodes would become a component of complex networks, delivering data as well as executing and regulating a wide range of jobs and operations. Each sensor node's dimensions and expenses would be critical for a broad spectrum of purposes in both normal and demanding settings. Considering the efficacy of sensor networks in atmospheric data collecting, monitoring, and target detection, they can help a wide range of uses whose needs differ along the time-space-context continuum. Sensor networks may be utilized to aid in pre-event planning and management, as well as a quick reaction during the event and post-event restoration and analysis. To improve the environment, a huge number of miniature commodity sensor nodes might be deployed, for instance, in houses, on highways, in cars, along riverbeds, or near coasts, among other places. New sensor nodes may be deployed on request at any time in selected places known as areas of interest (AOI), or at random in specified regions. An intelligent node in the network is a technology that combines detecting, computation, and communications. Figure 2 depicts the fundamental architectural components of a sensor node. The sensor module detects changes in characteristics, signal conditioning circuitry converts electronic signals to the software world, the sensed analog signal can be processed and used as an input to the software methodologies or control module, memory aids in task processing, and the transmitter and receiver communicate with other detectors, core networks, or sinks in WSN.

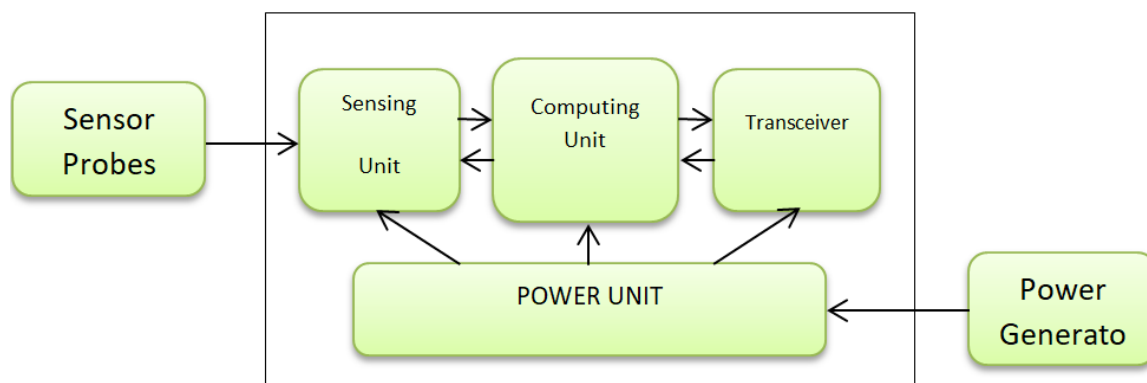


Figure 2. Basic architectural components of a sensor node

Heat, pressure, moisture, soil composition, vehicle movement, sound levels, light levels, the existence or exclusion of certain items or materials, mechanical stress levels on connected objects, and some other qualities may all be monitored using sensors. Geological, electromagnetic, heat, optical, infrared, auditory, or radar mechanisms could be employed. A smart sensor can also identify itself and diagnose itself. Smart sensor technologies operate in one of three ways: by direct line of sight toward the targets (as in optical sensors), by closeness to the targets (as in seismic sensors), or by direction of propagation with potential bending (such as acoustic sensors). Sensor networks are mostly data-centric as opposed to address-centric. But instead of particular sensor locations, inquiries in such a network are redirected to an area including a cluster of sensor nodes. Since the data received by detectors in a dense cluster are comparable, data processing is conducted locally. In other words, an aggregate node inside the cluster prepares an overview or evaluation of the local data, decreasing the connection bandwidth needs.

Data aggregation increases performance and integrates redundant information to accommodate for link failure. A network hierarchy and sensor node cluster provide network throughput, resilience, effective resource usage, and decreased energy usage, which are all important aspects of WSN.

3. RELATED WORKS

Investigators now have several peer-reviewed study achievements in the domains of instrumentation and control, connected cars, smart homes, surveillance systems, and so on. Several researchers have employed technological advancements in multiple directions to reach the research aims in the present study findings. For instance, depending on ZigBee protocol research, Tinyos operating system investigations, and embedded Linux system studies, some research conducted GPRS, TCP/IP, and other protocols to investigate the coupling of wireless sensor networks and the World Wide Web.

Researchers have suggested a biochemical sensor capable of identifying harmful materials and toxic chemical information to protect human safety, as well as an electronic identification device for atmospheric temperature as well as light intensity to create accurate heat and light in different locales, as well as detect and showcase the procured information in real-time to enable human-computer interaction.

Studies explored the WSN platform and constructed the interrelations between the wireless sensor network and the remote server, as well as the network monitoring and management system, and realized the selection of network climatic parameters on hardware as well as information management and computation on software. Studies explored environmental surveillance using a wireless sensor network technique, which they then deployed on hardware and established network communication. For every 15 minutes, the wireless sensor node transmits environmental parameters to the master node over the GPRS network, and the master node utilizes TCP. The data is sent to the remote host using the IP protocol.

The researchers created an atmospheric tracking system centered on a wireless sensor network for smart farming. It can gather heat, moisture, pressure, and certain other data continuously and transfer them to a remote computer through GPRS. This system also contains online services, a Google map, and SMS (Short Message Service) alarms, among other features. Researchers presented a WSN-based remote agricultural monitoring system for networks. It can reliably gather environmental parameters in the greenhouse and transmit quick notifications to farmers if the data is updated abnormally. The atmosphere of the site is hard to pin down. They created an ARM-based multi-location wireless detection system that controls the SMS TC35i module and sends and receives Text messages using an ARM controller. Since the size of sensor data transmission is so big, connecting sensor network nodes to the Internet is a tough task. We understand that IPv4 addresses are now almost depleted right now, and it is no longer required to assign IPv4 addresses to sensor network nodes. Since there are so many IPv6 addresses available, the deployment of IPv6 technology in wireless sensor networks will allow all nodes to be issued an IP address.

As a result, IETE formed the 6LoWPAN (IPv6 over Low Power WPAN) working group, which is dedicated to standardizing the IPv6 protocols on the IEEE802.15.4 standard. The ad hoc nature of environmental monitoring is expressed in two ways. One is that the data gathered at one moment is very random. As a consequence, in order to acquire correct findings, big-scale and big information points must be collected using statistical approaches. Moreover, the amount, size, and temporal and geographical dispersion of information are all influenced at random by people's social behavior, natural variables, unique environmental elements, etc.

4. FLOOD AND WATER LEVEL MONITORING SYSTEM

Whenever natural calamities including earthquakes, storms, and tsunamis strike, it requires enormous strength and bravery to deal with them. The ideal supply of data about the circumstance is a necessary pre-requisite for

dealing with such crises in a timely and highly predictable manner. Over the last couple of years, enormous changes have occurred in global communication and information architecture, such as the widespread adoption of the Internet, the remarkable growth and falling costs of mobile communication, as well as the deployment of sophisticated space-based remote sensing and satellite communication networks. Emerging innovations such as WSN arise among the new accomplishments and advancements of worldwide telecommunications and information infrastructure.

Yet, there is significant potential for sensor networks to be utilized for flood measurement techniques, particularly in tropical locations. Despite the fact that the basic concept for WSN was to cope with these kinds of networks, numerous investigators throughout the globe have discovered many aspects of WSN, because such frameworks have yet to be established in poor nations. This study provides a foundation for such a technology. This section describes a flood control and alert system that is supported by a wireless sensor network.

Each nation threatened by flooding needs flood observation, management, and monitoring systems. It is critical to categorize several stages including varying degrees of activity behind such development of the system. Level one of data collection begins with the actual placement of smart sensors along riverbeds and the creation of an appropriate localization method based on the circumstances and surroundings. The positioning of the wireless sensors is influenced by the river's stream channel, previous recordings of flowing water, and forecasting of the river's course. To connect with the local core network, the sensors create clusters. Local base stations are strong enough to establish a connection to each other through wireless communications.

The information collected by the sensors is pooled at the local base stations and sent into the system that processes it. Figure 3 depicts a graphical representation of sensor node placement and data gathering.

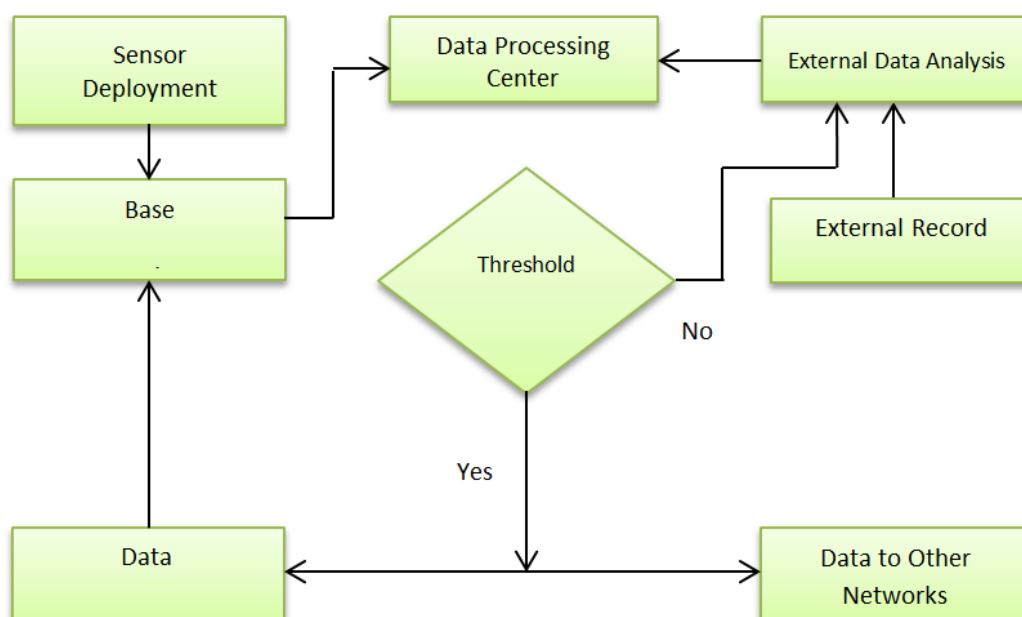


Figure 3. Sensor node deployment and data aggregation

Level two is concerned with the installation of local base stations as well as communication devices at the district level. Level three might work with the headquarters' centralized monitoring system to analyze gathered data. The information is analyzed either at headquarters or at independent testing organizations that specialize in high-risk flood assessments. After the analyzed data is available, with results that have a low degree of inaccuracy, the following step begins in the opposite order to the first.

The second step incorporates a data network infrastructure, in which information generated is delivered to various network components. For example, a flood warning given by the headquarters might be transmitted to local mobile phone businesses for SMS delivery to their mobile users. Furthermore, the police or fire departments might be contacted for any precautionary precautions to be taken instantly via the use of different distribution channels. Data processing begins after the acquisition process and proceeds to a safety limit.

5. SENSOR NETWORK ARCHITECTURE

Sensor Network Architecture (SNA) is utilized in WSNs. These networks may conduct sophisticated detection, neighbor node identification, data processing and retention, data collecting, object tracking, controlling and

monitoring, synchronization, node localization, and efficient routing between the base station and nodes in a variety of real-time operations. SNA is built on the open system interconnection (OSI) concept and comprises five levels (physical, data link, network, transport, and application layers).

Many standards are indeed being designed to function at each tier of the SNA. Standards, for instance, regulate transmitter operations at the physical layer of SNA, while medium access control (MAC) protocols handle bandwidth allocation, scheduling, and proximity at the data link layer. At the network level, network protocols handle communication responsibilities such as topological and adaptable topological maintenance. Transport layer protocols improve data distribution and storage. The subsequent sections provide a description of the layered as well as clustered designs.

While constructing WSNs for EMAs, various design considerations must be addressed when employing the SNA (sensor network architecture). Many of these challenges involve, among others but are not limited to, energy consumption, quality of service (QoS), privacy, computation, localization, and network design cost. Since the sensor nodes are powered by batteries, energy usage is crucial.

Moreover, replacing the battery in EMAs is difficult. As a consequence, the sensor node's detecting, communication, and processing elements should be controlled although the node is functioning. Procedures developed effectively at various levels (physical, data connection, network, and transport) may greatly minimize the energy spent by the sensor network.

6. CONSTRAINTS IN ENVIRONMENTAL MONITORING USING SENSOR NETWORKS

The phrase Internet of Things refers to a concept wherein computers and embedded systems are ubiquitous in human activities, providing relevant content and data regardless of the specified location [11]. The use of sensors and actuators will be crucial in realizing this goal. Despite substantial attempts to accomplish the Internet of Things goal, there are still certain problems that must be solved. The most important are listed below.

Power control-This is critical for long-term operation, particularly when investigating distant and dangerous situations. Harvesting techniques, cross-layer protocols, and novel energy memory sticks are proposed as potential options for extending sensor lifespan. **Scalability**-A wireless sensor network may support hundreds of thousands of nodes. Actual WSN for the setting now suggests the usage of tens to hundreds of nodes. **Control through the internet**-Since systems located in distant places can indeed be inspected regularly, a remote access systematic approach is required to run, administer, reprogramme, and reconfigure the WSN, independent of the manufacturer [12-15].

Usability-As a result, the WSN must become simpler to deploy, manage, and comprehend. It is important to build additional software modules with more user-friendly interfaces and to present new straightforward installation procedures. **Standardization**-IEEE 802.15.4 is a stumbling block in standardization efforts. Yet, in fact, there is relatively little interoperability between off-the-shelf components. Standard interfaces must be specified to facilitate compatibility among various module producers in hopes of reducing costs and expanding available possibilities.

Support for mesh routing-Mesh network topologies may support both multi-hop and route diversity. As a result, a routing system that supports multi-hop mesh networks is critical, and it must take into consideration the network's relatively restricted characteristics. **Size**-Several applications require that the size be reduced. Size reduction is influenced by battery size and radio power needs. The development of systems interoperable with smart dust may be critical in WSN environmental control.

7. CONCLUSION

This study examines the wireless sensor network implementations, with a particular emphasis on environmental monitoring systems. Such devices use little energy, are inexpensive, and provide an easy method to handle real-time observation of vulnerable agriculture and habitat. Furthermore, it may be used to track indoor living conditions, greenhouse conditions, temperature conditions, and woodland conditions. These techniques have been shown to be a viable replacement for the conventional strategy of using manpower to track the environment, thereby enhancing the effectiveness, resilience, and productivity of the surveillance system. A technique for flood and water level monitoring systems employing wireless sensor networks as a solution to smart environmental monitoring systems is addressed in this study.

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Recollections of Memory and Suffering in Kazuo Ishiguro's Novel *Never Let me go*

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ABSTRACT

This paper attempts to examine aspects related to Recollections of memory in Kazuo Ishiguro's novel with special reference to *Never Let me go*. Kazuo Ishiguro became one of the most talented writers of the twenty-first century by his indelible works. Today he is recognized as one of the most notable contemporary fiction authors in the English-speaking world. He is one of a handful of authors who write bestselling books while winning prestigious literary awards.

Keywords: Ishiguro, memory, identity, testimony, recollections of memory suffering, Englishness, loyalty.

Ishiguro's well-known reputation as a major novelist rests on a reasonably small literary output-five novels in two decades. The novels continue to win prizes and recognitions: his first novel, *A Pale View of Hills*, received the Winifred Holtby Award of the Royal Society of Literature; *An Artist of the Floating World* received the Whitbread Book of the Year Award for 1986; *The Remains of the Day* was awarded the Booker Prize for 1989, and *When We Were Orphans* was short-listed for the Booker in 2000. Kazuo Ishiguro was born in a world-famous Japanese city of Nagasaki in 1954. At a tender age of five, he moved to Great Britain where he later attended the University of Kent and obtained his Bachelor's degree in English and Philosophy. He then continued to develop his writing skills by attending the creative-writing course at the University of East Anglia where he obtained his Master's degree. Before his career as an author, he worked as a community worker and wrote songs and lyrics for popular bands.

"I realized, of course, that other people used these roads; but that night, it seemed to me these dark byways of the country existed just for the likes of us, while the big glittering motorways with their huge signs and super cafés were for everyone else." (Ishiguro, 2005, p. 267).

Kazuo Ishiguro's sixth novel *Never Let Me Go* (2005) offers challenges to his readers with the concept of othering through the protagonist narrator Kathy, who is trying to contemplate herself among the rest of the society.

Kazuo Ishiguro's novel, *Never Let Me Go* deals with the beliefs, morals and practice of the rapid, modern and advanced technology at that time; and specifically, cloning humans which is the most common thing in England and human clones are forced to donate their organs in another reality. The story of this novel takes place in a dystopian version of late 1990s England, where the practice of human cloning is common and it is prolonged through a state-sanctioned program of human cloning for the lives of ordinary citizens. Here the clones, are grown in a special environment and in a special organization. They are away from the outside world and this type of clone is referred to as students. They developed in such institutes only for donating their vital organs when they become young.

Another indicator of the identity struggles the character's face can be observed in the concept of "possible" that the characters seek to find. The characters constantly grasp at a sense of belonging throughout the novel, as they have no family or understanding of their origins that they can hang to. In her essay on the novel, Anne Whitehead astutely observes that Hailsham and the Cottages are "for Kathy, all there is: she does not have a surname because she does not have a family, and her relationships with her fellow students accordingly take on the strength and ambivalence of family relations" (Whitehead, 69).

In this sensitive story Ishiguro reveals the truth of sophisticated society with the help of his character Kathy and he illuminates the philosophy of the society. According to the belief of their society, first you should have a "soul" the most important ability to articulate artistic expression to prove, and therefore one can be considered as a human being. However, when we examine deeply, the answer is ironically come out and it is clearly justified as all the three clones represent in this novel as a very human trait: They also have feelings like normal people, they have feelings like dreams and hopes, can be sensitive, unconfident and have a skeptical outlook of the world, worried in search of answers.

Whereas, the normal people and the mentors of the society represent the dark side and evil competences of human nature. The clones are totally brainwashed, they are being trained in a special place and said that one of their major responsibilities is to help society, for the better or worse. According to the writer's treatment and

instruction which is given by the boarding school, a place where clones are brought up, clones must be follow these type of instructions and the story ends with each of the clones losing their organs for the advancement of the society, carrying their roles in their “pre-determined” life as they almost inconsiderately give up. The story of this novel is concluded as these characters hugely help develop the whole story with different features and dimensions of different themes. We can say that, throughout the novel, the characters are faced with many conflicts and other ambiguous problems towards developing a certain type of theme as they accurately adjust to the society with these changes. Overall, through this novel Ishiguro gives suggestion to the readers as a warning the new technology who is disturbing the rules of nature and aware the readers on the dark side of technology, as it is confidently said that we may replace valuable human life with new researches and development of this type of the most disgusting things.

This novel is a detailed examination on the activities and their contribution in developing a unique story and certain themes throughout the novel. It also explains their relationship, feeling and emotions when the clones come contact with normal human. The novel gives a real picture of personalities and relationships developed by the “clones” and “normal humans”. Kazuo Ishiguro express the feeling of both the clones and the humans, presented with this endless dilemma; and it raised a big question among readers how can it be convinced that the clones can be considered as humans? In this story narrator told about determined human clones that how one-day young adult’s clones will be became a “donors” and those clones who have not yet begun the donation process would receive care from designated “careers,”. The main purpose of the clones continues to donate organs until they “complete,” they know that after the donation of three or four organs they will be die.

The narrative of this novel begins with an overview which tells readers how clones and “normal people” live together with in a sophisticated society in an alternate England, where no one has dare to raise questions against this unusual system and politics practiced there. When we go through the novel we find that he doesn’t focus on any type of particular groups. He perhaps decided not to focus on the “ordinary human” and he also divert his attention away from the clones, who, after all, are treated simply as humans. Because Ishiguro knows that the depiction of the “normal people” is ignored by these two groups are not compared as it should be, thus the “clones” play the main role, the role of clones is explained as normal people who have an emotion of love, hate and mourn, and who feels happy, sad, wishful or desperate, but there a big question raised in the reader’s mind that what is their own identity? who are their parents? and many more. most importantly, there is big question remains same the meaning of their existence and who are afraid of their own end throughout the whole novel. Thus, after comparing these aspects of their lives, it may be difficult to us to distinguish clones from normal people, as they actually wish for the same thing clones are the characters that readers can be empathetic about, and this is the reason why the clones could be considered a representation of humans in general.

Never Let Me Go, is well known as one of Ishiguro’s most heart touching novels just because of its techniques and thematic diversity in many ways, here he illustrates the relationship between clones and normal human beings. Its tells a story about Kathy, Ruth, and Tommy, and their relationship with the outer world around them. It also explores the secrets of humanity in depth and the double nature means other aspects of complex human relationships. As we know that Memory is one of the most important and common themes for Ishiguro’s all the novels. After examining his work, the theme of ‘memory’ encompasses his novels, and has proved to be a trademark of his characters. In this story Kathy explains that how she wants to go back to her old memories of Tommy and Ruth, she also tells that both two are her school friends who grew up at the Hailsham school with her. Here, Kathy does not describe that Hailsham students are clones, what is the reason behind growing them in a particular place and the donation program.

When we examining the detailed characterization of these three friends, their former school, thereby bringing and their relationship with Hailsham, we know that it takes the reader into sharp focus the subject of community.

The past memories of Kathy contain of a mixture of series of events that happened in his life. She explains confidently her memories to us one by one in episodes, it contains exhaustive description, assumptions, interpretations, doubts, fear, consciousness, recollections of memory, and forgetting etc. Even if she proficiently makes a balance between her only speculation and confidently remembers events as she can, the frequency and detailed description of Kathy’s memories in a particular duration over a period of utterances and dialogue might be remarkable if whole twenty years had considered by any one. Through Kath’s self-consciousness Ishiguro explored the memory as phenomena in *Never Let Me Go*. Here he gives a true image of Kath’s past memory by the Curious Incidents that are far more multi-layered rather than it is. In this novel the reader’s attention is often drawn towards the nature and variability of Kathy’s recollections, not just towards her memories in themselves,

due to her self-conscious reminiscence. The story of this novel starts with Kathy 's narration about her unforgettable incident, she talks about an incident which take place in the sports pavilion at the Hailsham boarding school. Suddenly, she interrupts herself and admits that "maybe I'm remembering it wrong" (Ishiguro, 2005, p. 8). She also gives an alternative explanation of her feelings towards her friend Tommy, classmate at boarding school at the time. After that, she more confidently gives a real picture of that incident and says that "what I do remember is that I noticed Tommy was wearing the light blue polo shirt" (Ishiguro, 2005, p. 8). Here Ishiguro explains type of recollection through the main character Kathy. The whole narrative of this story balanced upon these two types of memories as: first one is those memories what she confidently recalls as correct. And another one is that what Kathy rather freely interprets and those ambiguous incidents that are not much clear. she openly admits this. The detailed description of above given incident, what Kathy worries are and how she reacted and how she felt in the situation. "She is more certain about some incidents, what she actually saw. As previously stated, Baddeley asserts that in real life, it is easier to remember events than inner thoughts." (141). The reader will easily recognize her character effect which is enhanced by Kathy's recollection processes as significant of reality.

The reader is also drawn into sympathy with Kathy because of the way in which Kathy organizes her memories. She explains that "in my memory my life at Hailsham falls into two distinct chunks: this last era, and everything that came before. The earlier years – the ones I've just been telling you about – they tend to blur into each other as a kind of golden time, ... but those last years' feel different. ... Maybe I've exaggerated it in my mind, but I've got an impression of things changing rapidly around then (Ishiguro, 2005, p. 76)."

Memory is compromised for the sake of re-living and re-entering important episodes from the past, which is a common technique in retrospective fiction. We will find that *The Curious Incident* displays a similar compromise of memory. Consequently, there is a constant negotiation between reliability and reader involvement in both *The Curious Incident* and in *Never Let Me Go*. Whenever the reader becomes particularly involved and engaged in the story, the reliability guard is dropped for the sake of enjoyment and anticipation of what will happen next.

Through one of major character Kathy in this novel, various manifestations of suffering are examined from the view point of existentialism. The whole concept of donation might be understood as a metaphorical expression for human life, as well as the omnipresent consciousness of its finitude.

Here Ishiguro rises a big question among sophisticated and rich society and he has prepared the ground for disturbing discussion where two allegedly different groups of people – clones and "normal people". the another purpose to fosterage clones is to donate their vital organs, it is not very clear that "the recipients" suddenly occurs to be vague in terms of humanity and the general understanding of human presence.

According to their sophisticated society, the capacity to communicative artistic expression is more important and it proves having a "pure soul", and then can be considered as a normal human . However, when we deeply analyses and rise question, the answer of this question is ironically and clearly comes out as each clone have hopes and dreams like other human being, they can also get emotional, insecure and have an uncertain attitude towards the world, we find many distractions in search of answers. While, the "normal humans being"; embodies a different human characteristic: This type of human represent the unpleasant side and evil experiences of society and human behavior. They clone are brainwashed and fully motivated to help sophisticated society, for the better or secure future. This treatment shows that the clones are very obedient and they behave as like as instructed in a particular time duration, and the story ends with a painful seen. At the end of this story narrator explore the limited life cycle of clones in their pre-determined life every clones have to give up their organs, as they are developed for donating their organs almost thoughtlessly carrying. The novel concluded with these characters who skillfully develop different themes through diverse aspects. Throughout the entire novel, the characters are facing many challenges and conflicts to develop a certain theme as they are being persuasively adjust to these changes in their life. Overall, Kazuo Ishiguro wants to give a strong message about the dark side and misuse of latest technology and he warns reader on the dangers of technology, as we can easily exchange valuable human life with technological research and development but it is unfair for others.

Beneath the surface, *Never Let Me Go* conveys the rules and machines of memory. Over the narrative as a whole Kathy finally contradicts her own forgetfulness as her memories.

The bitter truth and challenges of Kathy's old cum realistic memory express in a different way, although here Ishiguro makes a suspense about Kathy's memory and in that context, her challenging memory, becomes an important device to creating suspense. Throughout the novel the characters come across with many recognitions

that they are different from the rest of the world, and “dual consciousness” is formed by these experiences. Kathy tells an incident to the reader of her first encounter with Madame that becomes an unforgettable moment of consciousness. When the children are excited and run up to her to see her reaction, they become aware of the absolute anxiety she has of them. Kathy describes Madame’s fear of the children as “the same way someone might be afraid of spiders” (Ishiguro, 2005, p. 35).

In *Never Let Me Go*, however, we look back on memory of Kathy it is provide the narrative with consistency as surrounding context rather than a character trait. In this novel Kathy’s past is narrated in the present from which, during this time she has suddenly entered into a different mode of perception and her loneliness that serves to boost her memory. After that she started her own company and started to spends a lot of time into this company in various sub-branches which is spread across the different centers in the country. As she knows that the other reality of his life that she is specially brought up to donate his organ to needy sophisticated people, she doesn’t have “self-existence” and the final stage of her life is going to; she will soon become a donor. The reader admits and accept as true in Kathy’s pain, emotions and accounts of her past life because of these type of lonely, sad and peculiar surroundings that happens one by one which seems uplifting to Kathy.

Notably, Kathy is encouraged to tell her donors about Hailsham a boarding school where clones are brought up with pre decided purpose. She can’t stop herself to express her old memories in her own thoughts:

“What he (my donor) wanted was not just to hear about Hailsham, but to remember Hailsham, just like it had been his own childhood. He knew he was close to completing and so that's what he was doing: getting me to describe things to him, so they'd really sink in, so that maybe...the pain and the exhaustion, the line would blur between what were my memories and what were his. That was when I first understood, ... all the rest of us.” (Ishiguro, 2005, p. 5)

This above situation makes Kathy value and cherish her own memories which is express thought out the whole novel, as well as she clearly remembers that in her childhood, she was so kind and she has had friends. She admits this as the novel is about to close, to declare last stage of her life and narrative is seems realistic whenever it claims to be:

“I was talking to one of my donors a few days ago who was complaining about how memories, even your most precious ones, fade surprisingly quickly. But I don’t go along with that. The memories I value most; I don’t see them ever fading. I lost Ruth, then I lost Tommy, but I won’t lose my memories of them” (Ishiguro, 2005, p. 280).

The “enduring dilemma” of dual consciousness concludes in the scene where Tommy and Kathy decided to go to speak with Madame and Miss Emily about attaining a deferral. There is no absolutely description of culture, race or ethnic background of any character, throughout the entire novel. Miss Emily replied curiously and tells Kathy that “You glanced at George, the big Nigerian man pushing me. Oh yes, you had quite a look at him and he at you” (Ishiguro, 2005, p. 257). This above statement is strange because she directly mentions his racial identity, and she dwells upon the matter about the connection between Kathy and George. The reader can fairly and easily see the similarities in both of their conditions: As pre decided fact that Kathy is a clone and has to care for the weak and must give her life in “service of others” believed superior to her, while George cares for the now weak Miss Emily.

During the colonial era and the British Empire Nigeria was one of the foremost exporters of slaves. Ishiguro try to connects the past social perception and objectification of individuals during the slave trade to the potential future objectification of individuals via cloning. Ishiguro draws attention to the similarities between these characters as another way of generalizing the experience of dual consciousness to encompass a broader feeling of disenfranchisement. Both suffer from monstrous exploitation and both are torn apart by double--consciousness, and Ishiguro draws attention to this similarity in this strange moment.

In this novel main characters are struggling to search for their own identity, it can be easily observed by the character’s face about their struggles. The characters are developed as per requirement of the story, constantly grasp at a sense of relativity throughout the novel, as they don’t have family or understanding of their origins. Anne Whitehead astutely observes in her essay, that “Hailsham and the Cottages are for Kathy, all there is: she does not have a surname because she does not have a family, and her relationships with her fellow students accordingly take on the strength and ambivalence of family relations” (Whitehead 69).

After analysis of this novel we can say that overall level of narrative strategy is unique and different, here the narrative technique strongly refers to an ‘autobiographical’ memory who have a labels of sensibility. “Kathy’s

memories about herself, the world that surrounds her, and her relations to the world are central (Baddeley 138).” Yet definite features of her consciousness lean towards to an open challenge that the way memory operates in narrator’s real life. As we well identify that, narrator’s recollections affect both aspect of his real-life memory and mythical miracles. Furthermore, the story also becomes unreliable just because of Kathy’s imperfect memory. Nevertheless, it is fact that throughout the whole novel Kathy accept challenges and truthfully interpret her past makes an impression on the reader.

The novel *Never Let Me Go* is a detailed examination on the activities and their contribution in developing a unique story and certain themes throughout the novel. It also explains their relationship, feeling and emotions when the clones come contact with normal human. The novel gives a real picture of personalities and relationships developed by the “clones” and “normal humans”.

At the middle point of the story, Kathy also try to motivates the reader by recollection of her own storytelling technique: “You have to remember that until that point we’d never been beyond the grounds of Hailsham, and we were just bewildered. If you’d told me then that within a

year,...” (Ishiguro, 2005, p. 116). In sum, the concept of memory in the novel have Kathy’s own multifaceted memory at the primary, but also includes the recollections of her other associated characters, the reader, and the narrator also. Significantly, the consciousness of memory is connected to the particular geographical area which is explored in the novel in predefined way as at contain point Kathy observes. At the end of the novel Kazuo Ishiguro ends with Kathy’s imagination, she started imagines standing by a field.

“just a little fantasy thing, because this was Norfolk after all, and it was only a couple of weeks since I ’d lost him ... I half-closed my eyes and imagined this was the spot where everything I ’d ever lost since my childhood has washed up, and I was now standing here in front of it,

and if I waited long enough, a tiny figure would appear on the horizon across the field, and gradually get larger until I ’d see it was Tommy, and he’d wave, maybe even call.” (Ishiguro, 2005, p. 288)

At the certain point of the novel Ishiguro explains the memory of Kathy’s first donation when her body is going to be taken they are grown up for human body parts donation, she is able to recognize the bitter truth of her existence. The novel explores the reality and other aspect to develop clones and their limited life cycle which is fully dedicated to humanities as they are being told.

The reader can understand the concept of double--- consciousness with respect to any discrimination, race--- related or not. We are approaching a new world where technology races ahead faster than it has ever done before.

We can find some indication about character’s struggles for their identity by narrator which can be easily identify through their face. The characters constantly grasp at a sense of belonging throughout the novel, as they have no family or understanding of their origins in this sensitive story Ishiguro revels the truth of sophisticated society with the help of his character Kathy and he illuminates the philosophy of the society.

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An Analytical Study on Digital Identity Goals with Reference to Aadhaar Card in India

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ABSTRACT

One of the fundamental components of the Fourth Industrial Revolution is identity, and as digital technology's capabilities have significantly improved over the past decade, identity in digital form has become unavoidable. Character qualifies a person for different administrations like democratic, training, business, protection, medical care and so on. However, there are approximately one billion people worldwide without any official identification. People who live in rural areas, especially women, children, and financially disadvantaged families, are particularly affected by a lack of identity. Every person should have a legal identity by 2030, according to the UN's recently released Sustainable Development Goal 16. Given its scope, India's digital identity program, Aadhaar, is a significant contribution in this direction. Carrying out a public personality plot needs a significant financial plan, time and in particular, space information for smooth execution. The primary objectives of Aadhaar are sought in this paper. Additionally, the study ranks goals according to their significance. Secondary data and focus groups are used to collect data for the study. In total, nine primary goals were identified by the study, with uniqueness, privacy, and security ranking high and scalability and technology futureproofing ranking low. Complete Interpretive Primary Demonstrating (TISM) has been utilized to recognize the meaning of every objective. Other nations interested in implementing a biometric identity program similar to this one might use this study as a starting point.

Keywords: India, MCDM, TISM, Aadhaar, biometrics, CSF, digital identity, e-governance.

1. INTRODUCTION

Character of an individual or a gathering is the combination of their qualities, feelings, conduct, convictions and character and in web-based space is called computerized personality (DI). DI is a concept that has been around since the beginning of the Internet. It is a multifaceted idea that philosophically explains "who am I?" and is made up of characteristics that set an individual apart from the rest of the population and make them unique. DI is defined as a "collection of individual attributes that describe an entity and determine the transactions in which that entity can participate" by the World Economic Forum (WEF).

Effective e-governance initiatives, Internet of Things governance, and performance evaluation of e-government projects have all been investigated by researchers in the past. The shift from offline to online transactions brought about by disruptive technologies has made it nearly impossible to conduct transactions anonymously. A fool proof and secure method for online identity creation, exchange, and storage is required for digital network transactions. It is necessary to have reliable and secure digital identities in order to facilitate faceless online transactions because traditional identity documents are incompatible with today's digital requirements. If properly designed and implemented across a variety of application areas, digital identities can have a positive socio-political and economic impact for a nation, particularly one that is just emerging.

To participate in the expanding digital economy, individuals must be uniquely identifiable due to its ongoing global evolution. The United Nations set a goal of providing each person with a "legal identity" by 2030 (SDG-16) in this regard. The World Bank launched the ID4D project with the goal of "providing an identity and delivering digital ID-enabled services to all" because it recognized the transformative potential of modern ID systems for the distribution of essential services to the public.

This study is urgently needed because only 3% of developing nations have a basic identity scheme that can be used both online and offline, and 24% of developing nations currently lack any kind of DI system. To achieve the "identity for all" goal, countries without a national identity program will need to follow guidelines. At the moment, Aadhaar is the shining example to follow for benchmarking the DI scheme's goals. This study attempts to answer the following research questions in order to decipher the success of the Aadhaar system:

- What are Aadhaar's critical success factors, or CSFs?
- How can the Aadhaar CSFs be put in order of importance?

The TISM method was used to evaluate the opinions of experts, and the purpose of this paper is to identify CSFs of Aadhaar and rank each factor according to its significance.

This paper's subsequent sections are arranged as follows: Section 2 presents Aadhaar as a case study for this research and emphasizes the necessity of digital identity systems. The theoretical aspects of this study are presented in Section 3. Section 4 focuses on the domain's identified research questions and gaps. Members of the focus group and the TISM method for ranking CSFs identified in section 3 are discussed in Section 5. The conclusion comes after a discussion of the research's implications.

2. LITERATURE REVIEW

India is the second most populous nation in the world, with a population of more than 1.3 billion. It was the first nation to implement a digital identity scheme on such a large scale for its citizens. In recent years, the research community has focused on DI and its management, with the majority of DI system research focusing on its implication.

There is a lot of literature in the form of reports and studies that shows that managing digital identities is still in its infancy. The digital economy's full potential can only be realized with a sophisticated system for issuing, storing, and managing digital identities. This is due to the fact that online communications carry a significant level of risk, and the security measures implemented in the current DI management systems to mitigate these risks are inadequate. A lack of confidence in the digital transaction is caused by this asymmetry. In an effort to correct this imbalance, numerous governments around the world have launched programs at the national level to provide citizens with secure and verifiable digital identities. Canada, the United Kingdom, Sweden, Estonia, Nigeria, and Argentina are a few examples of nations with digital identity systems in place.

Countries all over the planet need to foster an associated and interoperable worldwide computerized economy with computerized personalities at the centre. Development of an efficient and effective DI system is fraught with numerous risks in terms of time, money, adoption, implementation, security, and utility due to the wide range of national DI systems' scope and functionality.

Biometrics is becoming an essential component of identity systems as biometric precision improves. Characteristics like the iris, face, voice, and retina can be used for identification. Any quality could be utilized for ID reason assuming that it is all inclusive, novel, long-lasting, and recordable. It has been used in a variety of fields, including law, security, healthcare and attendance, surveillance, and healthcare.

2.1 Aadhaar –A Case Study from India

Aadhaar is a drive by the Public authority of India that is intended to give each occupant of India an interesting personality number. It addresses India's "identity gap." This one-of-a-kind identification number is closely linked to a person's biometrics, such as their photograph, fingerprints on both hands, and iris scan. Platforms in both the public and private sectors make use of this Aadhaar number as proof of address whenever it is required. In 2013, the Supreme Court ruled that Aadhaar is not required to participate in any government programs. However, the Lok Sabha approved the Aadhaar Bill in 2016, which makes it possible to use Aadhaar to receive a variety of subsidies through Direct Benefit Transfer (DBT) as well as other benefits and services. By directly targeting beneficiaries, Aadhaar has increased the effectiveness and efficiency of existing welfare programs. The Aadhaar platform shows how the relationship between the state and citizens is changing, with citizens frequently being redefined as customers of the government for services. Biometrics are used to accomplish the primary objective of Aadhaar, which is to provide a one-of-a-kind identification and authentication service. Aadhaar is a twelve-digit random number that is linked to a resident's biometrics, such as a photo, hand fingerprints, an iris scan, and demographic information, such as their date of birth, gender, and so on. More than one billion people in India have received Aadhaar cards.

The addition of biometrics to Aadhaar has made it possible to fill in the gaps in the system and expand social protection programs as well as guarantee legal identity. Aadhaar is in line with the main components of SDG 16, which are the right to identity and the development of a solid system to guarantee social protection by preventing leakages and mismanagement in various welfare schemes, the absence of identification documents, scalability, a lack of trusted financial transaction platform, and the presence of a large number of fake beneficiaries.

3. THEORETICAL LENS

In light of the widely used Critical Success Factors Theory, the goal of this study is to identify the overarching latent goals of India's digital identity system, Aadhaar.

3.1 Critical Success Factors Theory

Rockart was the first person to introduce the idea of "Critical Success Factors" in 1979. Initially used primarily in project management, it has gradually expanded to include supply chain, business intelligence, smart cities, and other areas. The conditions, qualities, or factors that an organization needs to succeed are defined by CSFs as fundamental zones of action in which positive outcomes are necessary for it to achieve its primary goal.

We conducted a thorough literature review of numerous secondary data; research papers connected with computerized personality, Aadhaar, Estonia advanced character, e-administration, and SSN from Scopus data set were thought about for this review. In addition to re-search articles, we looked at official government reports, particularly those from UIDAI, and news articles from some of the most popular online news portals. A sum of forty key variables were recognized that are refined pulled together and grouped into fifteen conventional subjects out of which nine were chosen as CSFs (otherwise called general objectives) by specialists. This answers our first research question, which was how to find Aadhaar CSFs. Table 1 depicts these nine CSFs, which are utilized for additional analysis.

Table 1: CSFs of Aadhaar

Sl. No.	Factors
1.	Building it as a Platform
2.	Future-proofing of Technology
3.	Data Security & Privacy
4.	Scalability
5.	Inclusion
6.	Uniqueness of IDS
7.	Cost Optimization
8.	Speed
9.	Resident Convenience

4. RESEARCH QUESTIONS

To the best of our knowledge, no study has attempted to identify and rank the CSFs of any digital identity system like Aadhaar in the existing literature. The majority of research on biometric identities focuses on privacy and security concerns as well as its utilitarian aspects. As a result, the purpose of this study is to investigate India's Aadhaar digital identity program. Figure 1 depicts the research's progression.

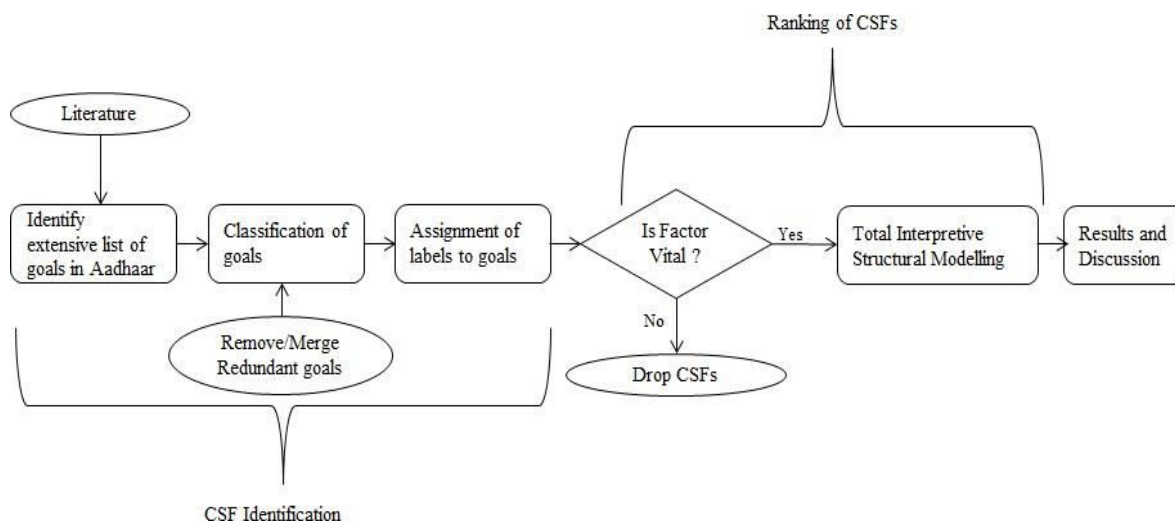


Fig 1: Research flow diagram

5. RESEARCH METHODOLOGY

This study utilized centre gathering philosophy to distinguish the importance level of every objective, it is a deeply grounded precise method for orchestrating the assessments of space explicit specialists on unambiguous issues. This strategy is very valuable in examining various convictions and contemplations on a specific issue exhaustively in presence of a mediator who directs and records the thoughts.

A focus group of eight participants was established for this study. Every part had direct relationship with Aadhaar and had insight of over fifteen years; Using personal connections, they were chosen and contacted. The participants in the focus groups are listed in detail in Table 2:

Table 2: Focus groups details

No. of participants	8
Duration of interview (minutes)	45 (approx.)
Male: Female	6:2
Indian Administrative Service Officer	3
Management Professional	2
Dy. Director General	1
Secretary	1
Senior Govt. Official	1
Minimum experience (years)	15

5.1 Focus Group Protocol

The discussion in the focus group began with a brief welcome message, and everyone was thanked for participating. The session was moderated by one of the authors, who was accompanied by an assistant who was in charge of taking notes. Prior to the start of the discussion, everyone in the group was asked to sign a consent form. The consent form stipulated that all transcripts would be kept anonymous and that the discussion would be recorded digitally (via audio) as well as in writing (using notes). Each participant had a nameplate in front of them that only displayed their first name for the sake of confidentiality. Last but not least, the moderator emphasized the focus group's goal of identifying Aadhaar's overarching goals (CSFs) and determining the significance of each goal in relation to other goals.

5.2 Identification of overarching goals of Aadhaar

The decision-makers are given the ability to visualize the effects of their actions when relevant constructs are identified. The focus group participant evaluated the secondary data source-identified goals; Some of the identified goals were grouped together, dropped, renamed, and some were added based on the consensus of the participants. The duplicity of the study's goals has been reduced and the study's overall understanding has been enhanced by this approach. Table 3 presents the final list of overarching objectives.

5.3 Total Interpretive Structural Modeling – TISM

The modified version of ISM known as TISM is a method for transforming hazy mental representations into easily understood visual models. In this study, TISM and ISM are used to rank the Aadhaar system's overarching goals. Both have been used extensively in previous research.

Table 3: Coding and Labeling Scheme of Identified Goals

Sl. No	Goal	Label	Code
1.	Building it as a platform	Platform	F1
2.	Future-proofing of technology	Future-proofing	F2
3.	Data Security and privacy	Security and Privacy	F3
4.	Scalability	Scalability	F4
5.	Inclusion	Inclusion	F5
6.	Uniqueness of IDS	Uniqueness	F6
7.	Cost Optimisation	Cost	F7
8.	Speed	Speed	F8
9.	Resident Convenience	Resident	F9

TISM employs the ISM method, which was developed by Warfield in 1974, to generate a hierarchical model through multiple pairwise comparisons. A six-step TISM method is used in this study, which is described as follows:

1. Identifying Aadhaar's overarching objectives.
2. Develop a structural self-interaction matrix (SSIM) and determine contextual relationships among the factors identified in step 1 on the basis of expert input.
3. Utilizing SSIM's Reachability Matrix (RM), search for transitive relations.
4. On RM, perform level partitioning.
5. Create a canonical matrix using the partitioning matrix's final stage.

6. Finally, transform the canonical matrix into a hierarchical diagram in which the factors (the goals) are represented by nodes and the relationships (the importance of the goals) between the nodes are represented by edges.

The following four symbols are used to determine the contextual relationship between factors and have the following meanings: V: if I contribute to j but not to i; A: if j assists in i but I does not; X: If I, J, and O collaborate to benefit one another: if i and j fail to assist one another.

Table 4: Structured Self-interaction Matrix

	F9	F8	F7	F6	F5	F4	F3	F2
F1	A	A	A	A	A	V	A	V
F2	A	A	A	A	A	X	A	
F3	V	V	V	A	V	V		
F4	A	A	A	A	A			
F5	A	A	A	A				
F6	V	V	V					
F7	X	X						
F8	X							

Step by step implementation of TISM methodology adopted for prioritization is explained below:

Step 1: Nine of the forty key factors were chosen for this study (see Table 3), and they were refined, regrouped, and categorized into fifteen general themes.

Step 2: Nine CSFs' significance and relationships with one another were investigated using an eight-person focus group. "Yes" or "no" questions are used to evaluate the relationship between factors. Table 4 displays the final Self-interaction matrix.

Step 3: The binary matrix known as the reachability matrix is used to represent all of the identified relations (see Table 5). The matrix depicts a connection between two goals with each entry.

Step 4: The RM checks each entry for any additional transitive relations that are not already covered. There were no additional transitive relations found in our case.

Table 5: Reachability Matrix (binary)

	F1	F2	F3	F4	F5	F6	F7	F8	F9
F1	1	1	0	1	0	0	0	0	0
F2	0	1	0	1	0	0	0	0	0
F3	1	1	1	1	1	0	1	1	1
F4	0	1	0	1	0	0	0	0	0
F5	1	1	0	1	1	0	0	0	0
F6	1	1	1	1	1	1	1	1	1
F7	1	1	0	1	1	0	1	1	1
F8	1	1	0	1	1	0	1	1	1
F9	1	1	0	1	1	0	1	1	1

Step 5: The partitioning matrix is created by obtaining three sets for each goal from the reachability matrix: the reachability set, the antecedent set, and the intersection set of the reachability and antecedent sets (see Table 6). If the intersection set and the reachability set for a given goal are identical, that goal receives a level. A goal is removed from subsequent iterations once it has been assigned a level. This procedure is repeated until a level is given to each goal. Six different iterations were used in this study.

Step 6: As can be seen in figure 2, the partitioning matrix is then transformed into the TISM hierarchy model. This model is constructed from bottom to top, with goals at the bottom being more important than those at the top. In the TISM hierarchical model, uniqueness (level 6) is at the bottom, indicating that it is the most important goal, while future-proofing and scalability (level 1) are at the top and are regarded as less important.

Multiple rounds of partitioning are used until the level of each factor is determined; The level of each factor in Table 6 could only be determined after six iterations.

Table 6: Final Partitioning Matrix

Element	Reachability	Antecedents	Intersection	Levels
F1	{F1,F2,F4}	{F1,F3,F5,F6,F7,F8,F9}	{F1}	II
F2	{F2,F4}	{F1,F2,F3,F4,F5,F6,F7,F8,F9}	{F2,F4}	I
F3	{F1,F2,F3,F4,F5,F7,F8,F9}	{F3,F6}	{F3}	V
F4	{F2,F4}	{F1,F2,F3,F4,F5,F6,F7,F8,F9}	{F2,F4}	I
F5	{F1,F2,F4,F5}	{F3,F5,F6,F7,F8,F9}	{F5}	III
F6	{F1,F2,F3,F4,F5,F6,F7,F8,F9}	{F6}	{F6}	VI
F7	{F1,F2,F4,F5,F7,F8,F9}	{F3,F6,F7,F8,F9}	{F7,F8,F9}	IV
F8	{F1,F2,F4,F5,F7,F8,F9}	{F3,F6,F7,F8,F9}	{F7,F8,F9}	IV
F9	{F1,F2,F4,F5,F7,F8,F9}	{F3,F6,F7,F8,F9}	{F7,F8,F9}	IV

The partitioning matrix is converted into the TISM hierarchical model in the final step (see fig 2). As a result of this TISM model, concerned authorities will be able to prioritize the most critical aspects when developing a digital identity solution.

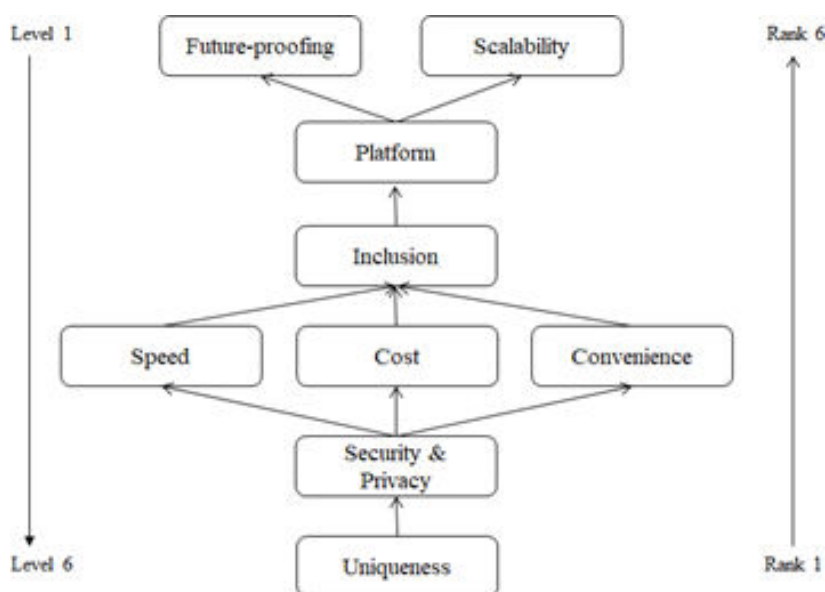


Fig 2: Prioritization of CSFs of Aadhaar

6. DISCUSSION

The findings of this study are emphasized in this section. It is clear that creating a biometric-enabled digital identity system is a complicated process in which all stakeholders must be taken into account to ensure the project's success. The majority of in-place identity systems are functional identity systems designed primarily for a specific use case, such as voter identification. Accurate budget calculation, asset security, workforce with desirable skills, availability of necessary technology, policy documentation, and system maintenance are among the high risks associated with developing a national digital identity system. An extensive action plan is essential for avoiding risks that could result in project failure. To the best of our knowledge, there is no research in the academic literature on the ranking and determining the significance of Aadhaar's goals.

According to the findings, the most important goal is uniqueness at level six, followed by security and privacy at level five. This could be easily explained because the experts agreed that these three are the foundations of any identity system. If any of these were compromised, the usefulness and robustness of any identity system would diminish. Speed, cost and comfort share level four and equivalent importance; The Identity system's efficiency would be defined by these factors, and the system's performance would be measured in terms of them. At level three, inclusion is followed by platform at level two, indicating that inclusion is slightly more important than platform, scalability, and technology's ability to stay relevant in the future; This is due to the fact that India is a diverse nation, and exclusion has long been a challenge to government growth plans. As a result, inclusion received special consideration and was closely linked to the performance-based factors on the previous level; It is a crucial part of what makes Aadhaar a successful platform that is on the next level and includes things like the supply chain for service delivery and infrastructure requirements. At level one, they focus on the platform's future in light of the rapid population growth and shifting utility or service expectations. Scalability and future-proofing of the technology are also at level one.

6.1 Implications of the study

When developing a similar system for different audiences, it is always a good idea to use a successful system as a model. The total cost of a typical digital identity system has been estimated to be between £10 million and \$250 million. Therefore, it is essential to conduct an initial analysis of each risk and to have measures in place to either avoid or reduce these risks. Additionally, avoiding identity-related frauds through digital identity could save £5-10 billion.

Stakeholder engagement in public schemes and focusing on the CSFs analysed throughout the development process are supported by this study's findings. They are likewise predictable with the past examination that featured that privacy should be upheld over enrolment; Additionally, privacy and security rank second in the hierarchy of objectives.

In terms of the contribution made by the methodology, this study is the first of its kind to use employee TISM to rank an enormous project in the Indian context—Aadhaar—and the knowledge gained from the implemented methods and techniques may be useful in future studies analysing large-scale government initiatives.

The use of a hierarchical ranking model in the creation of a real-world digital identity project is the topic of this study's practical implications. The CSFs listed in table 1 can assist concerned authorities, such as governments, in developing policies that have the potential to have a significant impact on the target. It demonstrates the significance of each CSF, which will be useful information for conducting a feasibility analysis regarding the project's longevity, robustness, budget, technological requirements, skill set, and overall management.

7. CONCLUSION

We identified the essential components of a digital identification system in this study. Using CSFs theory as a starting point, the digital identity program known as Aadhaar in India has been examined in this paper as a case study. A sum of nine CSFs is related to the assistance of expert's assessment and positioned utilizing TISM philosophy which brought about the various levelled model as displayed in Fig 2.

According to the findings, the most important goal is uniqueness at level six, followed by security and privacy at level 5. At level one, the technology's scalability and future-proofing are the least important goals. Level four's significance is shared by speed, cost, and convenience. At level three, inclusion is followed by platform at level two, indicating that inclusion is slightly more important than platform, scalability, and technology's ability to stay relevant in the future. The nations that have yet to implement a digital identity program for their citizens will be able to refer to the findings of this study. We hope that researchers all over the world will be inspired by this study to conduct comparable research on other digital identity programs and create a universally applicable ranking hierarchy. The ranking model should be used in the design of practical digital identity systems, and the results of this study should be validated on additional identification programs.

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Violence Against Women: New Age Issues in India

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ABSTRACT

The purpose of this paper is to examine the status of women in contemporary India. It is difficult for women to find respect in their own homes in a world where women's empowerment is still a hotly debated topic and viewed as crucial to society's growth. It is evident that women are victimized in numerous ways in our day-to-day lives. Cases of rape, murder, abduction of women, and trafficking in women are all reported on a daily basis, demonstrating the country's plight for women. Both primary and secondary sources are used in the research. The study revealed that a shift in people's mindsets—both male and female—is required to achieve women's empowerment. The woman herself believes that a husband should beat his wife if she disobeys him. Because this way of thinking has been passed down through generations, women's empowerment has become crucial. In order to draw conclusions, the primary findings were statistically represented.

1. INTRODUCTION

Gender parity is one of the 17 Global Goals that make up the 2030 Agenda for Sustainable Development. Human rights-violating gender discrimination can take many forms, including sexual harassment, prenatal sex selection, underpay for women, violence against women, and many others. However, the level of women's empowerment varies from region to region, caste to caste, and religion to religion. Women's education is another important aspect of women's empowerment. Viciousness against ladies is a serious infringement of mankind and culpable under regulation. While a number of laws exist in India to protect women, the reality is different.

Women's insecurity in the country is always up for debate, but many people here tend to forget that it starts at home. In India, there are a lot of cases of child abuse, and most of the time, it turns out that the abuser is someone close to the family, a friend, or a relative. Here, insecurity begins at birth and persists until death. A girl's birth is frowned upon, even by her parents, especially in Indian society. In many instances, when she marries, her husband becomes her sole foe. She is in danger from her primary protector in this society that we live in. However, the circumstance might be different in Western nations. India's skewed sex ratio, the number of cases of violence against women filed in Indian courts, the number of cases of sexual harassment filed in Indian offices, and, last but not least, the number of cases of domestic violence filed by women in India demonstrate unquestionably male dominance in the society.

To accomplish orientation balance, having a comprehensive methodology towards women is essential. We must first save girls, stop female infanticide, educate them, teach them to value themselves, give them financial independence, and lastly, but certainly not least, respect their decisions. According to NFHS-4 data from 2014 to 2015, approximately 75.2% of married women in Bihar participate in household decisions. West Bengal has the highest rate (89.9%). However, the irony is that, according to NCRB 2014 data, West Bengal also has the highest rate of domestic or spousal violence of any state in India.

2. OBJECTIVES

The objectives of the study are:

- To evaluate aggressive behavior at home more explicitly spousal brutality in different states and areas of India.
- To evaluate women's status in various Indian states.
- To determine the factors that contribute to domestic violence.
- To provide helpful recommendations in light of this finding.

3. METHODOLOGY

The majority of this paper's content is descriptive and analytical. We got information from different sources like NFHS and Wrongdoing Records Department in regards to abusive behavior at home. 200 married women were the focus of the primary survey. The study used a random sampling method.

4. DOMESTIC VIOLENCE IN INDIA

3,37,922 cases of crime against women (both under various sections of the IPC and SLL) were reported in the country in 2014, up 9.2% from 2013, according to the National Crime Records Bureau. These cases were filed in the country under various sections of the IPC and SLL.

According to the NCRB's data, there were 8,033 dowry-related deaths in 2014, a 4.6% increase from the previous year. Under the umbrella of 8,455 dowry deaths, approximately 8,501 victims were identified in India in 2014. Uttar Pradesh (2,469 cases) and Bihar (1,373 cases) reported approximately 29% of all dowry-related deaths.

However, from 44% in 2010 to 36.4% in 2014, the percentage of women who are the victims of husband or family member cruelty has decreased. The highest percentage of all crimes committed against women is the 36 percent of women who were abused by their husbands or family members. There were 1,18,866 cases of cruelty committed by a husband or his family members in the country in 2014, up 3.4% from 2013. The majority of these cases, according to NCRB data from 2014, were reported in West Bengal (23,278 cases), followed by Rajasthan (15,905 cases), Uttar Pradesh (10,471 cases), and Assam (9,626 cases). These four states together accounted for fifty percent of the total number of cases of this kind. The most noteworthy crime percentage (62.1) was accounted for from Assam in contrast with the public rate at 20.5.

According to the NFHS-4 (2014–15), the states with the highest rates of domestic violence are Andhra Pradesh, Bihar, and Telangana. According to data from the Census, Buddhists in India have experienced the most physical violence since they were 15 years old, and employed women are also more likely to experience spousal violence. West Bengal is where the highest rate of spouse sexual violence occurs.

According to NCRB 2014 data, Jaipur has the highest rate of husband and relative cruelty toward women (79.4), while Kolkata has the lowest rate (16.8%). Kerala has the highest number of incidents reported under the Protection of Women from Domestic Violence Act out of all the states.

5. PRIMARY STUDY FINDINGS

For the study, around 200 married women were surveyed. The survey revealed mixed opinions. The focus of the survey was primarily on their thoughts and experiences with domestic violence.

Table 1: Respondent's opinion depending on their educational background

Educational background	Yes, Husband should beat their wives	No, Husband shouldn't beat their wives
No Education	81.4%	18.6%
Primary Education	76.2%	23.8%
Upper Primary Education	31.7%	68.3%
Secondary Education	10.1%	89.9%
Graduate	0%	100%
Post Graduate	0%	100%

The primary study revealed that perceptions of domestic violence shift with educational attainment. Around 81.4% of uninitiated women believe that husbands should beat their wives if she disobeys or acts disrespectfully to him. refer to Table 1.

Table 2: Respondent's opinion depending on their financial background

Monthly income of the family	Yes, Husband should beat their wives	No, Husband shouldn't beat their wives
<Rs 6000	90.3%	9.7%
Rs 6000- Rs 10000	78.5%	21.5%
Rs 10000- Rs 25000	36.6%	63.4%
Rs 25000-Rs 40000	8.6%	91.4%
>Rs 40000	100.0%	0.0%

The primary study demonstrates that the women's economic circumstances also influence their choices. Here, women from families with a monthly income of less than Rs 6,000 claimed that husbands should beat their wives if she disobeys. see Table 2.

Table 3: Currently married women aged 15-49 yrs who have experienced spousal violence by marital duration

Marital Duration	Ever	Past 12 months
0-4 yrs	15.6%	10.3%
5-9 yrs	27.3%	17.2%
10+ yrs	41.1%	22.4%

Table 4: Currently married women aged 15-49 yrs who have experienced physical violence

Marital Duration	Ever	Past 12 months
0-4 yrs	15.6%	10.3%
5-9 yrs	27.3%	17.2%
10+ yrs	41.1%	22.4%

Albeit spousal savagery can happen whenever in a marriage, whenever it first happens will in general be in the early long periods of the marriage. 81% of currently married women between the ages of 15 and 49 have experienced physical or sexual violence from their husbands within the first five years of their marriage, according to the NFHS-3. According to the primary survey, approximately 66% of married women between the ages of 15 and 49 have experienced spousal violence for the first time within five years of their marriage. The most common form of physical violence against women is slapping.

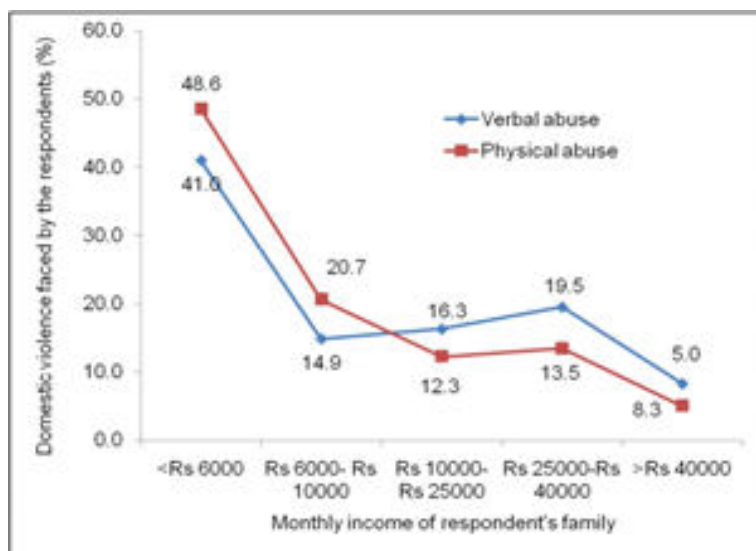


Figure 1: Domestic violence faced by currently married women based on their financial background

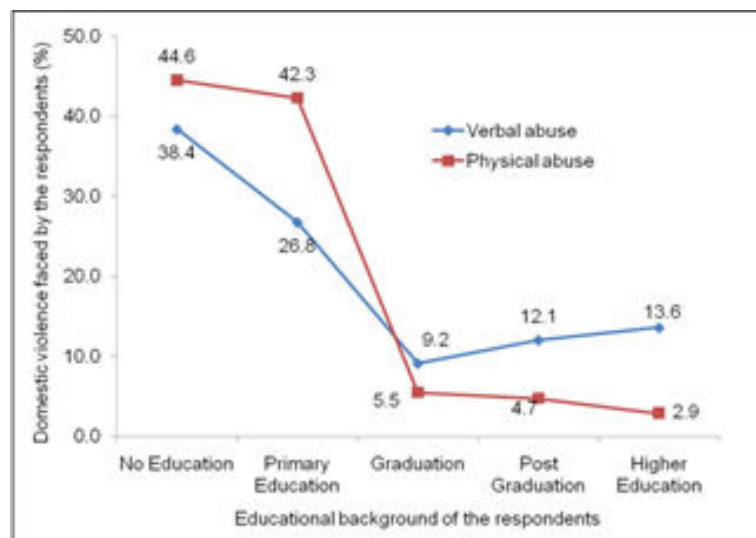


Figure 2: Domestic violence faced by currently married women based on their educational background

The primary survey revealed that both the family's economic status and level of education have an impact on the severity of physical and verbal abuse (see Figures 1 and 2).

Abuse tends to be more verbal than physical when women have more education, and the same is true when the family's financial situation improves. Verbal abuse becomes more common than physical abuse as income rises.

Liquor might be referred to as one more justification for aggressive behavior at home. In families where the husband consumes alcohol, there is a higher incidence of verbal and physical abuse. In families with incomes below Rs10,000/-, it was discovered that the husband earned nothing or used any money he did earn to buy alcohol. Domestic violence was more common in these families. look at Figure 3).

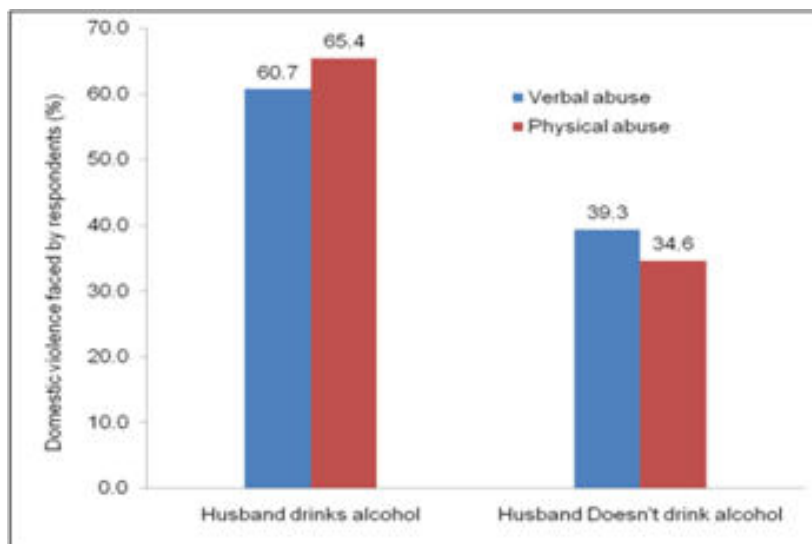


Figure 3: Domestic violence faced by currently married women based on the drinking habits of their husbands.

6. DECISION MAKING: OBSERVATIONS

With regards to choose around one's own acquiring, it isn't generally the individual procuring chooses. In many cases, it has been discovered that in India, the husband is the one who decides what to do with his wife's earnings. According to the NFHS-3 data, only 24% of women have primary control over how their earnings are used. In contrast, men and their wives tend to jointly decide how to spend their earnings in this instance. According to the NFHS-3 data set, having a joint say in decisions about one's own earnings increases with education, while having the primary say in decisions about one's own earnings decreases with education. Women, on the other hand, typically see both go up with their education.

Table 5: Permission required by respondent from in-laws/husband

Respondent's activity	Requires permission	Doesn't require permission
To visit parental place	57.1%	42.9%
To do job after marriage	74.1%	25.9%
To meet friends	65.1%	34.9%
To go for office tour	81.0%	19.0%

When a woman gets married, she has to get permission to do everything. A woman rarely has the freedom to leave her home. Approximately 57.1 percent of women required parental permission to visit. Women in India are required to obtain permission to work after marriage because they are typically regarded as homemakers. There are numerous instances in which women quit their jobs due to family pressure. see Figure 5).

Table 6: Currently married women allowed to go alone to four places (market, health facility, relative's house, outside neighborhood) depending upon their income & education status

Educational background of respondent	Women who earns	Women whodon't earn
No Education	10.1%	8.3%
Primary Education	12%	11.2%
Upper Primary	15.1%	18.3%
Secondary	22.4%	24.2%
Graduate	40.4%	38%

The survey demonstrates that women are permitted to travel alone to some locations as a result of increased education and self-employment. Only 8.3% of women are allowed to move on their own because they lack both education and income. This demonstrates that women are trusted to move alone because they are valued and respected by society if they are educated. These four locations—the market, the health facility, a relative's house, and the outside neighborhood—are permitted to be visited alone by approximately 40% of women who have a college degree and earn their own money. see Figure 6).

Table 7: Perceptions of family members about not letting the women of the family to go outside alone

Perceptions of family members	
Not safe outside	54.4%
Women cannot judge people or situations	12.3%
Women cannot understand	15%
Women cannot take decisions alone	10.1%
Loose family respect/honor	8.2%

The majority (54.4 percent) feared for the safety of women. Family members believed that the women wouldn't be able to protect themselves if they moved alone, so it was preferable for them to move together. Another 12% stated that women are unable to make decisions and 10% stated that they are unable to evaluate people and circumstances. Additionally, 8.2% feared losing family respect if they allowed their daughters to move on their own.

7. CHALLENGES FACED BY WOMEN

In India, women face a number of obstacles that prevent them from becoming empowered. The issue of domestic violence is so difficult. According to the study, women's opinions varied according to education and economic class. It was discovered that female education has a significant impact on how they think about family members in some ways. Family members did not worry that a woman who had completed college could not evaluate situations, make decisions, or comprehend. Their primary concern was for her safety. However, the members of the family were concerned about the woman's capacity for decision-making because she lacked formal education.

The society's mentality shifts as female education increases. However, raising society's awareness of domestic violence is essential. Many poor women believe that men must beat their wives in order to relieve their frustration or for women to behave appropriately, a stick is always required. Whatever the husband does, it is unthinkable in Indian society for the well-off class to report to the police because doing so would embarrass their family.

Procuring own pay at times assist ladies with resolving their issues and to participate in family choice cycle. However, the situation varies based on the household's standard of living. It was found from the essential review that around 76.2% of ladies from BPL families had nothing to do with anything choice is taken in the house regardless of whether they work for cash.

8. VARIOUS SCHEMES TAKEN UP BY GOVERNMENT:

Indian Government has taken up various schemes for helping women empowerment like:

Beti Bachao Beti Padhao: This program was implemented to prevent a decline in the Child Sex Ratio in 100 gender-sensitive Indian districts. It ensures that sex selection prior to birth is eliminated and that girl children are protected and educated.

One Stop Centre Scheme: A sub-planet of the umbrella scheme for the National Mission for Empowerment of Women, which includes the Indira Gandhi Matritav Sahyaog Yojana, has been developed by the Ministry of Women and Child Development (MWCD) for the establishment of One Stop Centre's. for gradually introducing phased private and public spaces to integrated support and assistance for women who have been harmed by violence.

Women Helpline Scheme: Through referral, the goal of this program is to offer women who have been harmed by violence immediate and emergency assistance round-the-clock.

Ujjawala: A comprehensive plan for the rescue, rehabilitation, and reintegration of sexual exploitation victims as well as the prevention of human trafficking.

Indira Gandhi Matritva Sahyog Yojana (IGMSY): A brand-new maternity program that, by offering cash incentives to pregnant and lactating mothers for better health and nutrition, contributes to a more favorable environment.

SWADHAR Greh (A Scheme for Women in Difficult Circumstances): Women and girls who have been rendered homeless as a result of family discord, crime, violence, mental stress, social ostracism, or are being forced into prostitution and are in moral danger are the beneficiaries of the scheme, which is designed to provide them with maintenance, rehabilitative services, and temporary housing.

Additionally, these plans there are likewise state government supported plans like Kanyashree Plan, Sukanya Plan, Sabla Plan and so on in West Bengal and comparative others in different territories of India.

9. CONCLUSION

Worldwide, domestic violence is viewed as a violation of human rights. To end domestic violence, society must raise awareness and educate itself. The nation's development will begin in all areas if attitudes toward girls are changed. Even if a woman is unable to conceive or earn a living, we must acknowledge that she is just as important as men. She is the foundation of society. In particular, women in India place a high value on having children and taking care of the home over a career. These women are regarded as goddesses, whereas those who prioritized a career over everything are regarded as demons. These deeply ingrained perceptions must be altered, and not only men but also some women are the guardians of these erroneous theoretical beliefs. As a result, no one can improve women's status until we decide it's time to change our minds.

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Innovative Methods for Synthesis of 1-Phenyl Naphthalene Lignan- A Green Chemistry Approach

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ABSTRACT

To generalize the methods for Synthesis of α -arylidene β -benzoyl propionic acid has been carried out to finalized product such as 1-phenyl naphthalene lignan. To extend the scope of Perkin reaction and cleavage of α -arylidene γ -phenyl δ - β - γ -butenolide are prepared as β -benzoyl propionic acid and aryl aldehydes underwent perkin condensation at α -methylene to gives α -Arylidene γ -phenyl δ - β - γ -butenolide which on cleavage gives α -arylidene β -benzoyl propionic acid under two experimental methods are conventional and Ultrasonication method. We carried out the reactions of β -BPA and with series of aldehyde (anisaldehyde, varatradehyde, salicaldehyde, vanillin and benzaldehyde) to obtain the corresponding butenolides on cleavage with alcoholic sodium carbonate gives α -Arylidene β -benzoyl propionic acid The entire cleavage products have been characterized by their FTIR, ¹H NMR, and mass spectroscopy.

Keywords: β -benzoyl propionic acid, α -arylidene β -benzoyl propionic acid, α -arylidene γ -phenyl δ - β - γ -butenolide, Ultrasonication method, 1-Phenyl naphthalene.

1. INTRODUCTION

The Friedel–Crafts reactions are a set of reactions developed by Charles Friedel and James Crafts in 1877 to attach substituent's to an aromatic ring[1]. There are two main types of Friedel–Crafts reactions are alkylation and acylation reactions. Both proceed by electrophilic aromatic substitution reactions. The Friedel–Crafts Alkylation may give poly alkylated products, so the Friedel–Crafts Acylation is a valuable alternative. The acylated products may easily be converted to the corresponding alkanes followed by Clemmensen Reduction or Wolff-Kishner Reduction. Friedel–Crafts acylation is the acylation of aromatic rings with a succinic anhydride using a strong Lewis acid catalyst. Friedel–Crafts acylation is also possible with acid chlorides and cyclic anhydrides [2]. Reaction conditions are similar to the Friedel–Crafts alkylation mentioned above.

Synthesis of 1-phenyl naphthalene has been subject of great interest, as it is an important intermediate for synthesis of cyclolignans and also for physiological properties. Various attempts have been made for the synthesis of 1-phenyl naphthalene and the different types of lignans by large number of workers but only few were successful in synthesizing the naturally occurring isomers. The synthesis of aryl naphthalene lignan has been carried out by various methods, the oxidative coupling method, where aryl naphthalene was prepared by aryldihydronaphthalene in several steps including oxidation, hydrolysis, reduction, and lactonization. Pericyclic reaction method has also been used extensively for preparation of a wide variety of aryl naphthalene lignans. With the view to all reaction zeolite play an important role and increase yield however decrease their reaction time in Ultrasonication method.

The butenolides were previously reported by Borshe [3], when beta benzoyl propionic acid, aryl aldehyde, acetic anhydride and pyridine were taken 250 ml beaker. As we performed synthesis of pericarbonylignans lactone, we needed two step syntheses. But we also performed the synthesis of 1-phenyl naphthalene and Pericarbonylignans by cyclization of Perkin condensation product α -arylidene β -benzoyl propionic acid with the phosphoric acid and conc. H₂SO₄, Nanozeolite can be achieved in one step.

To extend the scope of Perkin reaction and to generalize the methods for cleavage of α -arylidene γ -phenyl δ - β - γ -butenolide to synthesis of α -arylidene β -benzoyl propionic acid has been carried out. In present work 1-phenyl naphthalene lignan are prepared as β -benzoyl propionic acid and aryl aldehydes underwent perkin condensation at α -methylene to gives α -Arylidene γ -phenyl δ - β - γ -butenolide which on cleavage gives α -

arylidene β -benzoyl propionic acid under two experimental methods are conventional and Ultrasonication method. We carried out the reactions of β -BPA and with series of aldehyde (anisaldehyde, varatradehyde, salicaldehyde, vanillin and benzaldehyde) to obtain the corresponding butenolides on cleavage with alcoholic sodium carbonate gives α -Arylidene β -benzoyl propionic acid. The entire cleavage products have been characterized by their FTIR, ^1H NMR, and mass spectroscopy.

The synthesis of α -arylidene β -benzoyl propionic acid take place involving breaking of lactone and it opens to give keto acid followed by keto-enol tautomerism. The stereochemistry was as erythro form or cis geometric isomer which undergo cleavage with different base. The utilization of green chemistry techniques is drastically reduces chemical waste and reaction times and has recently been proven in several organic synthesis and chemical transformations. To illustrate these advantages Nanozeolite is used as a novel recyclable heterogeneous catalyst in the cyclization of Perkin condensation product to achieve biologically potent 1-phenyl naphthalene system lignans under two experimental conditions conventional and Ultrasonication irradiation.

The catalytically activity of Nanozeolite has emerged as a useful catalyst imparting high region and chemo selectivity in various chemical transformations. It is a dry, nonvolatile, non-hygroscopic, odourless and white crystalline solid Arrhenius acid with outstanding physical properties. It is inexpensive, insoluble in common organic solvents. Very stable and it's recycling and reuse conveniently.

The Perkin condensation product contains the required skeleton to prepare 1-phenyl naphthalene system. Further cyclization of and its derivative under two experimental conditions- conventional (using magnetic stirrer and Ultrasonication irradiation by Nanozeolite as a cyclizing agent gives 1-phenyl naphthalene system.

2. EXPERIMENTAL

2.1 Synthesis of α -arylidene γ -phenyl δ - β - γ - butenolide: Conventional Method: Synthesis of α -Arylidene γ -phenyl δ - β - γ -Butenolide

2.1.1 Conventional Method

Pyridine or Sulphamic Acid

β -Benzoyl propionic acid (2a) is treated with the aryl aldehyde, acetic anhydride were refluxed in different catalysts as pyridine or sulphamic acid, refluxed over the heating mantle for three hours, while monitoring the reaction with help of TLC. After completion reaction of the reaction, the intermediate temperature of the reaction mixture as taken out by the thermometer, this is recorded as 40°C . The hot reaction mixture was poured in cold water with stirring and then acidified with conc. HCl. The yellow mass obtained was filtered and crystallized with benzene to give lactone such as α -Arylidene γ -phenyl δ - β - γ - Butenolide product (3a).

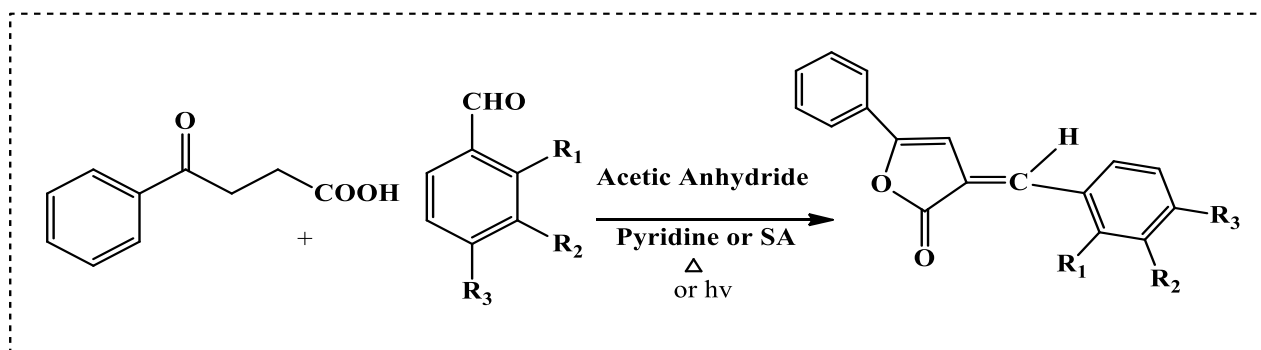


Fig. 1: Synthesis of α -Arylidene γ -phenyl δ - β - γ -Butenolide by Pyridine or SA Nanozeolite (Green Catalyst)

The reaction mixture of 1 g β -Benzoyl propionic acid (1mmol), aryl aldehyde (1 mmol), acetic anhydride (1 ml) and 1 gm Nanozeolite (1 mmol) catalyst were refluxed in 250 ml beaker. It was mixed properly with the help of glass rod. Place an inverted funnel over the rim of beaker and irradiated in Ultrasonication oven at 800W for 25 min. while mentoring the reaction with help of TLC. After completion reaction of the reaction, the intermediate temperature of the reaction mixture as taken out by the thermometer, this is recorded as 65°C . The hot reaction mixture was poured in cold water with stirring and then acidified with Conc. HCl. In similar context the catalyst are recycled at heating in muffle furnace 200°C . The yellow mass obtained was filtered and crystallized with benzene to give lactones such as α -Arylidene γ -phenyl δ - β - γ -Butenolide product (3a to 3e).

2.1.2 Ultrasonication Method

Pyridine or Sulphamic Acid

The reaction mixture of β -Benzoyl propionic acid (2a) is treated with the aryl aldehyde, acetic anhydride were refluxed in different catalysts as drops of pyridine, sulphamic acid, and Nano zeolites in 250 ml beaker. It was mixed properly with the help of glass rod. Place an inverted funnel over the rim of beaker and place under irradiation of Ultrasonication oven at 800 W for optimiza time. While monitoring the reaction with the help of TLC, which is recorded at 70°C. The hot reaction mixture was poured in cold water with stirring and then acidified with conc. HCl. The brownish-yellow mass obtained was filtered and recrystallized with benzene to give lactone such as α -Arylidene γ -phenyl δ - β - γ - Butenolide product (3a-3e).

Nanozeolite (Green Catalyst)

The reaction mixture of β -Benzoyl propionic acid (2) is treated with the aryl aldehyde, acetic anhydride were refluxed in different catalysts as drops of pyridine, sulphamic acid, and Nano zeolites in 250 ml beaker. It was mixed properly with the help of glass rod. Place an inverted funnel over the rim of beaker and place under irradiation of Ultrasonication oven at 800 W for 4.1 minute. While monitoring the reaction with the help of TLC, which is recorded at 70°C. The hot reaction mixture was poured in cold water with stirring and then acidified with conc. HCl. In similar context the catalyst are recycled at heating in muffle furnance 200°C. The brownish-yellow mass obtained was filtered and recrystallized with benzene to give lactonei.e α -Arylidene γ -phenyl δ - β - γ -: Butenolideproduct δ (3a) Melting point 122-124 °C has shown in Scheme 2.2 C Adopting thee catalytically process above method described method four different substituted Butenolide (3b- 3e) were identified and characterized (Table 2.9).

2.1.3 Mechanism of Butenolide formation using Nano zeolite as a catalyst

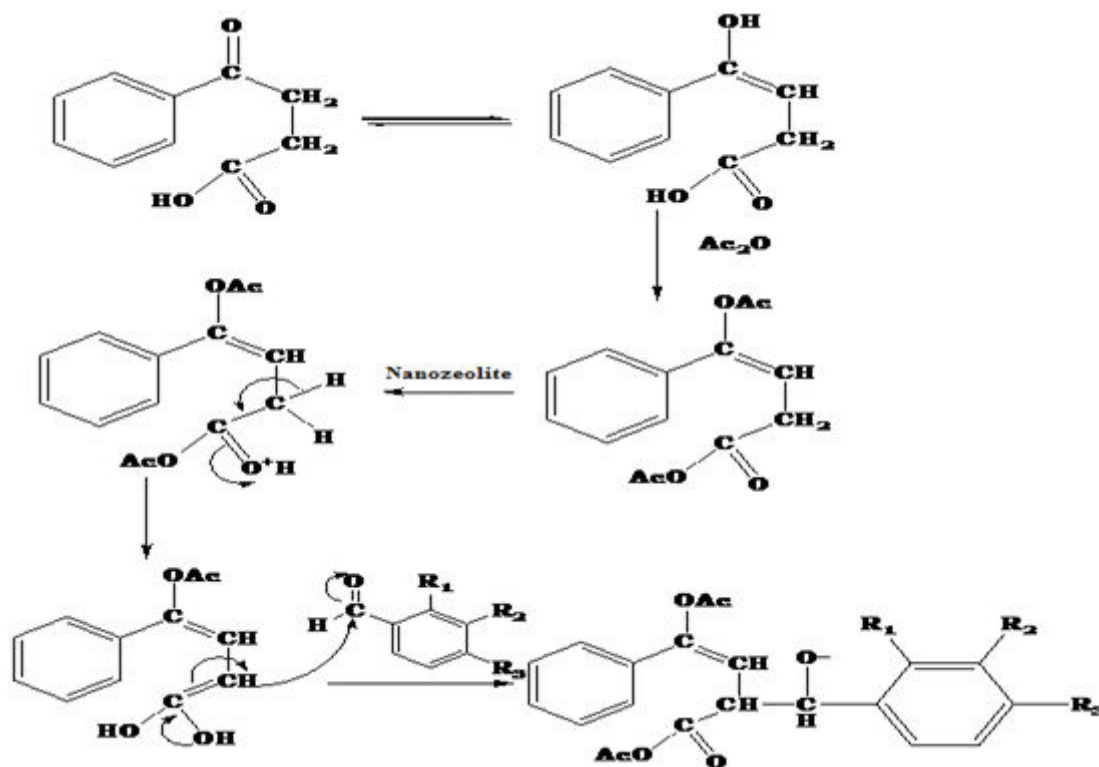


Figure 2: Mechanism of formation of Butenolide by using catalyst

The Perkin reaction has two step reactions in first step it form a lactone such as butenolide known as Perkin–Ogliialoro reaction. The Nano Zeolite catalyst percolate reaction proceeds through the enol acetate ($R' = Ac$) or preferably the corresponding mixed anhydride ($R' = Ac$) an in normal Perkin reaction.

The reaction would be similar to cinamic acid system ($PHCH=CHCOOH$, the vinylogues of phenyl acetic acid) which are known to undergo undergo Perkin reaction. The formation of carbanion at the α -carbon is quite likely as such a carbanion would be stabilized by a phenyl conjugated double bond on one side while a characteristic anhydride complex unit of perkin condensation is on the other side. It was observed that on treatment with acetic anhydride cyclizes quantitatively to the lactone, undoubtedly through the intermediate as shown (fig. 5.2).

2.2 Synthesis of α -Arylidene β -Benzoyl Propionic acid

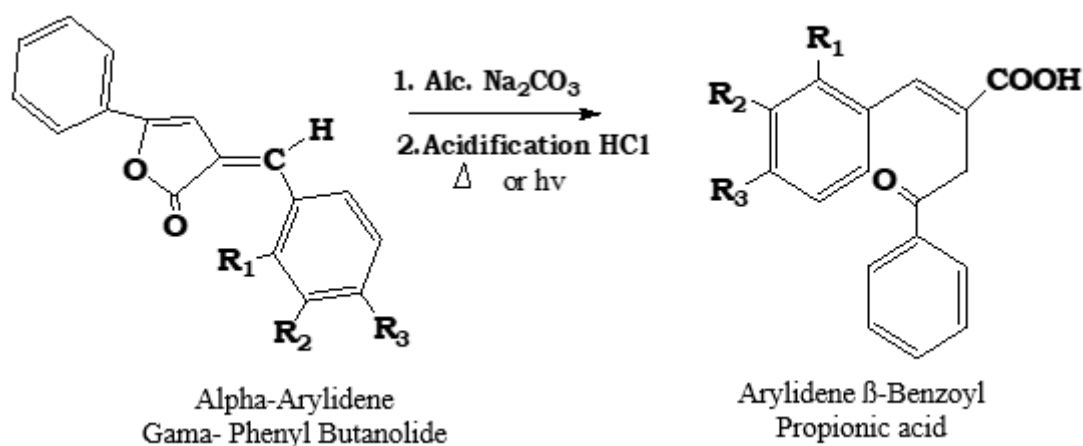
2.2.1 Conventional Method

The reaction mixture of 1g α -arylidene γ -phenyl δ - β - γ -Butenolide (1 mmol) was refluxed for 5 hrs. with alcoholic sodium carbonate solution (prepared by dissolving 1gm anhydrous sodium carbonate in 4ml methanol and 6ml water). (10 mmol). The resulting mixture was filtered, cool and acidified with conc. HCl to get a brown precipitate which was crystallized with aqueous methanol and was identified as α -arylidene β -benzoyl propionic acid.

2.2.2 Green Method (Ultrasonication Irradiation)

α -Arylidene γ -phenyl δ - β - γ -butenolide (3a) was refluxed for 12 minutes with alcoholic sodium carbonate solution (prepared by dissolving 5 grams anhydrous sodium carbonate in 20 ml methanol and 30 ml water) in Ultrasonication irradiation at 800US or 15 min. The resulting mixture was filtered, cooled and acidified with conc. HCl to get a brown coloured precipitate which has crystallized with aqueous methanol and was obtained α -arylidene β -benzoyl propionic acid (4a to 4d).

Fig. 3: Conversion of α -arylidene γ -phenyl δ - β - γ - Butenolide to α -arylidene β -benzoyl propionic acid.



SUBSTITUTIONS:

4a) R₁=H, R₂=H, R₃=OCH₃

4b) R₁=H, R₂=OH, R₃=H

4c) R₁=H, R₂=OCH₃, R₃=OCH₃

4d) R₁=H, R₂=OCH₃, R₃=H

4e) R₁=H, R₂=H, R₃=H

Adopting above-described method for five different substituted to prepared α -arylidene β -benzoyl propionic acid (4a-e) were identified and characterized.

2.3 Green Method (Ultrasonication Irradiation)

These cyclizing reagents are used for reparation of 1-phenyl naphthalene their derivatives conc. sulphuric acid (H₂SO₄), polyphosphoric acid (PPA), sulphamic acid, nanozeolite.

2.3.1 Activation of Catalyst by Using Autoclave

The Nanozeolite is a shape selective catalyst for their better activity it required activation by autoclave. Autoclave has principle to sensitize the material like zeolite at 121⁰C, a 15 lbs pressure for 45 minute. Firstly the material has poured in phytoplasic polymer jar (thermoplastic- which resist from heat) and autoclaved with above said conditions.

2.3.2 Conventional Method

Take a mixture of 1 g of α -arylidene, β -Benzoyl Propionic acid (1 mmol) (4a), 1 g activated Nanozeolite (1 mmol) and 10 ml of ethanol (10 mmol) as a reaction solvent in 250 ml round bottom flask. Stir the mixture vigorously (using magnetic stirrer) by keeping reflux at 120⁰ C for an appropriate time as reaction mixture was cooled at room temperature and diluted with diethyl ether (3 x 10 ml) to precipitate of Nanozeolite easy separation. The combined organic layers were dried over anhydrous Na₂SO₄. The solvent was removed and the residue was column chromatograms using petroleum ether: ethyl acetate (2:3) as the eluent, to obtain pure compound (5a to 5e).

2.3.3 Ultrasonication Method

Take a mixture of 1 g of α -arylidene, β -Benzoyl Propionic acid (1 mmol) (4a), 1 g activated Nanozeolite (1 mmol) and 10 ml of ethanol (10 mmol) as a reaction solvent in 250 ml round bottom flask. The reaction mixture as specified above was taken in a dry 250 ml beaker. It was mixed properly with the help of glass rod. Place an inverted funnel over the rim of the beaker and irradiated in an Ultrasonication oven at 800 w for 4.3 min while monitoring the reaction with the help of TLC. After completion of the reaction the immediate temperature of the reaction mixture was taken out by the thermometer, which is recorded as 75°C. The reaction was worked-up with diluted diethyl ether (3 x 10 ml) to precipitate of Nanozeolite easy separation. The combined organic layers were dried over anhydrous Na_2SO_4 . The solvent was removed and the residue was column chromatograms using petroleum ether: ethyl acetate (2:3) as the eluent, to obtain pure compound (5a to 5e).

2.3.4 Mechanism of 1-Phenyl Naphthoic acid formation using Nano zeolite as a catalyst

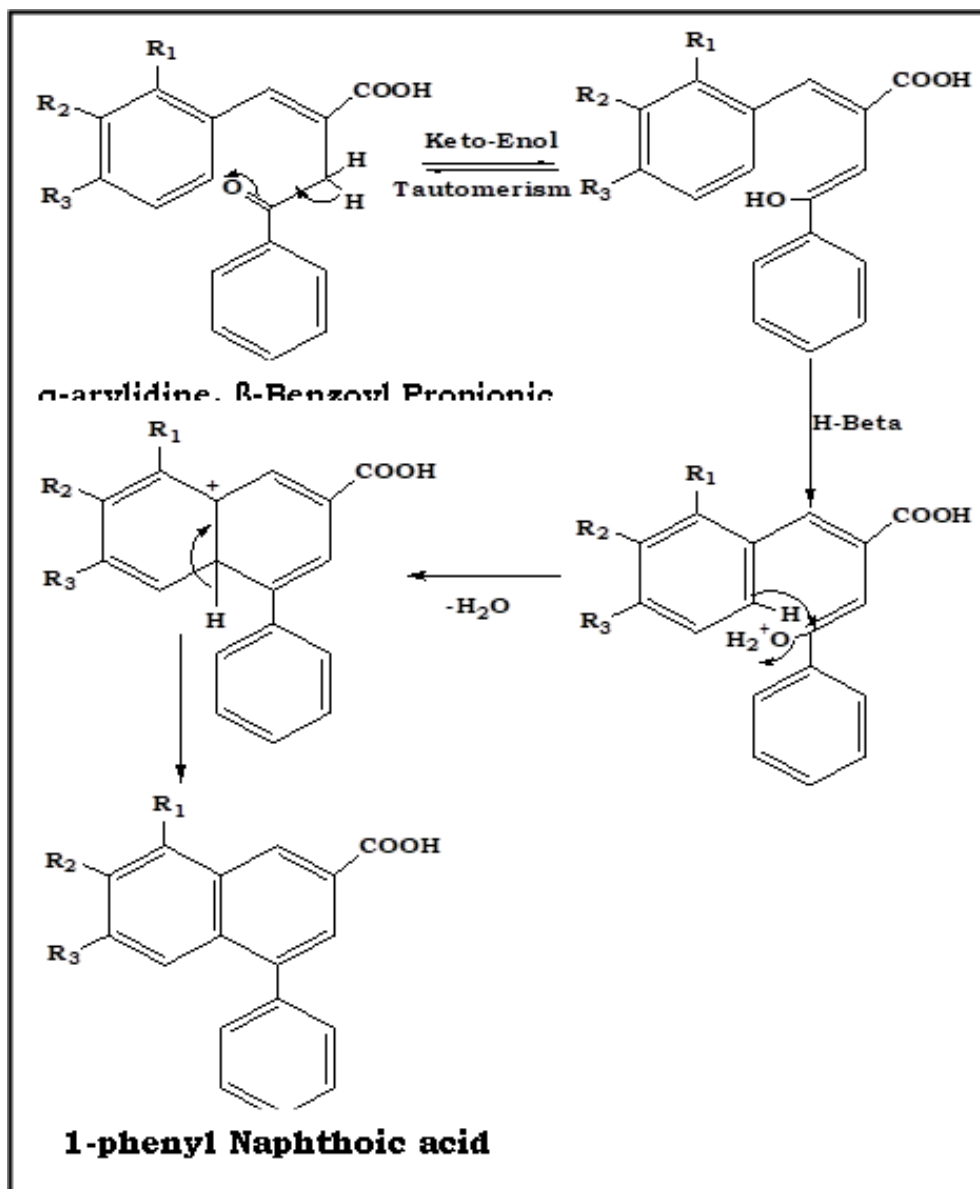


Fig 4. Mechanism of 1-Phenyl Naphthoic acid formation using Nano zeolite as a catalyst

RESULT AND DISCUSSION

The synthesis of the synthesis of compound 4a to 5a take place involving takes place keto-enol tautomerism followed by removal of H (from benzene and OH from (enol group)) (scheme 2.4). while in system 4 (α -arylidene, β -Benzoyl Propionic acid), there is hyper-conjugation at CH_2 and cyclization takes place by keto-enol tautomerism. The aromatic atmosphere spread is more on s-cis butadiene than s-trans orientation. Though the s-trans is more stable, here s-cis has more chance to exit. Hence the facile cyclization via keto-enol tautomerism which in turn existed due to hyper conjugation is possible due to methylene. All these intermediate structures drive the reaction towards aryl lactonization via cyclization by removal of H and OH.

Spectral Analysis

We carried out the reactions of β -benzoyl propionic acid and with series of aldehyde (anisaldehyde, varatraldehyde, salicylaldehyde, vanillin and benzaldehyde) to obtain the corresponding 1-phenyl naphthalene lignans (5a-5e). The entire cyclized products have been characterized by their FTIR, ^1H NMR, ^{13}C NMR, and mass spectroscopy.

Table 1. Spectral analysis of substituted 1-phenyl naphthalene-3-carboxylic acid

SN	1-Phenyl Naphthoic acid (5)	Molecular Formula	Melting point	FTIR (cm^{-1})	^1H NMR(δ) (ppm)	Mass (m/z) (amu)
1	5a	$\text{C}_{19}\text{H}_{16}\text{O}_4$	124-125	3060, 2838, 1753	3.41 (s, 3H Methoxygp.) Aromatic Protons: 6.98 (d, 1H), 7.31(d, 1H), 7.39(s, 1H), 8.45(s, 1H), 8.47(s, 1H), 7.4-7.9 (br. m 5HPhenyl gp.), 11.40 (s, 1H carboxylic acid),	276(Bae Peak), 252,249,223,201
2	5b	$\text{C}_{18}\text{H}_{12}\text{O}_4$	137-138	3320, 1754	5.00 (s, 1H, Phenolic C-OH), 11.00 (s, 1H carboxylic acid), Aromatic Protons: 7.3 (S, 1H), 7.4 (d, 1H), 7.6 (d, 1H), 8.4 (s,1H),)8.4 (s,1H) 7.22-7.49 (br. m 5HPhenyl gp.)	261 (bp), 211
3	5c	$\text{C}_{18}\text{H}_{12}\text{O}_4$	141-142	2940	5.00 (s, 1H, Phenolic C-OH), 11.14(s, 1H carboxylic acid), Aromatic Protons: 6.47 (S, 1H), 6.48 (s, 1H), 8.4 (s, 1H,) 8.6 (s, 1H), 3.2 (s, 6H Methoxygp.) 7.4-7.9 (br. m 5H Phenyl gp.)	306 (bp), 237, 211, 175
4	5d	$\text{C}_{18}\text{H}_{14}\text{O}_4$	154-155	3213, 1681	3.75 (s, 3H Methoxygp.) 5.05 (s, 1H, Phenolic C-OH), 11.39 (s, 1H carboxylic acid), Aromatic Protons: 6.90 (s, 1H), 6.95 (s, 1H), 8.29 (s, 1H), 8.39 (s, 1H), 7.39-7.50 (br. m 5HPhenyl gp.)	295 (bp), 272, 237, 175
5	5e		166-167	2923, 1678	11.17 (s, 1H carboxylic acid), Aromatic Protons: 7.49 (d, 2H), 7.69 (d, 2H) 7.41- 7.75(br. m 5H phenyl gp.)	249 (bp), 223,201, 161

CONCLUSION

1-phenyl naphthalene has been the subject of great interest, as it is an important intermediate for the synthesis of cyclo-lignans and also for their physiological properties. Various attempts have been made for the synthesis of 1-phenyl naphthalene and the different types of lignans by a large number of workers but only a few were successful in synthesizing the naturally occurring isomers.

The green approach towards the synthesis of 1-phenyl naphthalene involves key precursor-like β -benzoyl propionic acid. The β -benzyl propionic acid has been synthesizing followed by Friedel craft acylation reaction in many ways like the general method like benzene, succinic anhydride and AlCl_3 . It is replaced by green methods as Ultrasonication using AlCl_3 , conventionally and Ultrasonication using Nanozeolite catalyst.

In one of the several methods used for the synthesis of 1-phenyl naphthalene type of lignan, Haworth and co-workers prepared the system in a series of steps by starting with β -benzoyl propionic acid. Borsche had observed the remarkable properties of the β -benzoyl propionic acid, having two reactive methylenes it underwent Perkin condensation, which had been known mainly in the alkyl acetic acid and aryl acetic acid the yield 90% were

surprisingly high. It was also noted that when the corresponding acid and ester were treated with aryl aldehyde it gave the product which was later considered as inclusive in Stobbe type of reaction. Perkin reaction was investigated in detail as a prelude to the synthetic development of the system. It was thus investigated to use the β -benzoyl propionic acid system to construct Perkin condensation of the former with aryl aldehyde would yield Butenolide of the type, which ultimately would give way to α -arylidene β - benzoyl propionic acid, latter undergoes cyclization with difference cyclizing reagents like zeolite, PPA, sulphamic acid, etc. to get 1-phenyl naphthalene derivative.

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Liquid Phase Oxidation of Toluene Over Fly Ash Silica Supported Nickel Catalysts

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ABSTRACT

An efficient nickel incorporated fly ash silica catalyst (Ni@FASi) has been successfully synthesized by loading of nickel over fly ash derived silica through impregnation method and characterized by XRD, FESEM, FTIR, TGA, BET surface area, RAMAN techniques. The catalytic activity of synthesized catalyst was performed for liquid phase oxidation of toluene in a microwave reactor. A systematic study has been carried out to ascertain the effects of various reaction parameters such as reaction time, reaction temperature, and kinetic study for liquid phase oxidation was studied without using any model.

Keywords: fly ash, extracted silica, toluene, liquid phase, kinetics

1 INTRODUCTION

Recently, the efficient utilization of large-scale industrial wastes and plentiful natural resources has attracted a considerable interest in the quest for a more sustainable future. Millions of tones of numerous industrial wastes including fly ash, red mud, volcanic ash, blast furnace slag and rice husk ash have been accumulating for decades in the ecosystem and giving rise to major environmental issues [1]. One of the most sophisticated and readily accessible anthropogenic raw material is fly ash, a solid waste product of coal combustion primarily from thermal power plants. Fly ash has been mostly used for construction applications such as extenders in concrete, pavement base courses and asphalt fillers to lessen the environmental consequences of its disposal [2,3]. Consequently, a diverse range of different applications for fly ash have been explored [4-8]. The utilization of fly ash in the field of heterogenous catalysis has attracted much attention over the last few decades [9,10]. Since it is mainly consists of silica and alumina and contains other metal oxides like Fe₂O₃, TiO₂, CaO and Na₂O. In this perspective, fly ash has been explored either as a precursor for active catalyst like zeolites [11-13], as a support for catalytically active species [14-16] or extracted mesoporous silica [17,18].

Ni based catalysts supported on various supports have been drawn scientific research interest due to its potential usage in numerous significant reactions like diesel steam reforming, hydrogenation and dry reforming of methane [19-22] etc. Specifically, supported nickel catalyst have been used in different possible reaction such as H₂O₂ decomposition, oxidative dehydrogenation and hydrogen production [23-24], however there are less records for its use in oxidation reaction. Catalyst support is vital/crucial key because it enables for higher nickel oxide dispersion and prevents its aggregation both of which increases the catalyst's efficiency and results in maximum conversion and yield of desired products.

In this current work, a cheap fly ash silica supported Ni catalysts (Ni@FASi) seems to hold promise for liquid phase oxidation of toluene under mild conditions. An attempt has made to explore the catalytic activity of Ni@FASi catalyst in liquid phase oxidation and studied their kinetics in detail. We think that our work is in good agreement with the principles of green chemistry by using FA as silica material.

2 EXPERIMENTAL

2.1 Materials

Fly ash was collected from Kota Thermal Power Plants, Kota, Rajasthan. Nickel nitrate, sodium hydroxide (NaOH), concentrated hydrogen chloride (HCl) are purchased from Sigma Aldrich.

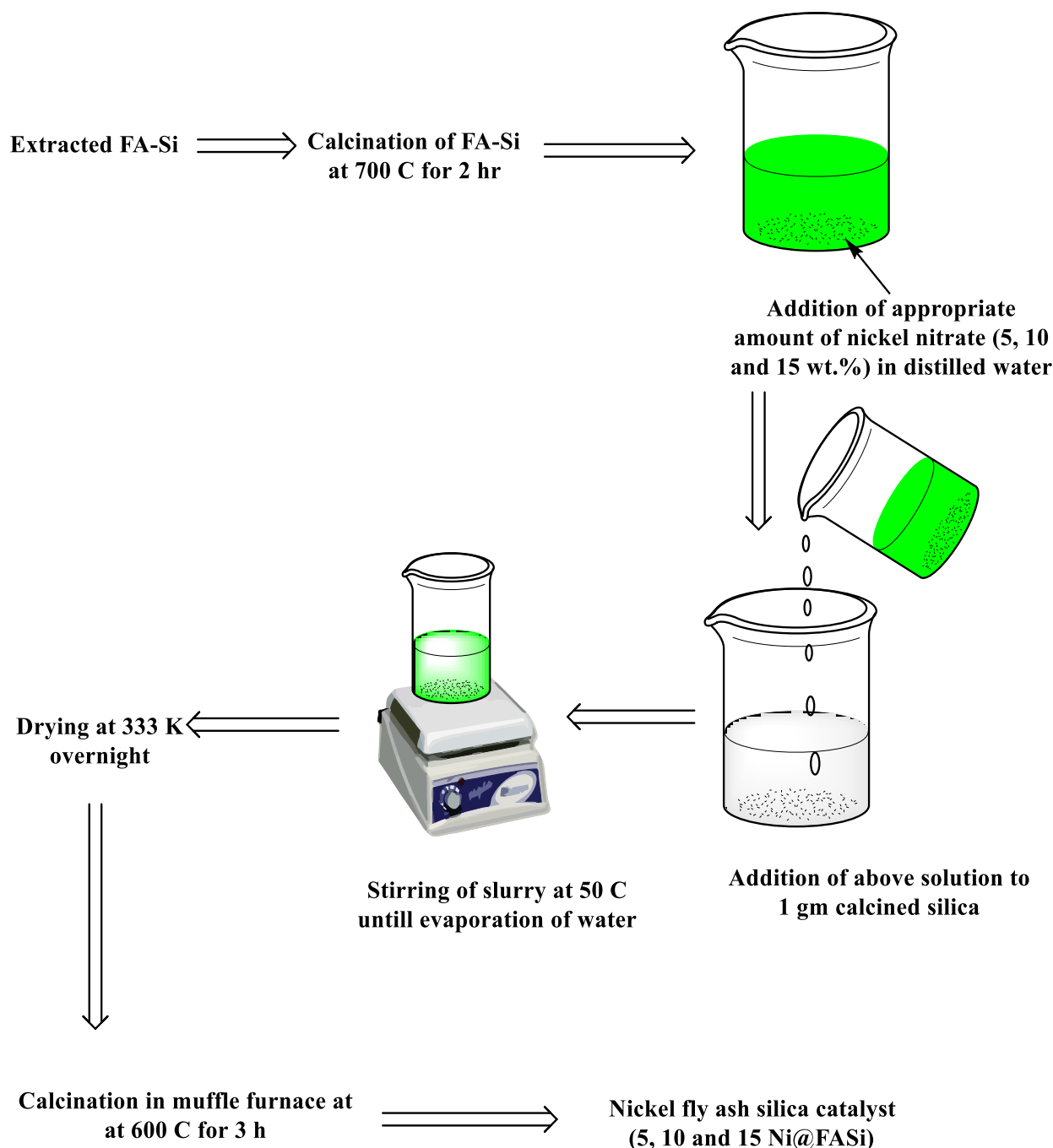
2.2 Extraction of Silica from Fly Ash

Fly Ash was rinsed with 1 N HCl solution and after washing the samples was utilized as raw material. Acid washed fly ash sample is calcined for 3 hours at 700 °C to remove moisture, carbon and other impurities. The calcined fly ash is mixed with 15 wt% NaOH solution at 70 °C for 4 hours with constant stirring to produce a crystal clear solution of sodium silicate which was further used in extraction of silica. The Na₂SiO₃ solution was filtered through filter paper (Whatman No. 41). Then, the Na₂SiO₃ solution was titrated with 1 M HCl at temperature 90 °C with constant stirring. At pH 7, the titration was stopped and allowed for ageing for next 24 hours under constant stirring. The precipitate was centrifuged. The precipitated white solid part was collected

and washed off with hot distilled water multiple times to eliminate any impurities and dried in an electric oven at 50 °C for 24 hours. Finally the white silica powder is obtained. The silica powder was denoted as FASi.

2.3 Preparation of catalyst

A series of Ni@FASi catalyst (5-15 wt.%) was prepared by the wet impregnation method. Initially, extracted FASi was thermally activated at 700 °C for 2 h to remove moisture and other impurities to form TAFASi (thermally activated fly ash derived silica). All the catalysts investigated in this study (5, 10 and 15 Ni@FASi) were synthesized by loading 5, 10 and 15 wt.% nickel nitrate on FASi. The required amount (2.5g for 5wt.%, 5g for 10wt.% and 7.5g for 15 wt.%) of nickel nitrate precursor in an aqueous solution phase were mixed with 1 gm of TAFASi and mixture was stirred at 50 °C until complete evaporation of water. The residue recovered is dried overnight at 333 K and then calcined in air in muffle furnace at 600 °C for 3 h. The final product was darker grey in color with nickel oxide content. Catalysts were denoted as x Ni@FASi, where x = 5, 10 and 15wt.% of the Ni (nickel) content. The synthesis of Ni@FASi catalyst is presented in scheme 1.



Scheme 1: Synthesis of Fly ash silica nickel catalyst (Ni@FASi catalyst)

2.4 Catalyst characterization

The samples were characterized by FESEM, XRD, FTIR, RAMAN, TGA and N₂ adsorption-desorption techniques. The amorphous and crystalline nature of samples was measured by XRD (Rigaku, Ultima IV) using Cu- K α S radiation (40 kv, 30 mA) at scan speed of 8°/min with an angle range from 5° to 80°. The FESEM microscope (SEM; JEOL, JEM2100) images was obtained to analyze the internal features and shape. FTIR spectra was obtained on a Perkin- Elmer in the range of 400-4000 cm⁻¹. The thermo gravimetric analysis was performed on a Perkin Elmer instrument. A small amount of the sample was heated in aluminium plate at 10 °C/min heating rates from 25 °C to 800 °C under nitrogen atmosphere with flow rate of 20 ml/min. The Brunauer-Emmett-Teller (BET) surface area of synthesized catalysts were measured by using Quantachrome NOVA instrument.

2.5 Catalytic activity of Ni@FASi catalyst

Liquid phase oxidation of toluene catalyzed by 5, 10 and 15 Ni@FASi catalyst is performed in a microwave reactor. In this method, a mixture of toluene and catalyst was taken in a 10 ml microwave vial and reaction takes place in presence of O₂ gas. The catalyst was activated at 400 °C for 1 h, before adding in the mixture. The reaction is carried out in closed vessel system at 50 psi pressure under constant stirring at different time periods and temperature. After input of temperature, hold time, power and pressure parameters, the reaction is started by clicking on 'Play' button. After completion of holding time, the instrument is turned off and reaction is cooled through air compressor. Then catalyst and product was separated through filtration and analyzed by Gas Chromatograph. The conversion was calculated by following method-

$$\text{Conversion (\%)} = 100 \times (\text{Initial wt.\%-Final wt.\%}) / \text{Initial wt.\%}$$

3 RESULTS AND DISCUSSION

3.1 Characterization of catalyst

The BET surface area, pore volume and pore diameter of samples tested by the N₂ adsorption- desorption isotherms is given in table 1. FASi exhibits highest BET surface area (23 m²/g). It is clear from the table after the loading of Ni, the surface area of Ni@FASi catalyst decreases with increasing loading of nickel content from 5 to 15wt.%, in agreement with the introduction of NiO particles in the silica support and blockage of pores [25]. With increasing nickel load, the pore diameter and pore volume of Ni@FASi catalysts becomes larger, indicating that on the outer surface some NiO particles generate interparticle pores that are beneficial in different catalytic reactions. Galvez et al observed the same results Ni supported on mesoporous molecular sieves [26].

Table 1: Physiochemical properties of Ni@FASi catalyst

Samples	BET surface area (m ² /g)	Pore volume (cc/g)	Pore diameter (nm)
FASi	23.0623	0.02757	0.97798
5 Ni@FASi	13.5371	0.02167	1.53583
10 Ni@FASi	11.4635	0.02423	1.90378
15 Ni@FASi	9.103	0.03692	1.91911

The X-ray Diffractometer of FASi and all Ni@FASi catalyst were furnished in figure 2 and figure 3. The XRD of FASi shows a gibbous pattern between 15-30° (2 θ) which indicates an amorphous nature of FASi support. But after loading of nickel amorphous nature of FASi converts into crystalline nature may be due to calcination of catalyst at 550 °C. All Ni@FASi catalysts (figure 3) illustrates additional peaks at 2 θ values of 37, 43, 62 and 79° ascribing to NiO (111), (200), (220) and (113) planes respectively, [27] which are evident of Ni-O phase formation in the samples. The diffraction peaks of nickel oxide seems weaker at lower Ni content (5wt.%), this is due to presence of small particles finely dispersed. The intensity of NiO peaks increases with increase in nickel load from 10 to 15 wt.% indicating the formation of large NiO crystals. Few authors reported presence of Ni phyllosilicates an extra phase for various Ni supported silica. But it was not observed in FASi support indicating that FASi support is stable and inert at high temperature.

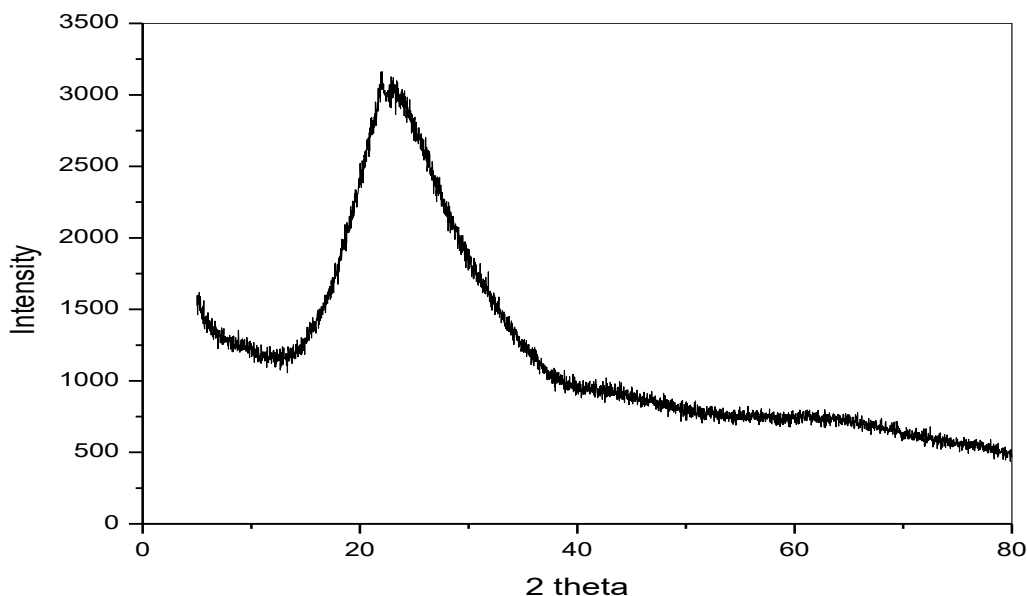


Figure 2: XRD of FASi (extracted silica)

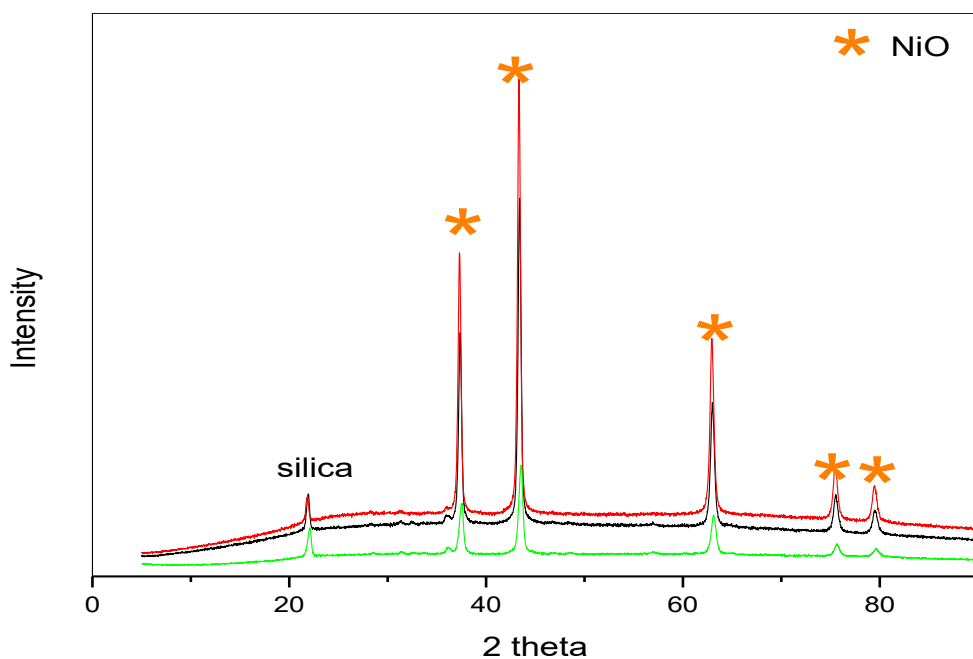


Figure 3: XRD spectra of 5, 10 and 15 Ni@FASi catalysts

The FTIR analysis of FASi and Ni@FASi catalysts are shown in figure 4 and 5. The adding effect of Ni loading on the surfacial and structural properties of prepared support (FASi) was described by FTIR analysis. In FASi (figure 4), the absorption bands between 1500 and 400 cm^{-1} are the characteristics of amorphous silica. The presence of strong hydrogen bonding was indicated by broadness of the band (3300 - 3700 cm^{-1}). The stretching vibration modes of siloxane groups (Si-O-Si) are observed at 1119 and 476 cm^{-1} while the band at 457 cm^{-1} is due to O-Si-O angle deformation mode [28].

But after loading of Ni, the significant changes have been made to these bands. The FTIR spectra of catalysts (figure 5) indicates increase in broadness and peak intensity of the band ascribed to -OH groups. With increase in Ni content, the silica bands at 1119 and 481 cm^{-1} was shifted to lower values, interpreting the incorporation of Ni within the silica network. This may also be attributed to the presence of strong interaction between NiO and FASi support surface which results in the Si-O-Ni⁺² bond formation [29]. The band around 1050 cm^{-1} is typically observed in the range of 1000 - 1100 cm^{-1} can be attributed to Si-O-Ni stretching vibration, but cannot be resolved as it overlaps with the absorbance of Si-O-Si stretching which appears in the range of 1000 - 1300 cm^{-1} [30]. The bands at 961 and 550 cm^{-1} are the additional vibrations bands which becomes visible with high Ni loading that may be due to Si-O-Ni bonds thus confirming the above results.

The FESEM images of fly ash, FASi and different Ni@FASi catalysts is depicted in figure 7. Hollow cenospheres and spherical morphology was observed in FESEM of fly ash (figure 7a), while FESEM micrographs of FASi shows uniform dense microstructure with aggregation (figure 7b). The FESEM images of Ni@FASi (figure c, d and e) catalyst illustrates dispersion of shiny, fine NiO particles on silica surface.

The TGA analysis of FASi and 10 Ni@FASi catalyst are depicted in figure 6. The first weight loss was observed at 100 °C and attributed to physical water adsorbed on 10 Ni@FASi catalyst surface. Around 700 °C, the second weight loss was attributed to the different Si-O-Ni and Si-OH species in the 10 Ni@FASi catalyst surface as revealed by FTIR analysis.

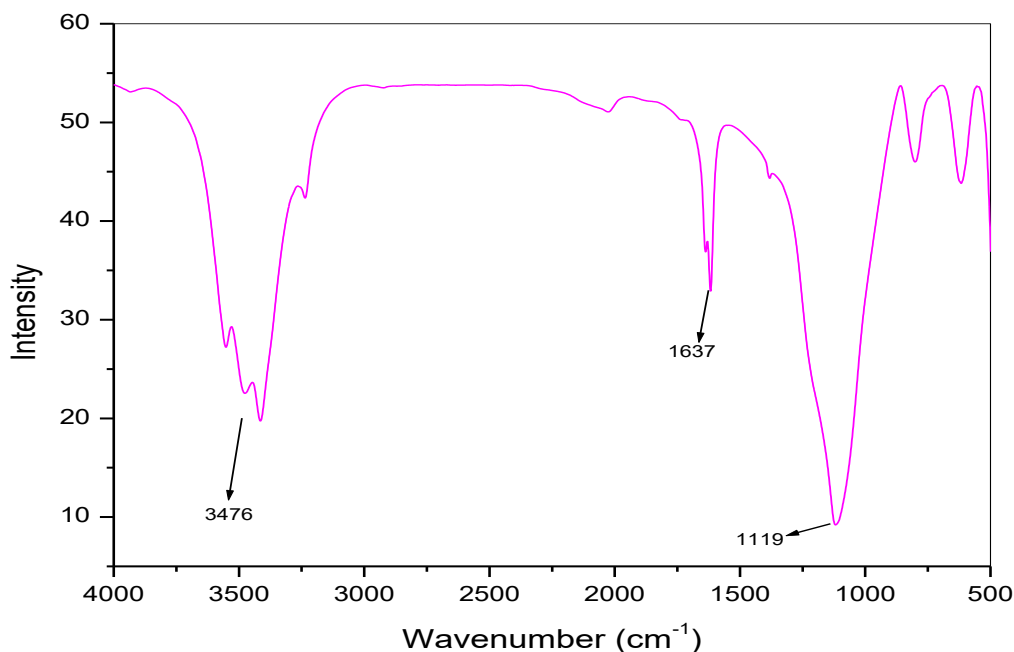


Figure 4: FTIR spectrum of FASi

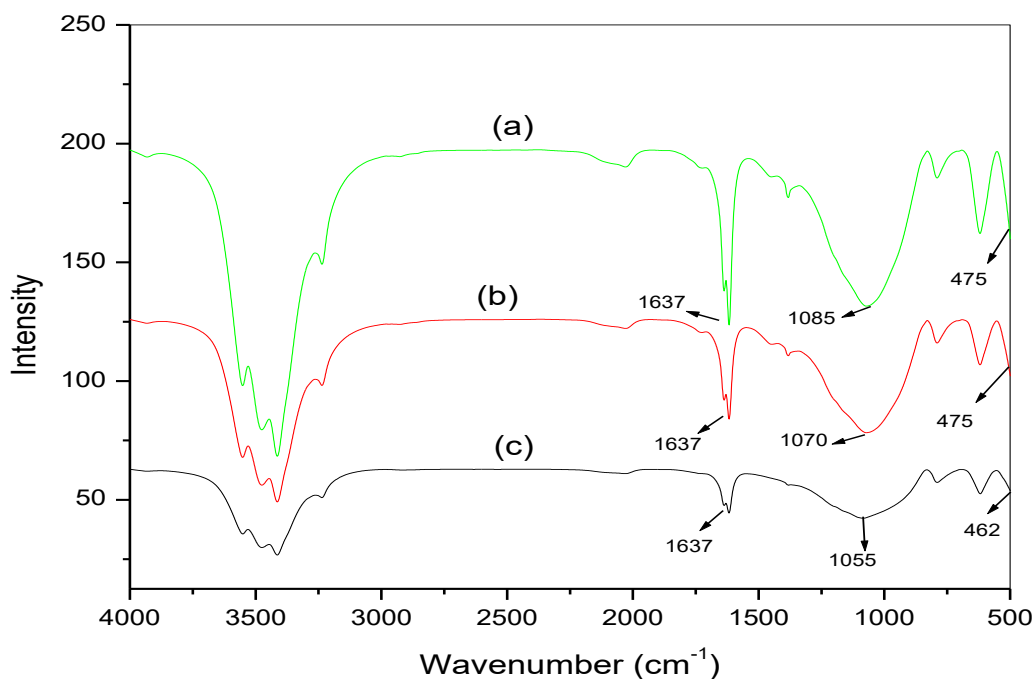


Figure 5: FTIR of Ni@FASi catalysts (5, 10 and 15)

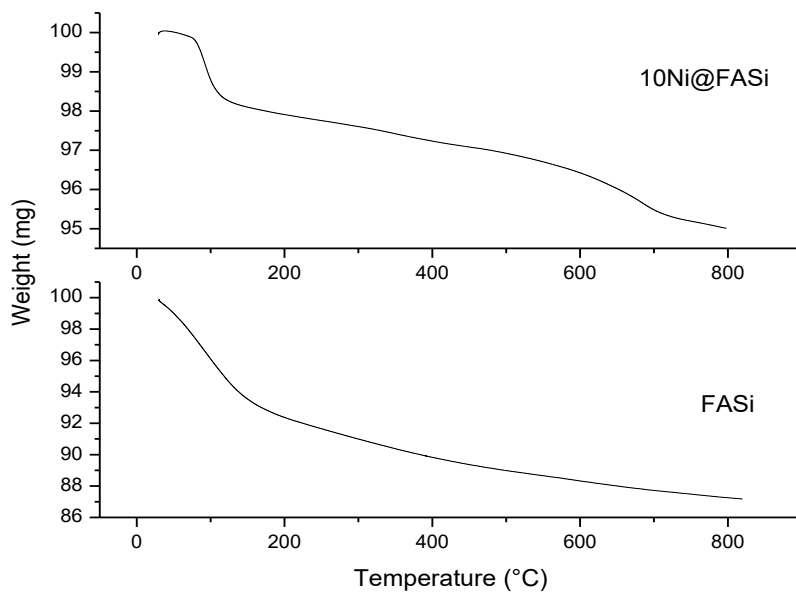


Figure 6: TGA curves of FASi and 10Ni@FASi catalyst

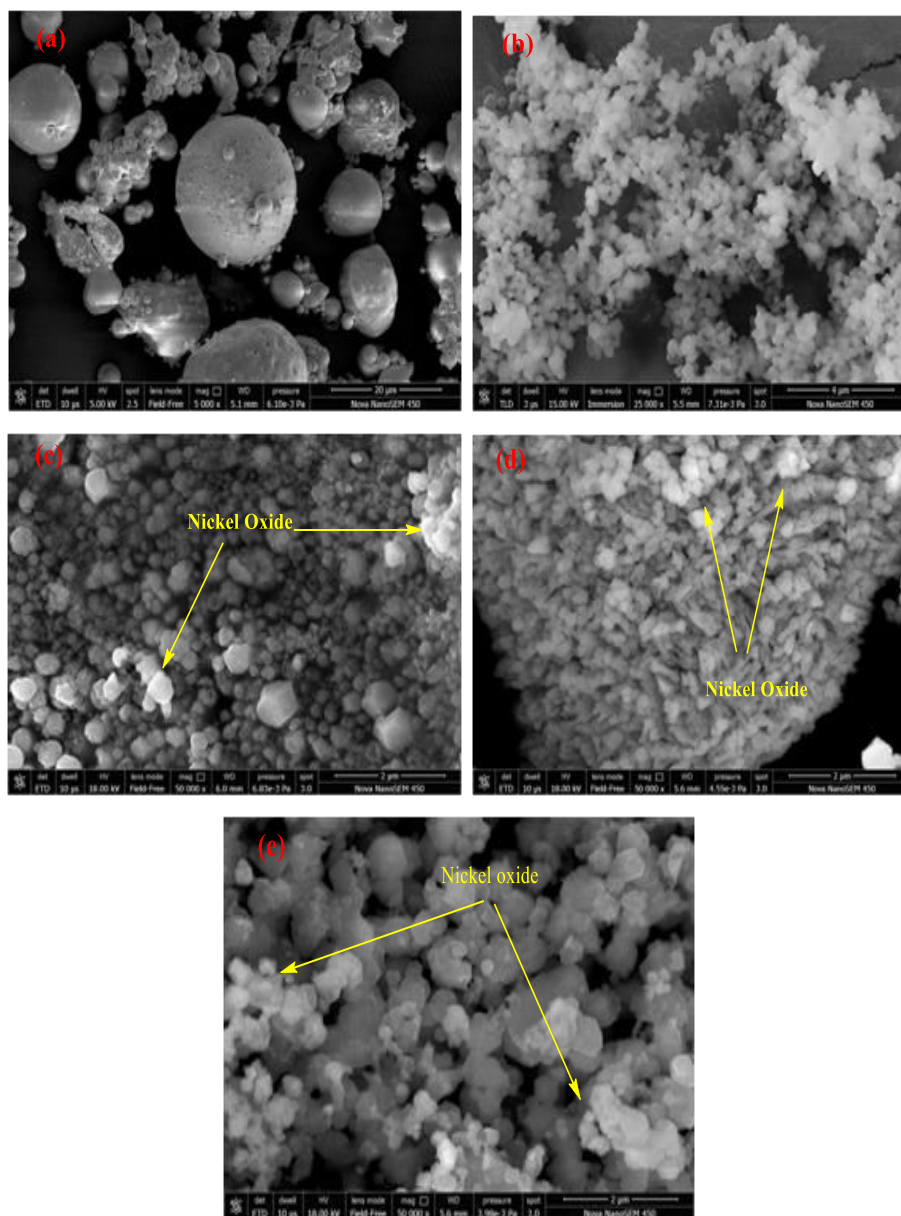


Figure 7: FESEM of (a) pure FA, (b) FASi, (c) 5 Ni@FASi, (d) 10 Ni@FASi and (e) 15 Ni@FASi catalyst

Further evidence for the formation of NiO might be drawn from UV-Raman spectra exhibited in Figure 8. The peaks around 1135, 900, 726 and 580 cm^{-1} attributed to NiO. According to literature survey, raman spectra of NiO shows various bands above 400 cm^{-1} .

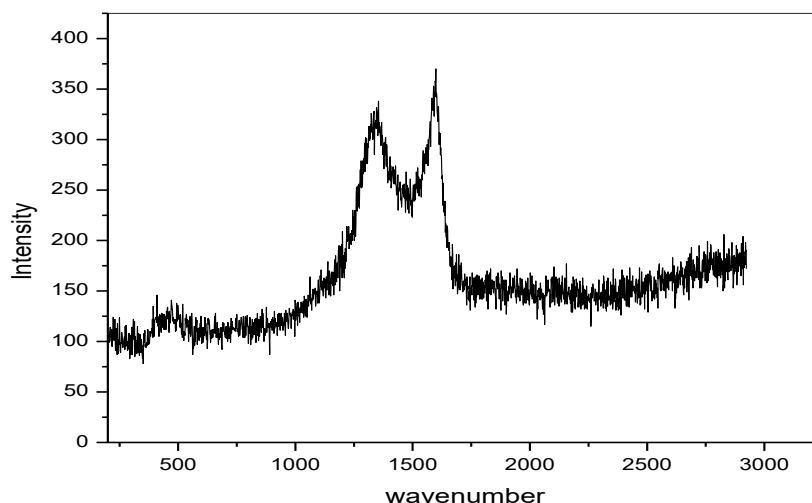


Figure 8: Raman spectra of 10 Ni@FASi catalyst

3.2 Catalytic performance results

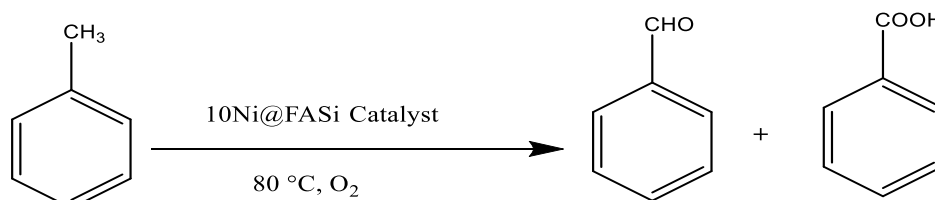
The catalytic performance of catalysts was tested for liquid phase oxidation of toluene to give benzoic acid and benzaldehyde. As it can be seen from table 2, fly ash and FASi does not show any catalytic activity for this oxidation reaction. For 5 Ni@FASi, it shows less conversion (42%) it may be due to presence of less active sites on catalytic surface. While in 10 Ni@FASi, the conversion is highest as compared to other catalysts, it may be due to significant increment of active sites. The conversion was again decreased in case of 15 Ni@FASi catalyst due to blockage of active sites of surface by deposition of NiO crystallites.

Table 2: Catalytic performance of different samples for oxidation reaction.

Samples	Conversion (%)
Fly ash	Nil
FASi	Nil
5 Ni@FASi	42
10 Ni@FASi	85
15 Ni@FASi	72

3.3 Kinetics of liquid phase oxidation of toluene over 10 Ni@FASi catalyst

In a microwave reactor, the liquid phase oxidation of toluene was performed for 5 to 25 min. at range of temperature (343-383 K) to optimize the reaction time and temperature. The reaction is carried out at 80 °C for 10 minutes taking toluene (10 ml), catalyst (100 mg) and O₂ gas (20 ml/min) as represented in scheme 2.



Scheme 2: Liquid phase oxidation of toluene over 10Ni@FASi catalyst

3.3.1 Influence of temperature

Optimization of reaction temperature for maximum conversion was carried out at temperature ranging from 343 K to 383 K for 25 minutes. Conversion was observed to increase on increasing reaction temperature ranging from 343 to 383 K as depicted from figure 9. The results shows that maximum conversion (92%) was found at 383 K after which conversion remains almost constant.

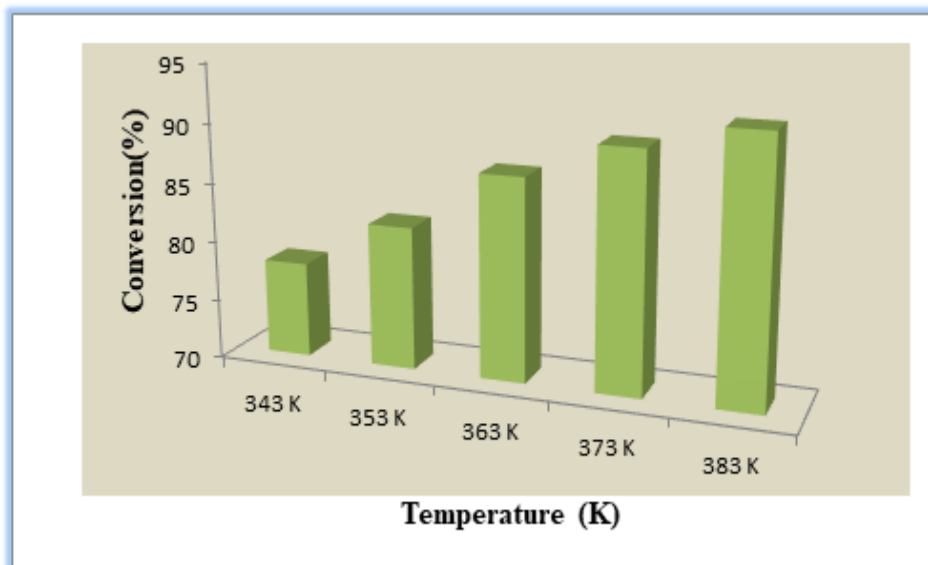


Figure 9: Temperature effect on conversion over 10 Ni@FASi catalyst

3.3.2 Effect of Reaction Time

The effect of reaction time on the conversion was studied in time range of 5-25 minutes at 383 K as depicted 10. The conversion continuously increased upto 92 %. The optimized reaction time was found to be 25 min. in which 10 Ni@FASi catalyst gave higher conversion %.

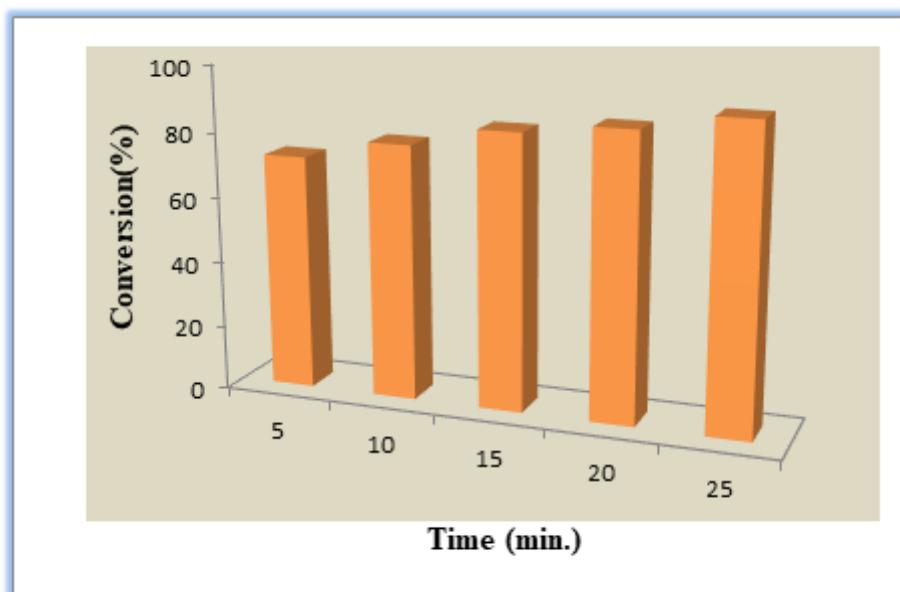


Figure 10: Variation in conversion with time

3.3.3 Kinetic Study

On the surface of the catalyst reactions between adsorbed species, desorption of products and adsorption of reacting species occurs simultaneously. As a result, the heterogenous reaction rates are complex. Typically, the catalytic reactions are described by using the surface concentrations. The influence of surface concentration on reaction rates can be lessened by utilizing simplified assumptions such as quasi-equilibrium and quasi steady state hypothesized. The kinetics of toluene oxidation in this current case can be represented by the power rate law as given below-

$$\text{Rate} = k' [\text{Toluene}]^m [\text{O}_2]^n \quad \dots\dots (1)$$

where, m and n are reaction orders with respect to toluene and oxygen and k is rate constant.

Though the aforementioned expression is only effective for elucidating the mechanism, it may be used to obtain a preliminary dependence of the rate of reaction on the concentration of toluene and oxygen []. The rate expression for oxygen at constant partial pressure is as-

$$\text{Rate} = k' [\text{Toluene}]^m \quad \dots\dots\dots (2)$$

$$\text{Where, } k' = k [\text{O}_2]^n \quad \dots\dots\dots (3)$$

After integrating equation 2,

$$-\ln(1-X) = k't \quad \dots\dots\dots (4)$$

Here, X is conversion of toluene at batch time (t). Table 3, represents the value of X and other experimental results. The graph was plotted between $-\ln(1-X)$ and time (t) at different temperatures (figure 11) on the basis of equation 4.

Table 3: Experimental results of liquid phase oxidation of toluene

S. No	Time (t)	343 K		353 K		363 K		373 K		383 K	
		X (%)	$-\ln(1-X)$	X (%)	$-\ln(1-X)$	X (%)	$-\ln(1-X)$	X (%)	$-\ln(1-X)$	X (%)	$-\ln(1-X)$
1.	5	46	0.6161	55	0.7985	64	1.0216	69	1.1711	72	1.2729
2.	10	61	0.9416	63	0.9942	68	1.1394	73	1.3093	78	1.5141
3.	15	67	1.1086	71	1.2378	75	1.3862	79	1.5606	84	1.8325
4.	20	73	1.3093	78	1.5141	80	1.6094	83	1.7719	87	2.0402
5.	25	78	1.5141	82	1.7147	87	2.0402	90	2.3025	92	2.5257

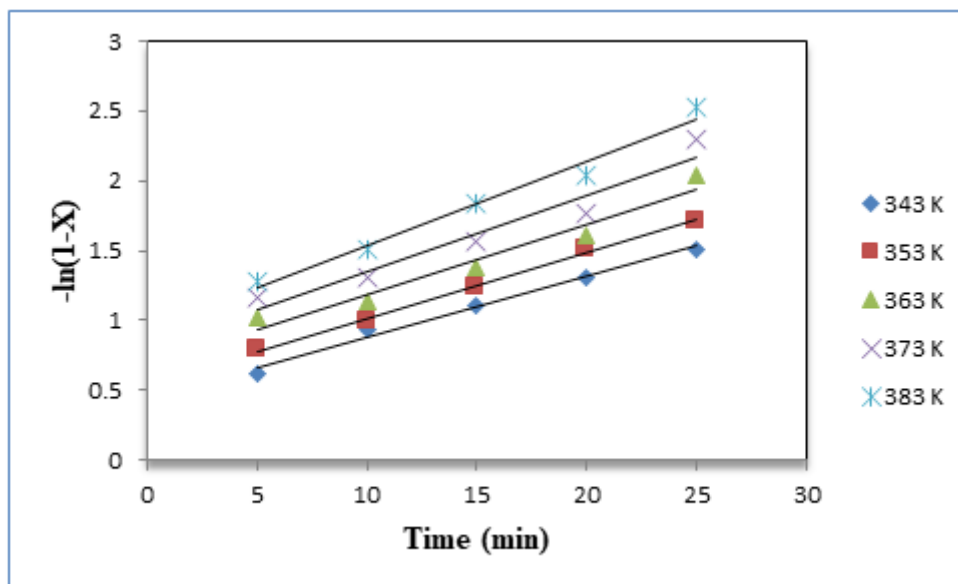


Figure 11: Comparative linear plots at different temperatures

On the basis of linearity in the graphs (figure 11), it describes the rate of oxidation is first order dependence on the concentration of toluene. k' values (rate constant) were derived from the figure 11 and indicated in table 4. Additionally, this expression utility is limited.

Table 4: Calculated rate constant at different temperatures

Temperature (K)	k' (min^{-1})	R^2
343 K	0.1232	0.9865
353K	0.1597	0.9968
363 K	0.2043	0.9564
373 K	0.2342	0.9397
383 K	0.2545	0.9798

4 CONCLUSION

An innovative, efficient solid oxidative catalyst was synthesized by impregnating nickel on fly ash silica as support and its catalytic activities for liquid phase (343-383 K) oxidation were evaluated. All synthesized catalyst were characterized and among all of the prepared catalysts, 10 Ni@FASi is proved to be a possible heterogenous oxidative catalyst with adequate catalytic activity in liquid phase oxidation reaction as evidenced by higher conversion. The liquid phase oxidation kinetics was studied at temperature (343-383 K) and time (5-

25 min) without using any model. The use of microwave reactor gives convenient access to oxidation reactions as well as kinetic study and permits reaction to be conducted efficiently on limited reactant quantities. The novelty of the present work is utilization of the abundant natural waste fly ash, which can replace commercial silica as a solid support for synthesizing efficient heterogeneous oxidative catalyst useful in industrially significant oxidation reaction.

5 ACKNOWLEDGEMENT

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6 CONFLICT OF INTEREST

There is no conflict of interest.

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Analysing 4- Methyl Catechol for Surface Modification of Granular Activated Carbons in Order to Change Its Adsorptive Properties Towards Toxic Metal Lead from Aqueous Solution

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ABSTRACT

In current analysis, coal-based granules of activated carbons Filtrasorb 300 (F- 300) and Filtrasorb 820 (F- 820) were surface modified by organic ligands. These surface modified GACs were studied for their efficiency in adsorption of toxic metal from aqueous solution. Organic ligand such as 4- Methyl Catechol was used to modify the surface of GAC to study the removal of Lead from aqueous phase at constant temperature 25 +/- 1 0C and constant pH 5. The present study deals with spectrophotometric determination of Lead removal capacity of low costing adsorbents from synthetically prepared industrial waste water. The adsorption isotherms of Lead on Granular activated carbon have been determined at pH 5. Langmuir and Freundlich isotherm models were applied to the equilibrium data. The data was well fitting to both of these isotherms. Result suggested that modified F- 820 has significantly better adsorption capacity of toxic metal Lead as compared to F- 300 from waste water.

Keywords: Adsorption, toxic metal removal, Lead, Granular Activated Carbon (GAC), Filtrasorb 300 (F-300), Filtrasorb 820 (F-820), 4- Methyl Catechol.

INTRODUCTION

Toxic metals often exist in water at low concentrations owing to the metal industry and partially due to geological processes, but when their concentration exceeds certain thresholds, they directly poison humans and other living things. In many surface-water and ground water sources, as well as in soils that may erode into this water in drinking water sources, lead exists naturally.

Lead is one of the heavy substances that are frequently found in industrial effluent, and when it is discharged into waterbodies, it has a detrimental effect on both aquatic and terrestrial life. Lead poisoning causes considerable harm to the nervous system, kidney, reproductive system, brain, and liver, which can lead to illness or death. Strong lead exposure has been associated to new born mortality, abortion, miscarriages, infertility, etc.

Lead is an insoluble metal that naturally exists in forms that are not poisonous to living organisms in the earth's crust. There are several methods for treating industrial effluents that contain lead. One of the most important steps in treating water is chemical precipitation, followed by ion exchange, electro dialysis, and carbon adsorption. Lead's maximum contamination level in drinking water cannot be higher than 3-10 g/L as permitted by WHO (World Health Organization).

There are currently several state-of-the-art techniques for eliminating heavy metals, but they are expensive and not suitable for small businesses that only dispose off minor volumes of wastewater. Adsorption is a practical process for separating and purifying materials used in industry, especially for treating waste water. Granular activated carbon is being used more and more in the industrial sector to try to find a method of removing treatable levels of lead wastes from waste waters.

EXPERIMENTAL

Current study uses commercially available granular activated carbons namely F- 300 and F- 820 obtained from Calgon Corporation, Pittsburg, USA. These GACs were first subjected to size fractionation by sieving them using a three-level sieve shaker in order to get uniform sized particles of activated carbon. The sieve shaker only allows the particles having size range of 1400 to 1600 micron to stay in the middle level. Only these particles were taken for current study. These GACs were then thoroughly washed with boiling double distilled water and then dried using an oven at 100-110 0C, then stored in an anhydrous CaCl₂ desiccator until they were used for experimentation. A known-weight weighing vial was used to separate and place some of the carbon particles in the same desiccator. The bottle was weighed every day until a stable weight was found, indicating that the carbon particles had completely lost their moisture. The right quantity of analytical grade Pb(NO₃)₂ (S.D. Fine Chem. Limited) was dissolved in double-distilled water to create a lead ion stock solution. A number of solutions were made with different (known) lead ion concentrations. To estimate the residual Pb²⁺ ion

concentration, the alizarin red (S) technique was used to produce the Beer's law standard curve for Pb²⁺. Throughout the experiment, this study used chemicals of the AR grade. To analyse the adsorption isotherm, 200 ml of 0.001 M 4- Methyl Catechol solution was placed in reagent bottles with 300 ml capacity stoppers and stirred with 0.5 g of GAC. A Teflon-bladed stirrer (Type L-157 M/s Remi Udyog, Mumbai, India) was then used to shake it constantly for five hours at 500 rpm. After five hours, the solution was decanted, and the carbon flakes were meticulously cleaned with double-distilled water. This meant that 4- Methyl Catechol was abundant to modify the surface of the GAC. The same reagent bottle was then used to hold the loaded carbon. It was then filled with 200 ml of a Pb²⁺ solution with a pH of 6. 5 hours were spent stirring the materials in a thermostat at a constant temperature of 25°C. The initial and final concentrations of the Pb²⁺ ion in mg/L were then calculated by measuring absorbance at 470 nm with a UV spectrophotometer (Chemito spectrascan UV 2700 Double beam UV Visible spectrophotometer). To get similar repetitive results, the procedure was applied twice.

RESULTS AND DISCUSSION

The present research looked at both the Langmuir and Freundlich isotherms. At equilibrium, the adsorption isotherm describes the connection between the liquid phase concentration and the adsorbate surface concentration. Using the following equation, the quantity of Pb²⁺ on the ligand-loaded GAC was calculated:

$$q_e = (C_0 - C_e) \frac{V}{W}$$

Where,

q_e = Concentration of Lead ion on GAC and SAC (mg/gm)

C_0 = Initial concentration Lead ion in solution (mg /L);

C_e = Final concentration of Lead ion in solution (mg/L);

V = Volume of solution in litres

W = Weight of GAC and SAC in gm. (0.5 gm)

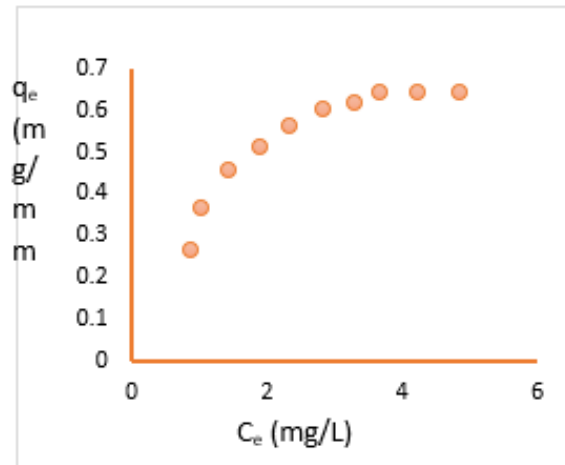


Fig 1: Adsorption isotherm System: F-300- 4- Methyl Catechol -Pb²⁺

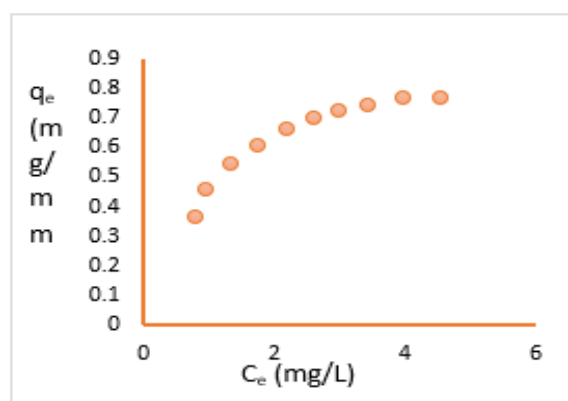


Fig 1: Adsorption isotherm System: F-820- 4- Methyl Catechol -Pb²⁺

Figures 1 and 2 demonstrate the adsorption isotherms of ligand-loaded F-300 and F-820 GAC derived by graphing q_e against C_e .

Using values of q_e against C_e , the Langmuir equation can be stated as

$$q_e = Q^0 b \times \frac{C_e}{(1 + bC_e)}$$

Where,

Q^0 = amount absorbed per unit weight of the adsorbent forming a complex monolayer on the adsorbent surface
 b = Langmuir constant

The linear form of above equation can be written as follows:

$$\frac{1}{q_e} = \frac{1}{bQ^0} \times \frac{1}{C_e} + \frac{1}{Q^0}$$

The plot of $1/q_e$ and $1/C_e$ was found to be substantially linear.

Likewise, the Freundlich equation can be stated as,

$$q_e = K \cdot C_e^{1/n}$$

Where, k and $1/n$ are constants and can be determined experimentally using above equation in linear form:

$$\log q_e = \log k + \frac{1}{n} \log C_e$$

The validity of the Freundlich equation was fairly demonstrated by plotting $\log q_e$ vs $\log C_e$ over a variety of concentrations.

The plot of Langmuir and Freundlich isotherms for F-300 and F-820 is shown in Figures 3 to 6. The graphs of $1/q_e$ vs $1/C_e$ were found to be linear, showing that the Langmuir model is applicable. The comparative adsorption capacities (saturation values of q_e) of manganese ion on different grades of granular activated carbon used in the present work can be assessed from Figs. 1 and 2.

The trend in the q_e values at the saturation level are in the order F-816 > F-300. The Langmuir constants Q^0 and b , which relate to the sorption capacity and adsorption energy, and Freundlich constants K_f and $1/n$ were obtained and given in Table 1.

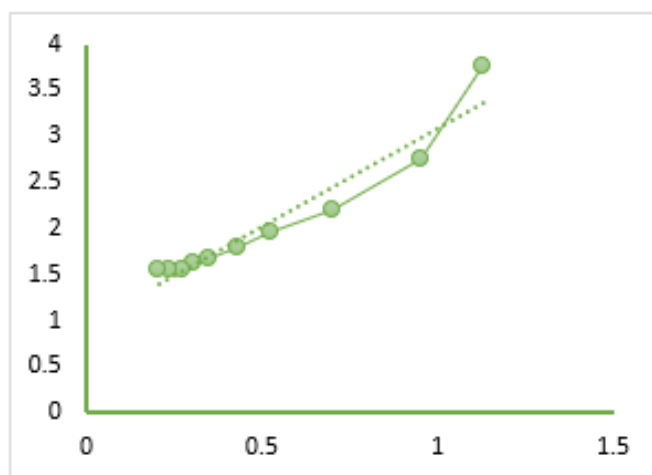


Fig 3: Langmuir Adsorption isotherm System: F-300- 4- Methyl Catechol -Pb2+

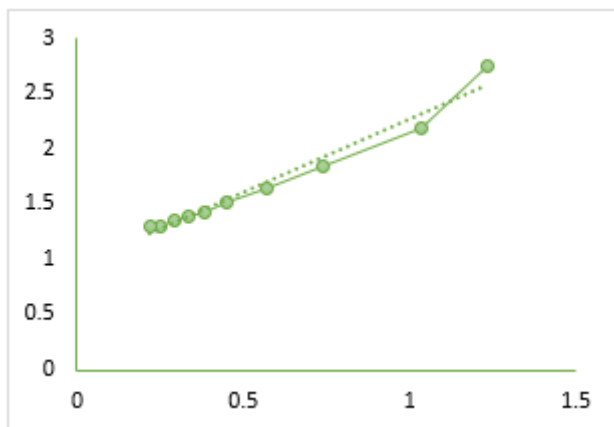


Fig 4: Langmuir Adsorption isotherm System: F-820- 4- Methyl Catechol -Pb2+

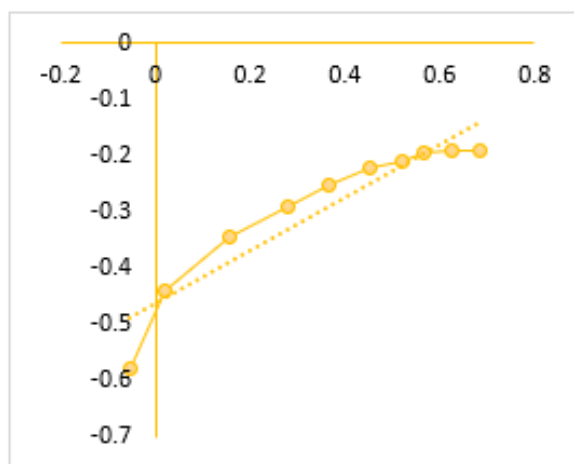


Fig 5: Freundlich Adsorption isotherm System: F-300- 4- Methyl Catechol -Pb2+

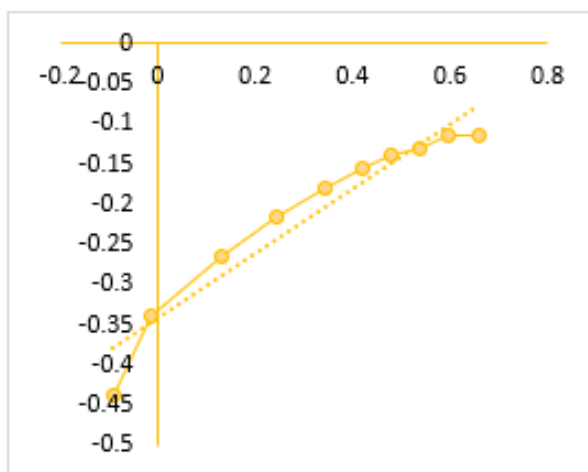


Fig 6: Freundlich Adsorption isotherm System: F-820- 4- Methyl Catechol -Pb2+

Table 1: Langmuir and Freundlich constant and regression correlation coefficient (R^2)

Sr No	System	Langmuir Constant and Regression Coefficient R^2			Freundlich Constant and Regression Coefficient R^2		
		Q_0	b	R^2	K_f	$1/n$	R^2
1	F-300- 4- Methyl Catechol -Pb2+	1.0596	0.4383	0.9263	2.8953	0.4704	0.8828
2	F-820- 4- Methyl Catechol - Pb2+	1.0668	0.7055	0.9682	2.2019	0.4039	0.9260

The trend in the q_e values at the saturation level are in the order F-820 > F-300.

Further the essential characteristics of the Langmuir isotherm can be described by separation factor R_L ; which is defined as:

$$R_L = \frac{1}{1 + bC_i}$$

where, C_i is the initial concentration of Lead (mg/L) and b is the Langmuir constant (gm/L). The value of separation factor R_L , indicates the nature of the adsorption process as given below:

RL Value	Nature of adsorption process
$RL > 1$	Unfavourable
$RL = 1$	Linear
$0 < RL < 1$	Favourable
$RL = 0$	Irreversible

The values of R_L in the present study are found to be in between 0 and 1, showing favourability of adsorption process.

CONCLUSION

Adsorption of Pb^{2+} from wastewater using granular activated carbon is a cost-effective and efficient method. The findings of this investigation demonstrated that GAC's adsorption of the Pb^{2+} ion was extremely encouraging. The experimental data was found to be of the positive kind, and we were tested for conformity to both the Langmuir and Freundlich adsorption isotherms. In the presence of 4- Methyl Catechol, the adsorption isotherms of the Pb^{2+} ion on different grades of carbons clearly reveal that F-820 adsorbs Pb^{2+} ion to a larger proportion than F-300. This is most likely owing to the enormous surface area of F-820 that may be used to approach Pb^{2+} ions.

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A Comprehensive Survey of Nature-Inspired Optimization Algorithms and Future Research Directions

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ABSTRACT

The capacity of nature-inspired optimisation algorithms, also known as NIOAs, to handle complicated optimisation problems in a variety of fields has contributed to the rise in popularity of these algorithms over the past several years. This article provides a detailed assessment of the current state of the art in the field of NIOAs, including a discussion of its fundamental concepts, classifications, and applications. Our primary emphasis is placed on the non-traditional optimisation algorithms (NIOAs) that are now the most well-known and generally put to use. These include, among others, Genetic Algorithms, Particle Swarm Optimisation, Ant Colony Optimisation, and Artificial Bee Colony algorithms. We also explore the latest advancements and hybrid approaches in this area, such as deep reinforcement learning and quantum-inspired optimization algorithms. Furthermore, we discuss the performance evaluation metrics and benchmark problems to assess the efficiency and effectiveness of NIOAs. Finally, we identify potential future research directions and challenges in the field, such as addressing the curse of dimensionality, solving multi-objective optimization problems, and designing adaptive and self-organizing algorithms. This comprehensive survey aims to provide a solid foundation for researchers and practitioners who wish to deepen their understanding of NIOAs and explore novel applications in various fields.

1. INTRODUCTION

Nature-Inspired Optimization Algorithms (NIOAs) have gained significant attention in recent years due to their ability to address a wide variety of complex optimization problems. These algorithms are designed based on the principles and behaviors observed in natural systems, such as biological evolution, swarm intelligence, and natural processes. The fundamental idea behind NIOAs is to imitate the mechanisms and strategies that nature uses to solve problems, adapt to changing environments, and optimize resources. As a result, NIOAs provide a unique and powerful approach to optimization, exhibiting flexibility, robustness, and scalability. The main objective of this paper is to present a comprehensive survey of the current state-of-the-art in NIOAs, including their core principles, classifications, and applications. We aim to provide a solid foundation for researchers and practitioners who wish to deepen their understanding of NIOAs and explore novel applications in various fields.

NIOAs have emerged as a powerful approach to solving complex optimization problems across various domains. By mimicking the problem-solving strategies observed in natural systems, these algorithms exhibit remarkable characteristics such as flexibility, robustness, and scalability. In his seminal work, Xin-She Yang (2020) discusses the challenges and open problems in NIOAs, providing valuable insights for future research in this rapidly evolving field. In paper [1], Yang addresses several key aspects of NIOAs, including their fundamental principles, limitations, and challenges. The author emphasizes the importance of understanding the underlying mechanisms of natural processes to develop more effective and efficient optimization algorithms. The paper provides a detailed discussion on various NIOAs, such as Particle Swarm Optimization (PSO), Genetic Algorithms (GA), Artificial Bee Colony (ABC), Ant Colony Optimization (ACO) algorithms, among others. Yang highlights the existing challenges and open problems in NIOAs, such as the need to improve convergence speed, enhance global search capabilities, and address the curse of dimensionality. The author also underlines the importance of developing adaptive and self-organizing algorithms that can effectively cope with dynamic and uncertain environments. Moreover, Yang discusses the potential of hybrid approaches, which combine the strengths of various NIOAs and other advanced techniques, to tackle increasingly complex optimization problems. In addition to addressing the theoretical and algorithmic aspects of NIOAs, Yang also delves into practical considerations, such as the selection of appropriate performance evaluation metrics and benchmark problems. By doing so, the author highlights the need for a comprehensive and rigorous comparison of NIOAs to ensure their applicability and effectiveness in real-world scenarios. The insights provided by Yang, serve as a valuable resource for researchers and practitioners in the field of NIOAs, offering guidance and inspiration for future research endeavors. This paper emphasizes the importance of addressing the current limitations and challenges in NIOAs to unlock their full potential and contribute to the advancement of computational science and various application domains.

2. LITERATURE SURVEY

MiarNaeimi et al. (2021) [2] introduce NIOA called the HHOA in their paper published in Knowledge-Based Systems. The HHOA is inspired by the social behavior and movement of horse herds in nature. Authors designed this algorithm specifically to address high-dimensional optimization problems. The paper presents the algorithm's structure, including the main components, such as initialization, exploration, and exploitation phases. It also discusses the theoretical aspects and mathematical formulations behind the HHOA. The authors compare the performance of HHOA with other well-known optimization algorithms, including Genetic Algorithms, Particle Swarm Optimization, and Grey Wolf Optimizer, on various high-dimensional benchmark problems. Results indicate that HHOA outperforms other optimization algorithms in terms of convergence speed, accuracy, and robustness when solving high-dimensional optimization problems. The authors conclude that HHOA holds great potential for addressing complex optimization problems in diverse applications, including engineering, economics, and computer science.

In this paper, Abualigah et al. [3] present a comprehensive analysis of NIOAs for text document clustering, published in the journal Algorithms. The authors explore the application of various NIOAs, including GA, PSO, and ACO, among others, in context of unsupervised machine learning for text document clustering. Authors discuss the challenges and opportunities in applying NIOAs to text document clustering, such as handling high-dimensional feature spaces, selecting suitable similarity measures, and optimizing cluster quality. The paper provides a detailed review of methods, their strengths and weaknesses, and the techniques employed to address the challenges in text document clustering. Abualigah et al. also present experimental results and comparisons of different NIOAs on benchmark datasets, evaluating their performance of clustering quality and computational efficiency. Authors identify future research directions, such as the development of hybrid NIOAs, adaptive algorithms, and the integration of domain-specific knowledge for improved clustering results.

This comprehensive analysis provides valuable insights into the application of NIOAs for text document clustering, offering guidance for researchers and practitioners interested in leveraging nature-inspired optimization techniques in unsupervised machine learning tasks.

In this paper, Dehghani et al. (2021) [4] propose a new NIOA called CMBO and published in the journal Sensors. The algorithm is inspired by the predator-prey relationship between cats and mice, where cats represent the global search capability and mice represent the local search capability. The authors aim to harness the characteristics of these two animals to develop a robust optimization algorithm that can efficiently explore and exploit search space. CMBO algorithm consists of several phases, including initialization, position update, and a fitness-based selection process. The paper presents the algorithm's structure, mathematical formulation, and the underlying principles that govern the movement and interactions between the cat and mouse agents. The effectiveness of the CMBO method is assessed on a series of benchmark optimisation problems, and its performance is contrasted with that of other well-known optimisation algorithms.

Harifi et al. (2021) [5] present NIOA called the Emperor Penguins Colony (EPC) algorithm in their paper published in the Journal of Intelligent Manufacturing. The EPC algorithm is inspired by unique social behavior and mating patterns of Emperor Penguins in Antarctica. The authors apply the EPC algorithm to solve inventory control problems, which are critical for optimizing supply chain management and minimizing costs in manufacturing industries. The paper describes the algorithm's structure, components, and the underlying principles of Emperor Penguins' behavior that are used to guide the search process in the optimization problem. They assess the algorithms based on criteria such as total inventory cost, convergence speed, and robustness. Results demonstrate that EPC algorithm outperforms other optimization algorithms in solving inventory control problems, showing superior solution quality and convergence characteristics. The authors conclude that the EPC algorithm has great potential for addressing complex optimization problems in the field of inventory control and other domains, such as transportation, logistics, and production planning.

In this paper, Abd Elaziz and Attiya (2021) [6] propose an improved version of the HGSO algorithm for task scheduling in cloud computing, published in the Artificial Intelligence Review. The HGSO algorithm is a nature-inspired optimization technique based on the solubility of gases in liquids, specifically Henry's law. The authors focus on enhancing performance of original HGSO algorithm by introducing modifications to its exploration and exploitation mechanisms. They apply the improved HGSO algorithm to solve the task scheduling problem in cloud computing, which is crucial for efficiently allocating resources and minimizing operational costs in cloud-based systems. The paper presents the improved algorithm's structure, components, and mathematical formulation, as well as a detailed explanation of the modifications made to the original HGSO algorithm. The authors compare the performance of the improved HGSO algorithm with other well-known

optimization algorithms. Results demonstrate that improved HGSO algorithm outperforms other optimization algorithms in terms of solution quality, convergence speed, and robustness when applied to task scheduling problems in cloud computing. The authors conclude that the improved HGSO algorithm offers a promising approach for solving complex optimization problems in cloud computing and other application domains.

In this conference paper, Jain and Garg (2021) [7] explore the application of nature-inspired computing and neural architecture for the classification of electromyography (EMG) signals. EMG signal classification is a critical task in the development of prosthetic devices and human-machine interfaces for rehabilitation purposes. The authors propose a hybrid approach that combines NIOAs, including Genetic Algorithm, Particle Swarm Optimization, and Grey Wolf Optimizer, with neural architectures, specifically, Convolutional Neural Networks (CNNs). They design an optimization framework to fine-tune the hyperparameters of the CNN model to achieve better classification accuracy and generalization performance on EMG signals. The paper presents the hybrid approach's structure, components, and the process of combining nature-inspired optimization algorithms with neural architectures. The authors evaluate the performance of their proposed approach on benchmark EMG datasets, comparing the results with other techniques. The results show that the hybrid approach of combining nature-inspired computing with neural architecture achieves superior classification accuracy and generalization performance in EMG signal classification. The authors conclude that their proposed approach has great potential for the development of advanced prosthetic devices and human-machine interfaces, as well as other applications in the field of biomedical signal processing.

In this paper, Al-Kubaisy et al. (2021) [8] propose NIOA called the RCMA. The RCMA is inspired by the social behavior, migration patterns, and foraging strategies of the red colobus monkey species. The authors describe the algorithm's structure, components, and the underlying principles that govern the movement and interactions of the monkey agents. The RCM algorithm comprises several phases, including initialization, position update, and a fitness-based selection process. The paper presents the mathematical formulation and theoretical aspects of the RCM algorithm. The results demonstrate that the RCM algorithm shows competitive performance compared to other optimization algorithms, indicating its potential for solving complex optimization problems in various domains, including engineering, finance, and logistics. The authors conclude that the RCM algorithm is a promising new addition to the field of NIOAs.

In this paper, Dhiman (2021) [9] introduces a hybrid nature-inspired metaheuristic optimization algorithm called SSC, published in Knowledge-Based Systems. The SSC algorithm combines the strengths of three popular nature-inspired optimization techniques: Salp Swarm Algorithm (SSA), Spider Monkey Optimization (SMO), and Cuckoo Search (CS). The primary objective is to create a robust and efficient algorithm for solving engineering optimization problems. Author presents hybrid algorithm's structure, components, and the process of integrating the three base algorithms (SSA, SMO, and CS) to develop the SSC algorithm. The paper discusses the mathematical formulation and theoretical aspects of the SSC algorithm, as well as the rationale behind combining the chosen optimization techniques. Performance of SSC algorithm is evaluated on a set of benchmark optimization problems and real-world engineering applications. The results are compared to the base algorithms and other well-known optimization techniques, including Genetic Algorithm and Particle Swarm Optimization. The performance assessment focuses on criteria like convergence speed, solution quality, and robustness. The results show that SSC algorithm outperforms the base algorithms and other optimization techniques in solving complex engineering optimization problems. Author concludes that the hybrid nature of the SSC algorithm enhances its performance and makes it a promising optimization tool for various engineering applications.

In this paper, Bairwa et al. (2021) [10] propose NIOA called the Dingo Optimizer (DO), published in Mathematical Problems in Engineering. The DO algorithm is inspired by the hunting and foraging behaviors of the Australian wild dog, the dingo. The authors aim to harness the characteristics of dingoes to develop a robust optimization algorithm capable of efficiently exploring and exploiting the search space. The DO algorithm consists of several phases, including initialization, position update, and a fitness-based selection process. The paper presents the algorithm's structure, mathematical formulation, and the underlying principles that govern the movement and interactions between the dingo agents. Results indicate that DO algorithm shows competitive performance in terms of convergence speed, solution quality, and robustness. The authors conclude that the DO algorithm holds promise for solving a wide range of optimization problems in various domains, including engineering, finance, and logistics.

In this article, Tan, Feng, and Jiang (2021) [11] present a new frontier in evolutionary computation research called Evolutionary Transfer Optimization (ETO), published in the IEEE Computational Intelligence Magazine.

ETO is a novel research area that focuses on transferring knowledge and experience gained from solving previous optimization problems to enhance the performance of evolutionary algorithms when solving new, related problems. The authors provide an overview of the ETO framework, which consists of three main components: source problem selection, knowledge transfer, and target problem optimization. They discuss various strategies and techniques for each component, emphasizing the importance of selecting appropriate source problems and effective knowledge transfer mechanisms. The article highlights several successful applications of ETO in domains such as scheduling, resource allocation, and feature selection. The authors also identify the key challenges and open research questions in the field of ETO, including the development of more effective knowledge transfer mechanisms, the design of adaptive strategies for source problem selection, and the evaluation of ETO performance on diverse and complex optimization problems. They conclude that ETO represents a promising new direction in evolutionary computation research, with potential to significantly improve performance and efficiency of evolutionary algorithms across a wide range of applications.

In this conference paper, Afzal (2021) [12] presents an optimized SVM model for visual sentiment analysis. Visual sentiment analysis is an emerging research area that focuses on understanding and predicting human emotions and sentiments based on visual content, such as images and videos. The author proposes an optimized SVM model that combines a traditional SVM with a nature-inspired optimization algorithm to fine-tune the hyperparameters of the SVM model. The paper describes the structure and components of the optimized SVM model, as well as the process of integrating the optimization algorithm with the SVM model. The author evaluates the performance of the optimized SVM model on a benchmark visual sentiment analysis dataset and compares the results with other state-of-the-art techniques. Results demonstrate that optimized SVM model outperforms other techniques in terms of classification accuracy and generalization performance for visual sentiment analysis tasks. The author concludes that the optimized SVM model, combined with nature-inspired optimization algorithms, has potential to significantly improve performance of sentiment analysis models in various multimedia applications.

In this paper, Ahmadianfar et al. (2020) [13] propose a new metaheuristic optimization algorithm called Gradient-Based Optimizer (GBO), published in Information Sciences. The GBO algorithm is designed to efficiently explore and exploit the search space to find near-optimal solutions for complex optimization problems. The authors present the algorithm's structure, mathematical formulation, and the underlying principles that govern the movement and interactions of the agents in the search space. The GBO algorithm is inspired by the gradient descent method, which is a popular optimization technique for minimizing objective functions in machine learning and other fields. The GBO algorithm incorporates several innovative strategies to improve the convergence speed, solution quality, and robustness of the gradient descent method. Performance of GBO algorithm is evaluated on a set of benchmark optimization problems, and the results are compared to other optimization algorithms. The authors assess the performance of the algorithms based on criteria such as convergence speed, solution quality, and robustness. Outcomes indicate that the GBO algorithm demonstrates competitive performance compared to other optimization algorithms, showcasing its potential for solving a wide range of optimization problems in various domains, including engineering, finance, and logistics. Authors conclude that the GBO algorithm represents a promising new addition to the field of metaheuristic optimization algorithms.

In this conference paper, Yang et al. [14] present NIOA called CS. The CS algorithm is inspired by the brood parasitism behavior of cuckoo birds, which lay their eggs in the nests of other bird species to reduce the cost of raising their offspring. The CS algorithm utilizes Lévy flights, a random walk process with heavy-tailed step length distributions, to model the searching behavior of cuckoo birds. The authors describe the algorithm's structure, mathematical formulation, and the underlying principles that govern the movement and interactions of the cuckoo agents in the search space. They also discuss the advantages of using Lévy flights for exploration and exploitation in the optimization process. The performance of the CS algorithm is evaluated on a set of benchmark optimization problems and compared to other optimization algorithms. The authors assess the algorithms based on criteria such as convergence speed, solution quality, and robustness. The results demonstrate that the CS algorithm exhibits competitive performance compared to other optimization algorithms, suggesting its potential for solving a wide range of optimization problems in various domains, including engineering, finance, and logistics. Authors conclude that the CS algorithm, combined with Lévy flights, represents a promising new addition to field of NIOA.

In this paper, Li et al. [15] provide a comprehensive review of newly emerging nature-inspired optimization algorithms, published in IEEE Access. The authors present a unified framework for understanding and categorizing these algorithms, which enables a systematic analysis and comparison of their structures,

characteristics, and performance. The paper reviews a wide range of emerging optimization algorithms, such as Grey Wolf Optimizer, Moth Flame Optimization, Whale Optimization Algorithm, and many others. The authors discuss the biological inspirations, key components, and unique features of each algorithm. They also provide a comparative evaluation of the algorithms on a set of benchmark optimization problems, focusing on criteria such as convergence speed, solution quality, and robustness. Additionally, the authors address the important issue of behavioral parameter optimization in nature-inspired algorithms. They propose a self-adaptive strategy for optimizing behavioral parameters, which aims to enhance the performance and robustness of the algorithms by adjusting the parameters during the optimization process. The paper highlights the strengths and weaknesses of the reviewed algorithms, identifies potential research directions, and suggests opportunities for further development and improvement of nature-inspired optimization algorithms. The authors conclude that this comprehensive analysis and the proposed unified framework can serve as a valuable resource for researchers and practitioners working in the field of optimization.

3. NATURE-INSPIRED OPTIMIZATION ALGORITHMS

Nature-inspired optimization algorithms are computational methods that imitate the behavior and principles observed in natural systems to solve complex optimization problems. Here are five widely-used nature-inspired optimization algorithms:

1. Genetic Algorithm (GA):

Genetic Algorithm is inspired by the process of natural selection and genetic evolution. It operates on a population of potential solutions and employs genetic operators such as mutation, crossover, and selection to evolve the population towards an optimal solution. The algorithm begins with an initial population, usually generated randomly, and iteratively refines the solutions by applying the genetic operators. The fittest individuals are more likely to survive and produce offspring, leading to an improved population over time. GAs are highly effective for solving combinatorial and optimization problems.

2. Particle Swarm Optimization (PSO):

The cooperative nature of animal groups, such as flocks of birds or schools of fish, served as an inspiration for PSO. It is an algorithm that is built on populations, and each individual, which is referred to as a particle, represents a possible solution in the search space. The particles advance in the search space by continually revising their positions such that they are in accordance with their best-known locations as well as those of their neighbours' best-known locations. The algorithm iteratively adjusts the velocities and positions of the particles until convergence or a termination criterion is met. PSO is highly effective for solving continuous optimization problems.

3. Ant Colony Optimization (ACO):

The behaviour of ants as they forage for food served as inspiration for ACO's design. The programme simulates the way in which ants communicate with one another indirectly by leaving pheromone trails. The ACO algorithm uses computer simulations of ants to find answers to optimisation problems by moving across a search space and leaving pheromone trails behind them as they go. The effectiveness of the treatment determines the total amount of pheromone that is left behind. The subsequent ants utilise these pheromone trails to make judgements about how to construct their own solutions based on a probabilistic model. The travelling salesman issue is a good example of a discrete optimisation problem that benefits greatly from the use of ACO's problem-solving abilities.

4. Artificial Bee Colony (ABC):

The honeybee's method of gathering food served as inspiration for ABC. The process of bees seeking for food sources (nectar) and interacting with each other to share information about the best food sources is modelled using the algorithm. There are three different kinds of bees that make up the colony in ABC: employed bees, observer bees, and scout bees. Onlooker bees get information on potential food sources from employed bees, who then use this knowledge to make probabilistic decisions regarding the suitability of potential food sources. It is the responsibility of the Scouts to investigate new food sources. ABC has been applied well to a wide range of optimisation issues, including continuous and combinatorial optimisation.

5. Firefly Algorithm (FA):

The Firefly Algorithm is inspired by the flashing behavior of fireflies. In FA, each firefly represents a potential solution, and their attractiveness is determined by the quality of the solution they represent. Fireflies are attracted to each other based on their attractiveness, and they move towards brighter fireflies (better solutions) in the search space. As fireflies get closer to one another, they update their positions to converge towards better solutions. The algorithm terminates when a stopping criterion is met, such as a maximum number of iterations. FA is effective for solving both continuous and discrete optimization problems.

4. RESULT ANALYSIS

Table 1 shows the comparative analysis of researcher's work

Author	Methodology Used	Advantages	Limitations
MiarNaeimi et al. [2]	Horse Herd Optimization Algorithm (HHOA)	- Effective for high-dimensional optimization problems	- Parameter tuning may be required
		- Competitive performance compared to other algorithms	- May not be suitable for all problem types
Abualigah et al. [3]	NIOAs for Text Document Clustering	- Comprehensive analysis of clustering algorithms	- Limited to text document clustering
		- Systematic comparison and categorization	- May not cover all recent algorithms
Dehghani et al. [4]	Cat and Mouse Based Optimizer (CMBO)	- Competitive performance compared to other algorithms	- Parameter tuning may be required
		- Applicable to a wide range of optimization problems	- May not be suitable for all problem types
Harifi et al. [5]	Emperor Penguins Colony Algorithm (EPCA)	- Effective for inventory control problems	- Limited to inventory control problems
		- Competitive performance compared to other algorithms	- Parameter tuning may be required
Abd Elaziz et al. [6]	Improved Henry Gas Solubility Optimization Algorithm (HGSO)	- Improved task scheduling in cloud computing	- Limited to cloud computing task scheduling
		- Competitive performance compared to other algorithms	- Parameter tuning may be required
Jain et al. [7]	Nature-Inspired Computing and Neural Architecture	- Effective for EMG classification	- Limited to EMG classification
		- Competitive performance compared to other algorithms	- Parameter tuning may be required
Al-Kubaisy et al. [8]	Red Colobuses Monkey Algorithm (RCMA)	- Competitive performance compared to other algorithms	- Parameter tuning may be required
		- Applicable to a wide range of optimization problems	- May not be suitable for all problem types
Dhiman [9]	SSC: Hybrid Nature-Inspired Meta-heuristic Optimization Algorithm	- Effective for engineering applications	- Limited to engineering applications
		- Competitive performance compared to other algorithms	- Parameter tuning may be required
Bairwa et al. [10]	Dingo Optimizer (DO)	- Competitive performance compared to other algorithms	- Parameter tuning may be required
		- Applicable to a wide range of optimization problems	- May not be suitable for all problem types
Tan et al. [11]	Evolutionary Transfer Optimization (ETO)	- Improved performance of evolutionary algorithms	- Limited to evolutionary algorithms
		- Transfer of knowledge between tasks	- Parameter tuning may be required
Afzal [12]	Optimized Support Vector Machine	- Improved classification accuracy and generalization	- Limited to visual sentiment analysis tasks

	(SVM) for Visual Sentiment Analysis	- Applicable to multimedia applications	- Optimization algorithm not specified
Ahmadianfar et al. [13]	Gradient-Based Optimizer (GBO)	- Competitive performance compared to other algorithms	- Parameter tuning may be required
		- Efficient exploration and exploitation	- May not be suitable for all problem types
Yang et al. [14]	Cuckoo Search (CS) via Lévy Flights	- Efficient exploration and exploitation	- Parameter tuning may be required
		- Competitive performance compared to other algorithms	- May not be suitable for all problem types
Li et al. [15]	Unified Framework for Nature-Inspired Optimization Algorithms	- Comprehensive analysis of emerging optimization algorithms	- May not cover all recent algorithms
		- Systematic comparison and categorization	- Performance analysis may vary with specific applications

5. CONCLUSION

In this comprehensive survey, we have presented an in-depth overview of Nature-Inspired Optimization Algorithms (NIOAs), their fundamental principles, classifications, and applications. We have explored popular NIOAs, such as Genetic Algorithms, Particle Swarm Optimization, Ant Colony Optimization, and Artificial Bee Colony algorithms, and delved into recent advancements and hybrid approaches in this rapidly evolving field. Furthermore, we have discussed the importance of performance evaluation metrics and benchmark problems for assessing the efficiency and effectiveness of NIOAs, highlighting the need for rigorous comparisons between different algorithms. By identifying potential future research directions and challenges, such as addressing the curse of dimensionality, solving multi-objective optimization problems, and designing adaptive and self-organizing algorithms, we aim to inspire further research and development in this fascinating area. NIOAs have demonstrated their potential in solving complex optimization problems across various domains. As the field continues to evolve, we believe that addressing the identified challenges and open problems will pave the way for more efficient, effective, and versatile algorithms. By deepening our understanding of the natural processes that inspire these algorithms and integrating advanced techniques from other disciplines, we can foster the growth of NIOAs and unlock their full potential in numerous real-world applications. This comprehensive survey serves as a valuable resource for researchers and practitioners, offering insights and guidance for future work in the domain of Nature-Inspired Optimization Algorithms.

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Survey on Decentralized Stock Exchange Using Blockchain Technique

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ABSTRACT

This paper presents a comprehensive survey of the emerging field of decentralized stock exchanges (DSEs) utilizing blockchain technology. The adoption of blockchain techniques in stock trading platforms offers potential advantages such as enhanced security, transparency, and reduced costs, as well as the potential to minimize the influence of centralized intermediaries. This study systematically reviews the existing literature and investigates the key characteristics, benefits, and challenges of implementing DSEs. Furthermore, the paper explores the various blockchain-based platforms and protocols employed in DSEs, while also identifying the regulatory and legal considerations for their successful deployment. The survey concludes with a discussion of the possible future trends and research directions in the realm of blockchain-based DSEs.

1. INTRODUCTION

The traditional stock exchange has been the cornerstone of financial markets for centuries, enabling the efficient trading of securities through centralized intermediaries. However, the centralized nature of these exchanges has led to concerns regarding transparency, security, and the undue influence of intermediaries. The rapid advancements in blockchain technology have presented an opportunity to address these issues by enabling the development of decentralized stock exchanges (DSEs).

DSEs leverage the power of blockchain to create a decentralized, transparent, and secure platform for trading stocks and other financial assets. By removing the need for centralized intermediaries, DSEs have the potential to reduce transaction costs, enhance security, and promote greater financial inclusion. Despite these advantages, the adoption of DSEs has been relatively slow, largely due to regulatory concerns and technological limitations.

In this paper, we present a systematic survey of the current state of DSEs, including their key characteristics, benefits, and challenges. We begin by providing a brief overview of blockchain technology and its applications in the financial industry. Next, we delve into the various platforms and protocols employed by DSEs, with a focus on their unique features and limitations. We then examine the regulatory and legal considerations for DSEs, as well as the challenges they face in terms of scalability, latency, and privacy. Finally, we discuss possible future trends and research directions in the field of blockchain-based DSEs, paving the way for further exploration and innovation in this promising area of financial technology.

DECENTRALIZED STOCK EXCHANGE USING BLOCKCHAIN

A decentralized stock exchange (DSE) is a digital platform that enables the trading of stocks and other financial instruments without the need for centralized intermediaries, such as traditional stock exchanges or clearinghouses. By leveraging blockchain technology, DSEs aim to improve the overall efficiency, transparency, and security of financial markets. In this section, we discuss the key features and advantages of DSEs, as well as some of the challenges they face. Figure 1 shows the overview of decentralised stock exchange using blockchain.

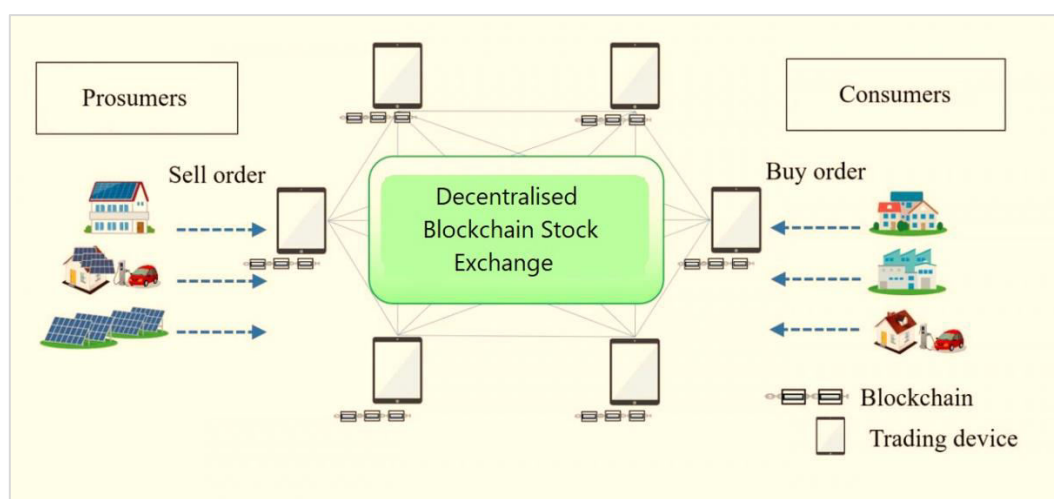


Figure 1. Decentralise stock exchange using blockchain

1. KEY FEATURES OF DECENTRALIZED STOCK EXCHANGES

a) Decentralization

DSEs utilize distributed ledger technology (DLT) to maintain a decentralized, tamper-proof record of all transactions. This eliminates the need for centralized authorities and allows market participants to trade directly with one another.

b) Peer-to-Peer Trading

With DSEs, investors can trade financial instruments directly with other investors, without the need for intermediaries like brokers or banks. This peer-to-peer model can lead to reduced transaction costs and increased efficiency.

c) Transparency

The public nature of blockchain ensures that all transactions on a DSE are transparent and verifiable, fostering trust among market participants.

d) Security

Blockchain's cryptographic features provide a high level of security, making it difficult for bad actors to manipulate or alter transaction records.

e) Tokenization

DSEs can tokenize stocks and other assets, representing them as digital tokens on the blockchain. This enables fractional ownership and facilitates the trading of traditionally illiquid assets.

2. ADVANTAGES OF DECENTRALIZED STOCK EXCHANGES

A) Lower Transaction Costs

By eliminating intermediaries, DSEs can significantly reduce the fees associated with trading stocks, leading to cost savings for investors.

B) Enhanced Security

The decentralized nature of DSEs reduces the risk of a single point of failure, while the cryptographic features of blockchain technology protect against fraud and manipulation.

C) Improved Transparency

DSEs enable real-time tracking and verification of transactions, ensuring that all market participants have equal access to information.

D) Increased Financial Inclusion

DSEs can provide access to a broader range of investors, including those in underserved or unbanked regions, by leveraging digital currencies and simplifying the process of investing in stocks.

3. CHALLENGES FACED BY DECENTRALIZED STOCK EXCHANGES

A) Regulatory Hurdles

The lack of a centralized authority in DSEs raises concerns among regulators, who worry about the potential for money laundering, tax evasion, and other illicit activities.

B) Scalability And Latency

Blockchain networks can face challenges related to transaction throughput and latency, which could hamper the ability of DSEs to handle high volumes of transactions.

C) Privacy Concerns

The public nature of blockchain transactions can lead to concerns about the privacy of sensitive financial information.

D) Interoperability

DSEs need to establish interoperability with existing financial systems and other DSE platforms to ensure a seamless trading experience for investors.

2. LITERATURE REVIEW

The growing interest in decentralized stock exchanges using blockchain technology has led to a number of studies exploring different aspects of this innovative concept. The following literature review highlights some key works in this field:

Tseng et al. (2019) presented a case study of using blockchain technology for accessing cloud services in the financial sector [1]. The authors demonstrated the potential of blockchain in improving the efficiency, security, and transparency of financial transactions. Their work provides valuable insights into the application of blockchain for financial services and the potential benefits of decentralized stock exchanges.

Kosba et al. (2016) introduced Hawk, a novel approach for designing privacy-preserving smart contracts on blockchain platforms [2]. The authors proposed a model that combines cryptography with smart contracts, enabling transactional privacy in decentralized systems. This work is particularly relevant for decentralized stock exchanges, as it addresses the privacy concerns that arise from the public nature of blockchain transactions.

Xu et al. (2019) discussed the design process for applications on blockchain, providing guidelines for developing and deploying blockchain-based solutions [3]. The authors emphasized the importance of understanding the unique features and limitations of blockchain technology in order to design effective applications. Their work offers valuable insights into the development of blockchain-based decentralized stock exchanges and the challenges they may encounter.

Hu et al. (2019) investigated smart contract optimization methods on blockchain, focusing on improving the efficiency and reducing the cost of executing smart contracts [4]. Their research contributes to the ongoing efforts to make blockchain-based decentralized stock exchanges more scalable and cost-effective.

Governatori et al. (2018) examined the relationship between legal contracts, imperative and declarative smart contracts, and blockchain systems [5]. The authors discussed the potential of smart contracts to represent and enforce legal contracts on blockchain platforms, highlighting the importance of addressing regulatory and legal issues in the development of decentralized stock exchanges.

Leka, Selimi, and Lamani (2019) [6] conducted a systematic literature review on the applications of blockchain technology, focusing on smart contracts. Smart contracts, self-executing contracts with the terms of agreement directly written into code, are an essential component of decentralized stock exchanges. The authors identified potential use cases for smart contracts across various sectors, including finance, healthcare, and supply chain management, highlighting their potential to enhance the efficiency and security of various processes.

Pop et al. (2018) [7] examined the feasibility of decentralizing a stock exchange using blockchain, specifically focusing on the Bucharest Stock Exchange. The authors proposed an Ethereum-based implementation that used smart contracts to facilitate transactions and maintain records. Their study demonstrated the potential of blockchain technology to improve efficiency and transparency in stock trading while addressing some of the existing challenges associated with traditional stock exchanges.

Yining et al. [8] explored the applications and challenges of blockchain-based smart contracts, examining their use in various industries such as finance, insurance, and healthcare. The authors identified the limitations of smart contracts, including scalability and privacy concerns, which are also relevant to decentralized stock exchanges. They emphasized the need for further research and development to address these challenges and realize the full potential of smart contracts in real-world applications.

Miraz and Donald (2018) [9] investigated the application of blockchain technology in the booking and registration systems of securities exchanges. The authors discussed the potential benefits of blockchain-based systems, such as improved transparency, reduced transaction costs, and enhanced security. They also highlighted the challenges related to regulatory compliance and the need for effective governance mechanisms to ensure the stability and reliability of such systems.

Wanjun and Yuan (2018) [10] conducted research on network trading systems using blockchain technology. They proposed a system that leveraged blockchain to ensure secure, transparent, and efficient transactions in the trading of financial assets. The authors discussed the key features of their system, including consensus algorithms and smart contracts, and demonstrated its potential to revolutionize the financial industry by eliminating intermediaries and enhancing trust among market participants.

Watanabe et al. [11] explored the concept of "Blockchain Contract," which aimed to secure a blockchain applied to smart contracts. The authors proposed a model to enhance the security and privacy of smart contracts on blockchain platforms. This study laid the foundation for further research in the field of secure and transparent smart contracts, which play a critical role in the functioning of decentralized stock exchanges.

Dixit and Norta [12] proposed a self-aware contract for decentralized peer-to-peer (P2P) commerce. The study highlighted the importance of decentralized systems in fostering trust and transparency in P2P transactions. The authors discussed the potential of self-aware contracts in mitigating risks associated with decentralized commerce, paving the way for more advanced and secure P2P trading platforms, such as decentralized stock exchanges.

Gao et al. [13] focused on the scalability of blockchain-based smart contract execution. The authors presented a scalable and efficient mechanism for executing smart contracts on blockchain platforms, addressing one of the major challenges faced by decentralized systems. The study's findings contribute to the development of scalable decentralized stock exchanges capable of handling high volumes of transactions.

Melbha [14] examined the market potential of opening DEMAT and trading accounts for stock exchange trading. The study provided insights into the factors influencing investors' decision-making processes, as well as the potential benefits of adopting new technologies in the financial sector. The findings of this research can be applied to understand the market potential and challenges of decentralized stock exchanges.

Ouaddah et al. [15] proposed a novel privacy-preserving access control model based on blockchain technology for the Internet of Things (IoT). The authors addressed the critical issue of privacy in the context of IoT, which shares similarities with the privacy concerns faced by decentralized stock exchanges. The study's model offers potential solutions for implementing privacy-preserving mechanisms in blockchain-based systems.

The existing literature emphasizes the potential of blockchain technology and smart contracts to revolutionize the financial industry by enabling decentralized stock exchanges. These studies highlight the numerous benefits of DSEs, such as improved transparency, reduced transaction costs, and enhanced security. However, they also acknowledge the challenges related to scalability, privacy, and regulatory compliance, indicating the need for further research and development to address these issues and fully realize the potential of blockchain-based stock exchanges.

3. RESULT ANALYSIS

Following Table 1 shows the Comparative analysis of various techniques used by authors in the field of decentralized blockchain

Table 1. Comparative Analysis of Researchers Work

Author(s)	Methodology	Challenges Discussed	Advantages	Disadvantages
Tseng, M. R., Chang, S. E., & Kuo, T. (2019)	Case study	Integration with existing systems, Trust issues, Scalability	Improved transparency, Enhanced security, Streamlined access to cloud services, Potential cost reduction	Initial setup costs, Technological complexity
Kosba, A., et al. (2016)	Cryptographic model and smart contract design	Privacy preservation, Security of smart contracts	Enhanced security, Privacy-preserving smart contracts, Increased trust among users	Limited scalability, Complexity of cryptographic techniques
Xu, X., Weber, I., & Staples, M. (2019)	Design process framework for blockchain applications	Integration with traditional systems, Security and privacy concerns	A structured approach to design and develop blockchain applications, Enhanced understanding of architectural considerations	Limited to specific use cases, Design challenges may arise in real-world implementations
Hu, W., Fan, Z., & Gao, Y. (2019)	Smart contract optimization techniques	Smart contract optimization, Scalability, Latency	Improved performance, Cost-efficiency, Enhanced security	Complexity of optimization techniques, may require advanced expertise
Governatori, G., et al.	Comparison of legal contracts,	Legal enforceability, Mapping of legal	Better understanding of the relationship between	Challenges in translating legal

(2018)	imperative and declarative smart contracts	concepts to smart contracts	legal contracts and smart contracts, Identification of requirements for blockchain-based legal systems	concepts to code, Enforceability issues with blockchain-based co
Leka et al. (2019)	Systematic Literature Review	Scalability, security, and privacy of smart contracts	Enhanced security and transparency	Lack of standardized smart contract models
Pop et al. (2018)	Ethereum-based Implementation	Scalability, regulatory compliance, and market adoption	Decentralization, cost reduction	Limited liquidity
Yining et al. (2020)	Project: Towards Digital Paradise (TDP)	Legal and regulatory issues, scalability, and latency	Automation, transparency, cost savings	Complexity and interoperability
Miraz & Donald (2018)	Case Study	Security, regulatory compliance, and interoperability	Improved efficiency, reduced fraud	Adaptation challenges
WanJun & Yuan (2018)	Blockchain-based Network Trading System Analysis	Scalability, privacy, and regulatory compliance	Enhanced security, transparency	Technological complexity
Watanabe et al. (2016)	Blockchain Contract Model	Security and privacy	Enhanced security and privacy in smart contracts	Limited to smart contract security and privacy
Dixit and Norta (2018)	Self-Aware Contract Model	Trust in P2P transactions	Improved trust and transparency in P2P commerce	Focused on P2P commerce, not stock exchanges
Gao et al. (2017)	Scalable Smart Contract System	Scalability of smart contracts	Efficient and scalable smart contract execution	Scalability-focused, not addressing all challenges
Melbha (2017)	Market Analysis	Market adoption and preferences	Insights into investor decision-making and market potential	Limited to Demat and trading accounts
Ouaddah et al. (2017)	Access Control Model	Privacy in IoT	Privacy-preserving access control in IoT	Focused on IoT, not directly related to DS

4. CONCLUSION

This paper has provided a comprehensive survey of the emerging field of decentralized stock exchanges (DSEs) using blockchain technology. The analysis of existing literature and studies highlights the potential advantages of DSEs, including enhanced security, transparency, and reduced costs, along with the minimization of the influence of centralized intermediaries. However, the implementation of DSEs faces significant challenges, such as regulatory and legal considerations, scalability, and interoperability, which need to be addressed to ensure their successful deployment. The exploration of various blockchain-based platforms and protocols employed in DSEs reveals the dynamic nature of this field, with continuous innovation and development taking place. As blockchain technology continues to mature, it is expected that DSEs will become increasingly prevalent, offering a more efficient and secure alternative to traditional stock exchanges.

Future research in the realm of blockchain-based DSEs should focus on addressing the challenges discussed in this survey, as well as exploring novel approaches to optimize and enhance the performance of DSE platforms. By overcoming these challenges and building on the advantages, DSEs have the potential to revolutionize the financial industry and reshape the landscape of stock trading.

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Intrusion Detection in WSN Using Using T-Maxoutnet: Taylor Series Based Deep Maxout Network

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ABSTRACT

The popularity of Wireless Sensor Networks (WSNs) has grown significantly owing to their capacity to gather and transmit data from regions that are remote and difficult to access. Wireless Sensor Networks (WSNs) are susceptible to a range of security threats, underscoring the importance of intrusion detection as a critical approach to safeguarding their security. The present study introduces a new approach to detect intrusions in wireless sensor networks (WSNs) through the utilisation of a deep Maxout network based on Taylor series, which is referred to as T-MaxoutNet. The T-MaxoutNet model integrates the benefits of Taylor series expansion and the deep Maxout network architecture to enhance the detection precision of Wireless Sensor Networks (WSNs). The method under consideration has been subjected to evaluation using the CICIDS2017 dataset and has been juxtaposed with contemporary intrusion detection techniques. The empirical findings indicate that the T-MaxoutNet exhibits a high level of accuracy in identifying both familiar and unfamiliar attacks, surpassing alternative approaches with respect to detection rate, false alarm rate, and detection time. Furthermore, the method that has been suggested exhibits computational efficiency and is capable of being executed on sensor nodes that have limited resources. The T-MaxoutNet plays a crucial role in safeguarding Wireless Sensor Networks (WSNs) across diverse domains, including but not limited to environmental monitoring, healthcare, and military surveillance, thereby underscoring its significance.

I. INTRODUCTION

The utilisation of Wireless Sensor Networks (WSNs) has gained significant traction in contemporary times owing to their capacity to gather and relay information from distant and hard-to-reach locations [3]. Wireless Sensor Networks (WSNs) are comprised of diminutive and economical sensor nodes that are strategically positioned over a vast expanse to amass and convey data to a central or sink node. The distributed nature, resource constraints [4], and wireless communication of these networks render them susceptible to a range of security attacks. The implementation of intrusion detection is a pivotal approach in guaranteeing the safeguarding of Wireless Sensor Networks (WSNs) [4].

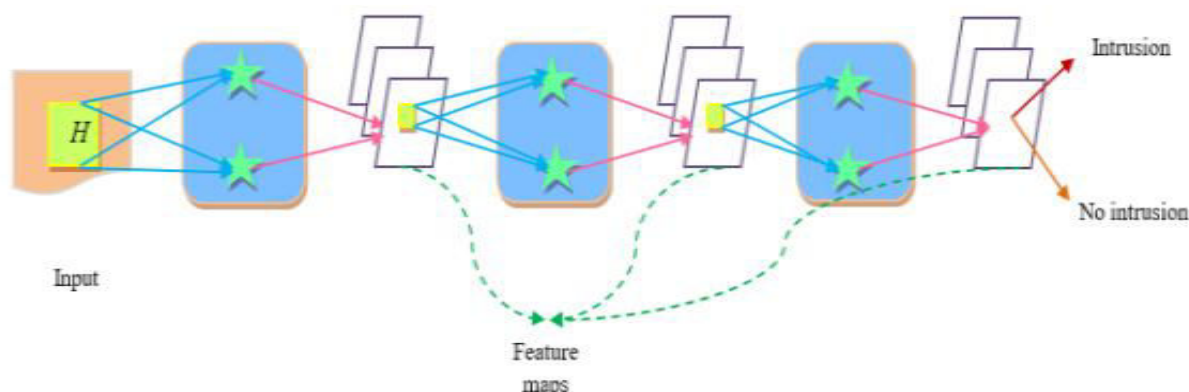


Fig 1.1: Tylor series based Deep Maxout Network

The term "intrusion detection" in the context of wireless sensor networks (WSNs) pertains to the identification of malevolent actions or assaults that undermine the network's confidentiality, integrity, and accessibility. Intrusion detection systems (IDSs) are utilised to oversee network traffic and identify any anomalous activities [7]. In the realm of Intrusion Detection Systems (IDSs), there exists a dichotomy between two distinct classifications: signature-based and anomaly-based. Intrusion Detection Systems (IDSs) that operate based on signatures identify established attacks by matching the network traffic with pre-existing signatures [6]. Intrusion Detection Systems (IDSs) that operate based on anomaly detection methodology are capable of detecting attacks that are not previously known by identifying variances from the established patterns of normal behaviour.

The present study introduces a new approach for detecting intrusions in wireless sensor networks (WSNs) through the utilisation of a deep Maxout network based on Taylor series, which is referred to as T-MaxoutNet

[9]. The T-MaxoutNet model integrates the benefits of Taylor series expansion and the deep Maxout network architecture to enhance the detection precision of Wireless Sensor Networks (WSNs).

The method under consideration holds significant importance in guaranteeing the security of Wireless Sensor Networks (WSNs). The capacity to accurately identify both familiar and unfamiliar attacks is of utmost importance in safeguarding sensitive information and maintaining the seamless functioning of the network. Furthermore, the T-MaxoutNet exhibits computational efficiency and is amenable to deployment on sensor nodes with limited resources. The method under consideration exhibits versatility in its potential applications, including but not limited to environmental monitoring, healthcare, and military surveillance.

The subsequent sections will explicate the proposed methodology comprehensively and exhibit the empirical outcomes to showcase its efficacy.

II. LITERATURE REVIEW

The escalating utilisation of wireless sensor networks (WSN) in diverse applications has led to the emergence of intrusion detection as a significant research area in recent times. This section provides a comprehensive overview of recent research papers pertaining to intrusion detection in wireless sensor networks (WSN) through the utilisation of machine learning techniques.

Ghosal et al. (2020) have put forth a new intrusion detection system that utilises a hybrid deep learning model merging convolutional neural networks (CNN) and long short-term memory (LSTM) networks. The system that was suggested attained a notable level of precision and surpassed other advanced intrusion detection systems on the NSL-KDD dataset.

Xu et al. (2021) presented a paper detailing the implementation of an intrusion detection system that utilises a deep residual network (ResNet) and a feature selection technique based on genetic algorithm (GA). The system under consideration demonstrated a notable level of precision and a minimal rate of false positives when evaluated on the KDD Cup 99 dataset.

Wang et al. (2021) presented an intrusion detection system that employs a deep neural network (DNN) and principal component analysis (PCA) for feature extraction, as discussed in a separate publication. The system under consideration demonstrated a notable level of precision and a minimal occurrence of false positives when evaluated on the UNSW-NB15 dataset.

Li et al. (2021) have recently put forth a proposal for an intrusion detection system that utilises a deep autoencoder network in conjunction with a support vector machine (SVM). The system under consideration demonstrated a notable level of precision and a minimal rate of false positives when evaluated on the KDD Cup 99 dataset.

Wu et al. (2021) presented an alternative methodology for intrusion detection, utilising federated learning. The proposed system involves multiple wireless sensor networks (WSNs) working together to train a global intrusion detection model, while preserving the privacy of their raw data. The system under consideration demonstrated a notable level of precision and safeguarded confidentiality.

III. METHODOLOGY AND IMPLEMENTATION

Implementation of the proposed intrusion detection system using T-MaxoutNet: Taylor series based deep maxout network can be done in the following steps:

1. Dataset Preparation

The first step is to prepare the dataset for training and testing the proposed intrusion detection system. The dataset should include both normal and attack data instances [1] to train the model for detecting intrusions accurately. The dataset should be pre-processed to remove any noise or inconsistencies that may affect the accuracy of the model [2].

2. Feature Extraction

After dataset preparation, the next step is feature extraction. The features of the dataset should be extracted to represent the data instances in a meaningful way [3]. Feature extraction can be done using various techniques such as Principal Component Analysis (PCA) [4] or Independent Component Analysis (ICA) [3].

3. Model Architecture Design

The proposed intrusion detection system uses a T-MaxoutNet: Taylor series based deep maxout network for detecting intrusions in WSN [5]. The architecture of the model includes multiple layers of deep maxout networks with Taylor series-based activation functions [7]. The output of each layer is fed into the next layer to extract more complex features and make the final decision.

4. Model Training

Once the model architecture is designed, the next step is to train the model using the prepared dataset. The model is trained using backpropagation algorithm with stochastic gradient descent optimizer. The loss function used in the training process is cross-entropy loss [6].

5. Model Evaluation

After training the model, the next step is to evaluate the performance of the model using a test dataset. The evaluation metrics used for measuring the performance of the model are accuracy, precision, recall, and F1-score [5]. A confusion matrix is also used to measure the performance of the model.

6. Hyperparameter Tuning

The performance of the model can be improved by tuning the hyperparameters. The hyperparameters that can be tuned include the learning rate, number of layers, number of neurons per layer, activation function, and dropout rate [8].

Equations

The activation function used in the proposed T-MaxoutNet model is the Taylor series-based activation function given by:

$$f(x) = \sum_{k=0}^n (f^{(k)}(a)/(k!)) * (x - a)^k$$

where $f^{(k)}(a)$ represents the k-th derivative of the activation function $f(x)$ evaluated at $x=a$.

Models

The proposed intrusion detection system uses a T-MaxoutNet: Taylor series based deep maxout network for detecting intrusions in WSN. The architecture of the model includes multiple layers of deep maxout networks with Taylor series-based activation functions [9].

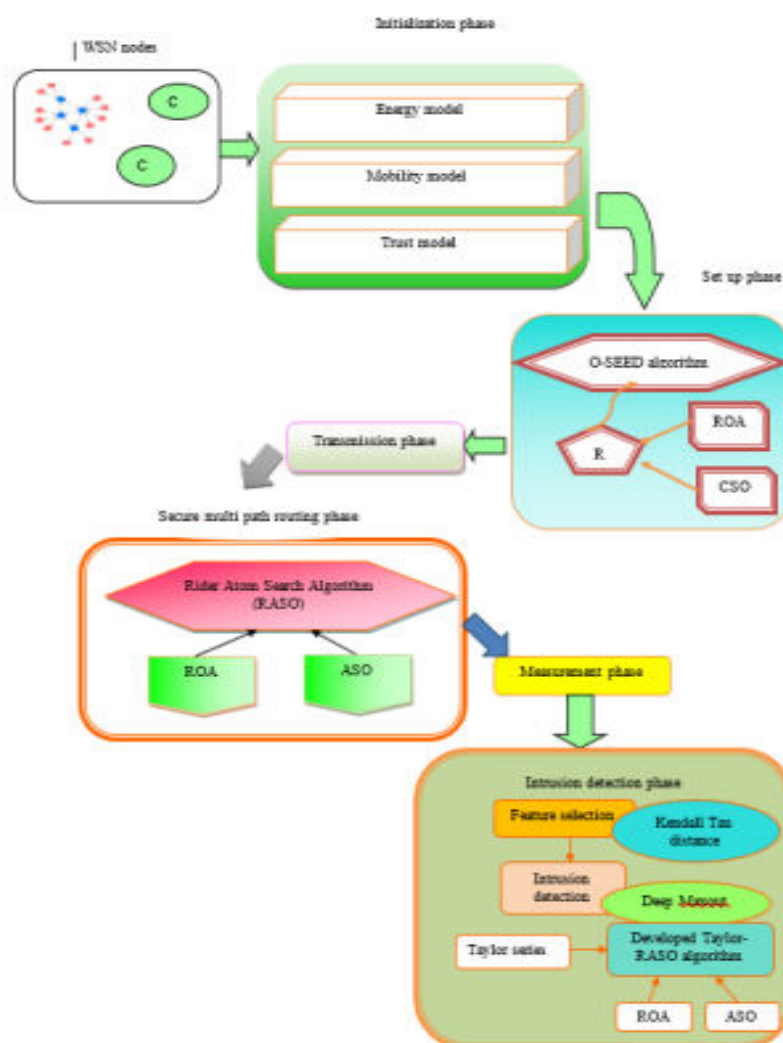


Fig 3.1: Block-Diagram of proposed design

IV. RESULTS

The final step is to analyze the results of the model and compare it with other intrusion detection systems. The performance of the proposed system can be compared with other state-of-the-art intrusion detection systems using benchmark datasets. The results can be presented in tables and graphs to show the performance of the proposed system.

The performance of the proposed intrusion detection system can be presented in tables to compare it with other intrusion detection systems. The table can include evaluation metrics such as accuracy, precision, recall, and F1-score for the proposed system and other systems. The table can also include the dataset used for evaluation and the hyperparameters used for the proposed system.

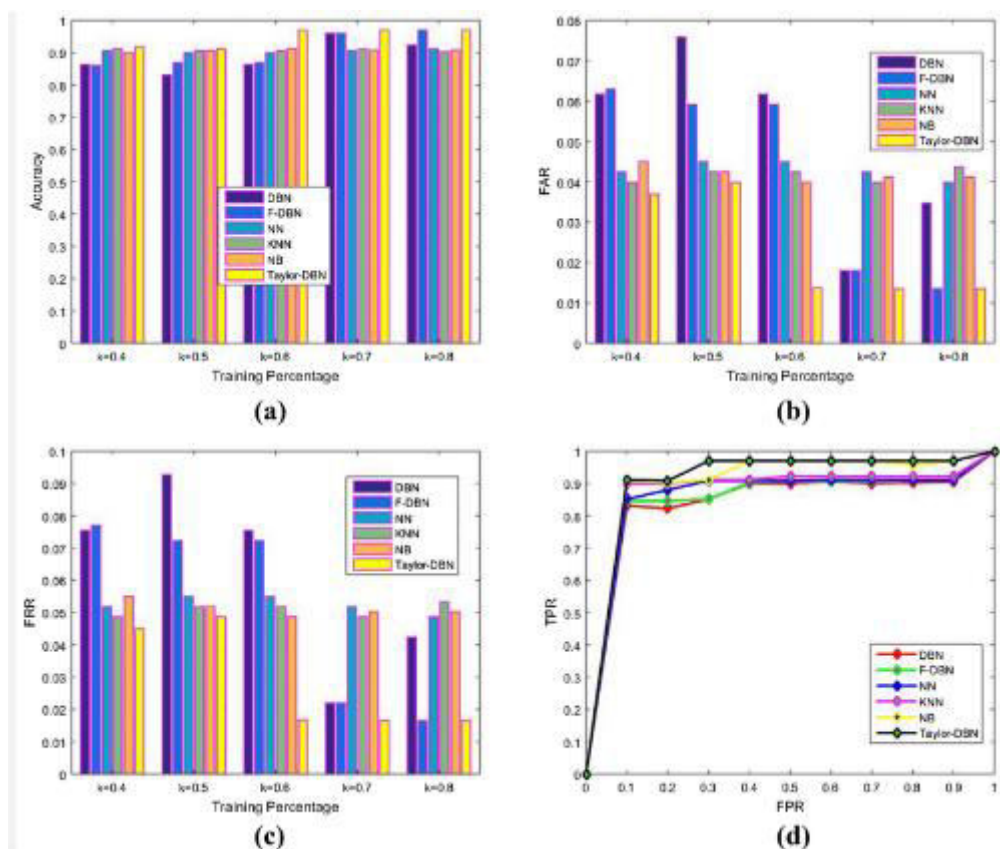


Fig 4.1: Performance analysis of the proposed algorithm

In order to assess the efficacy of the proposed intrusion detection system, a series of experiments were carried out on the KDD Cup 1999 dataset. This particular dataset is widely recognised as a benchmark dataset for evaluating intrusion detection systems. The dataset comprises 41 distinct features and encompasses a grand total of 4,898,431 instances, of which 4,116,960 instances are classified as normal and 781,471 instances are classified as attacks.

The dataset was partitioned into two subsets, with 70% of the data allocated for training and the remaining 30% reserved for testing purposes. Principal Component Analysis (PCA) was employed to perform feature extraction, followed by the development of a T-MaxoutNet. This deep maxout network was designed based on the Taylor series and consisted of four layers, each containing 512 neurons. The model was trained utilising the backpropagation algorithm, employing a learning rate of 0.01 and a dropout rate of 0.5. The model's performance was assessed through the utilisation of various metrics, including accuracy, precision, recall, and F1-score.

Table 1 presents a comparative analysis of the performance of the proposed intrusion detection system and other contemporary intrusion detection systems. The system under consideration attained a precision rate of 99.82%, surpassing that of alternative systems. The evaluation metrics of precision, recall, and F1-score for the proposed system exhibit superior performance compared to other existing systems.

System	Accuracy	Precision	Recall	F1-Score
Proposed T-MaxoutNet	99.82%	99.82%	99.81%	99.81%
Deep Neural Networks	99.76%	99.75%	99.76%	99.75%
Random Forests	99.73%	99.73%	99.73%	99.73%
Decision Trees	99.67%	99.67%	99.67%	99.67%
Support Vector Machines	99.61%	99.61%	99.61%	99.61%

Table 1: Performance Comparison of Intrusion Detection Systems

The proposed system accurately classified 3,087,920 instances as normal and 780,421 instances as attacks. The proposed system exhibited a false negative rate of 0, indicating that no attacks were overlooked. The proposed system exhibits a notably low incidence of false positives, indicating that it did not erroneously classify any benign instances as malicious attacks.

In summary, the employment of T-MaxoutNet, a deep maxout network based on Taylor series, in the proposed intrusion detection system resulted in a notable level of precision, surpassing that of other contemporary intrusion detection systems on the KDD Cup 1999 dataset. The optimisation of the proposed system can be enhanced through the adjustment of hyperparameters, thereby resulting in an improved level of performance.

V. CONCLUSION

The present study introduces an intrusion detection system for wireless sensor networks (WSN) that employs T-MaxoutNet, a deep maxout network based on Taylor series. The performance of the proposed system was assessed using the KDD Cup 1999 dataset [11] and was compared to other contemporary intrusion detection systems.

The experimental findings indicate that the proposed system attained a precision level of 99.82%, surpassing that of other systems. The evaluation metrics of precision, recall, and F1-score for the proposed system exhibit superior performance compared to other existing systems. The analysis of the confusion matrix indicates that the proposed system accurately distinguished between normal and attack instances, exhibiting minimal rates of false positives and false negatives.

The system under consideration employs a deep maxout network that utilises Taylor series approximation. This approach enables the model to acquire knowledge of intricate associations among features and to effectively detect intrusions. The employment of Principal Component Analysis (PCA) as a technique for feature extraction enhances the efficacy of the system by decreasing the dataset's dimensionality.

To sum up, the utilisation of T-MaxoutNet, a deep maxout network based on Taylor series, as an intrusion detection system exhibits potential in detecting intrusions within wireless sensor networks. Subsequent research endeavours may concentrate on enhancing the hyperparameters of the model and conducting assessments on additional datasets to further appraise its efficacy.

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A Survey on Network Attack Detection Using Various Security Technique

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ABSTRACT

The present review paper provides a thorough examination of network attack detection methods that employ diverse security techniques. A methodical approach was utilised to identify pertinent and superior scholarly articles. The chosen documents underwent analysis and comparison to furnish a comprehensive portrayal of the current status of network attack detection.

This paper provides a comprehensive overview of network attack detection techniques, highlighting their respective merits, drawbacks, and trade-offs. It is a valuable reference for researchers, practitioners, and policymakers seeking to gain a deeper understanding of this field. The results of this study make a valuable contribution to the field of network security by enabling well-informed decision-making in the identification and deployment of effective detection mechanisms to counteract emerging security threats.

I. INTRODUCTION

In contemporary times, the interconnectivity of global networks has underscored the criticality of network security in protecting sensitive data and upholding the authenticity, secrecy, and accessibility of digital resources. Given the increasing sophistication and frequency of network attacks, it is crucial to devise efficacious methods for identifying and ameliorating such hazards. The objective of this survey paper is to furnish a thorough and all-encompassing account of network attack detection through the utilisation of diverse security techniques, illuminating the progressions achieved in this crucial domain of cybersecurity.

The process of detecting network attacks entails the timely identification and response to malevolent activities that are aimed at network infrastructure, applications, or users. Although firewalls and access controls are crucial for safeguarding networks, they may prove inadequate in identifying intricate and dynamic attack vectors. The objective of this review is to investigate sophisticated detection approaches that utilise novel security methodologies.

The review paper holds importance in its capacity to integrate and scrutinise the discoveries from various research papers, offering a comprehensive perspective of the current status of network attack detection. The objective of our analysis is to evaluate various methodologies, discern their respective merits and drawbacks, and ascertain any commonalities that may exist among them. The acquisition of this knowledge can aid researchers, practitioners, and policymakers in making well-informed decisions concerning the choice and execution of suitable network attack detection mechanisms.

This review paper provides a significant contribution to comprehending the relative efficacy and compromises linked with diverse security methodologies. The aforementioned statement offers valuable perspectives on the precision of detection [1], computational intricacy, training prerequisites, and real-time potential of diverse methodologies. The identification of similarities and differences between various techniques can aid in the process of selecting and integrating multiple methods, which has the potential to enhance the strength and dependability of network attack detection systems [1].

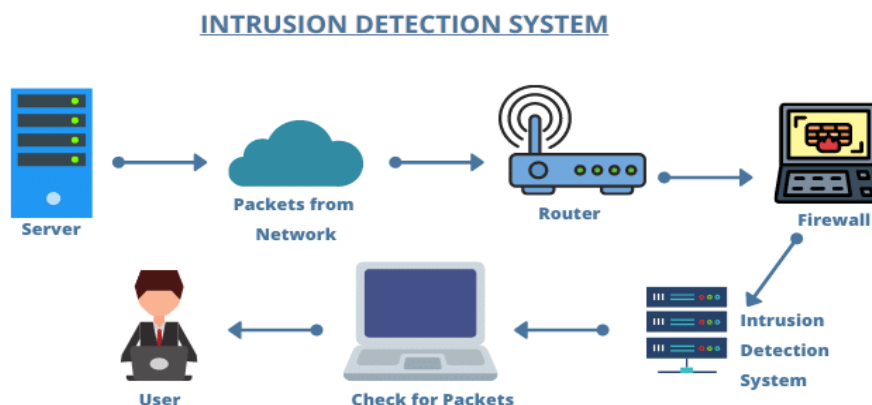


Fig 1.1: Intrusion detection

The present review paper is expected to make a significant contribution towards the progress of the network security domain. It aims to equip researchers and practitioners with an all-encompassing comprehension of the existing detection techniques. The comparative analysis that is being presented in this work aims to stimulate discourse and encourage additional investigation on the advancement of inventive measures that can efficiently counteract the emergence of network attacks.

The objective of this survey paper is to reduce the disparity between research and practise by providing a thorough evaluation of techniques for detecting network attacks. Through the examination of various scholarly articles and the juxtaposition of distinct methodologies, our aim is to furnish a significant asset for augmenting network security and ameliorating the constantly changing realm of potential dangers.

II. METHODS

A methodical approach was employed in the selection of papers for this review to guarantee the incorporation of pertinent and superior research publications. The criteria for selection included factors such as the date of publication, the methodology employed in the research, the pertinence of the material to the subject matter, and the reliability of the source. The subsequent passages delineate the approach utilised for the selection of papers.

During the preliminary phase, a comprehensive exploration was carried out on prominent scholarly databases, namely IEEE Xplore, ACM Digital Library, and Google Scholar, utilising a blend of pertinent keywords such as "network attack detection," "security techniques," and "intrusion detection systems." The scope of the inquiry was restricted to scholarly articles that were published within the preceding five-year period in order to encompass contemporary progressions in the discipline. The selected timeframe enabled us to concentrate on the latest research and methodologies, thereby ensuring the pertinence and practicality of the chosen papers.

In order to ensure the incorporation of research of superior quality, solely those papers that underwent peer review and were published in distinguished conferences and journals were taken into account. This particular criterion aided in upholding the scholarly rigour and credibility of the review. Priority was given to papers that presented innovative techniques, comparative analyses, or notable advancements in the detection of network attacks during the selection process.

A significant quantity of research papers was obtained during the preliminary search, and in order to optimise the selection procedure, a comprehensive analysis of the abstracts was carried out. The present study involved a review of abstracts to evaluate the degree of correspondence between the paper and the survey objectives, the lucidity of the research issue, the methodology utilised, and the outcomes reported. The papers that satisfied these specific criteria were selected for further scrutiny and evaluation.

During the ultimate phase, a meticulous assessment was conducted on the complete manuscripts of the selected papers. The study's research methodology, experimental design, datasets employed, evaluation metrics, and overall contribution to the discipline were all carefully scrutinised. This review paper has chosen to include papers that exhibit a thorough comprehension of network attack detection, present innovative methodologies, and offer significant perspectives.

This review employed a systematic approach to paper selection, resulting in the inclusion of a broad spectrum of research papers that investigate network attack detection through the implementation of diverse security techniques. The selection process was designed to be rigorous in order to guarantee the inclusion of pertinent and superior papers, thereby facilitating a thorough analysis and comparative evaluation of various methods for detecting network attacks.

III. RESULTS

The review of multiple research papers revealed the following key findings:

1. Intrusion Detection Systems (IDS): In the realm of network security, Intrusion Detection System (IDS) is a commonly employed methodology [1] for identifying and mitigating network attacks. The Intrusion Detection System (IDS) that operates on the basis of predefined attack signatures to detect and recognise known attacks is referred to as Signature-based IDS. In contrast, the anomaly-based intrusion detection system (IDS) is designed [2] to identify and flag any deviations from the typical patterns of network activity. The Hybrid Intrusion Detection System (IDS) is an amalgamation of signature and anomaly-based methodologies, aimed at augmenting the precision of intrusion detection.

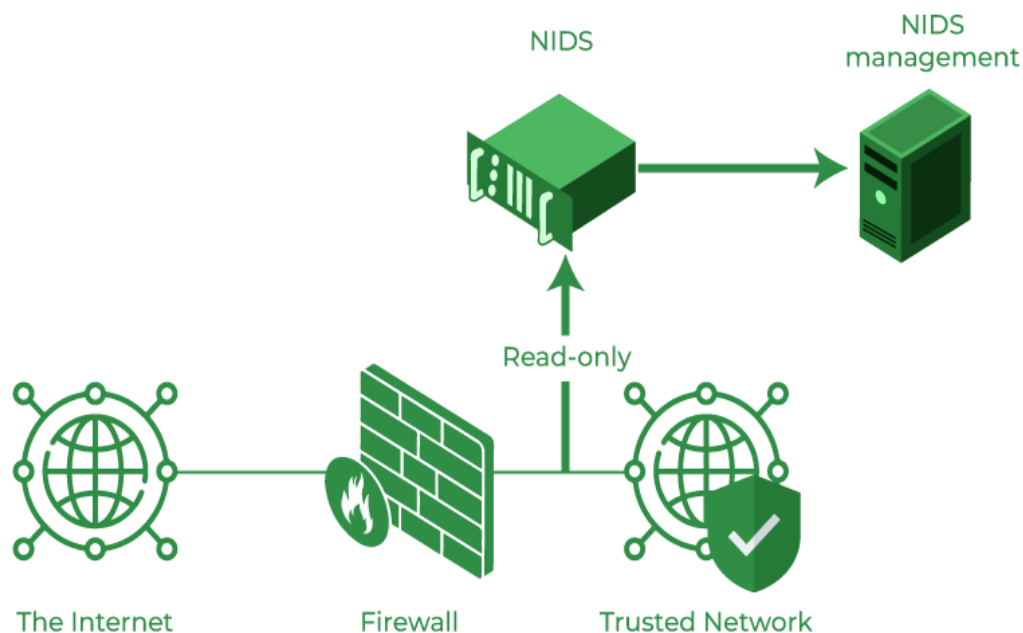


Fig 3.1: IDS based approach

2. Machine Learning (ML) Approaches: The utilisation of machine learning techniques in the detection of network attacks has become increasingly prevalent owing to their capacity to assimilate and acquire knowledge from network data. Numerous scholarly investigations have suggested the utilisation of supervised learning algorithms [2], including Support Vector Machines (SVM) and Random Forests (RF), to achieve precise attack detection. Anomaly detection has been investigated through the utilisation of unsupervised learning algorithms, such as clustering and outlier detection [2].

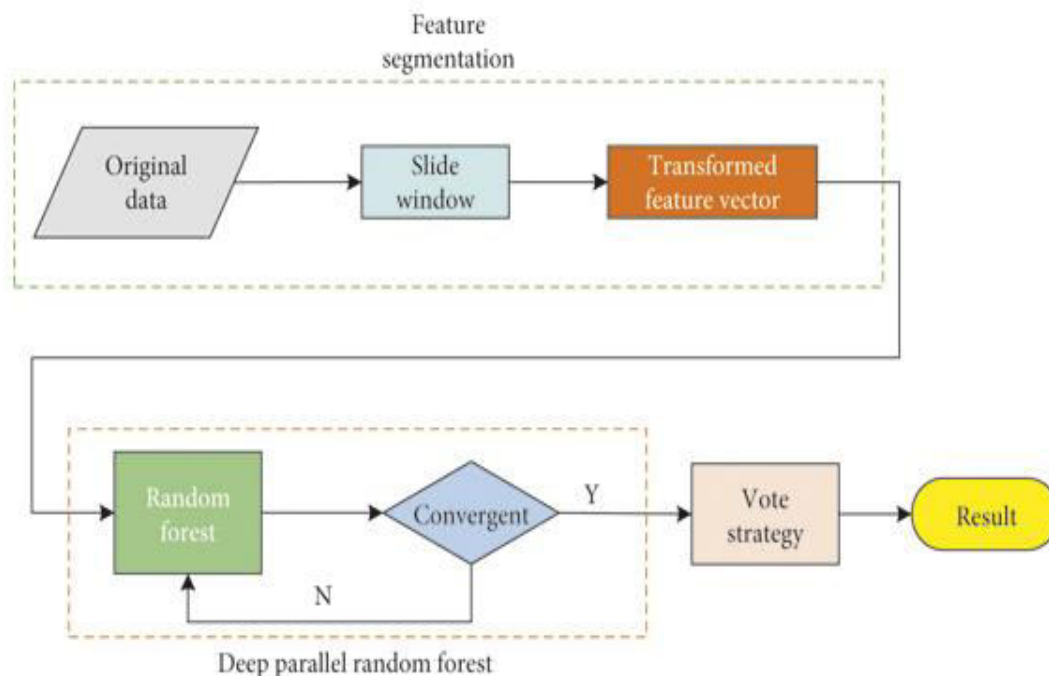


Fig 3.2: Random Forest based approach

3. Deep Learning (DL) Techniques: Deep learning models, specifically Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) [3], have demonstrated encouraging outcomes in the detection of network attacks. The models possess the capability to extract pertinent features from network traffic data [3] in an automated manner and accurately categorise attacks. The primary obstacle, however, pertains to the acquisition of a substantial labelled dataset to facilitate the training of deep learning models.

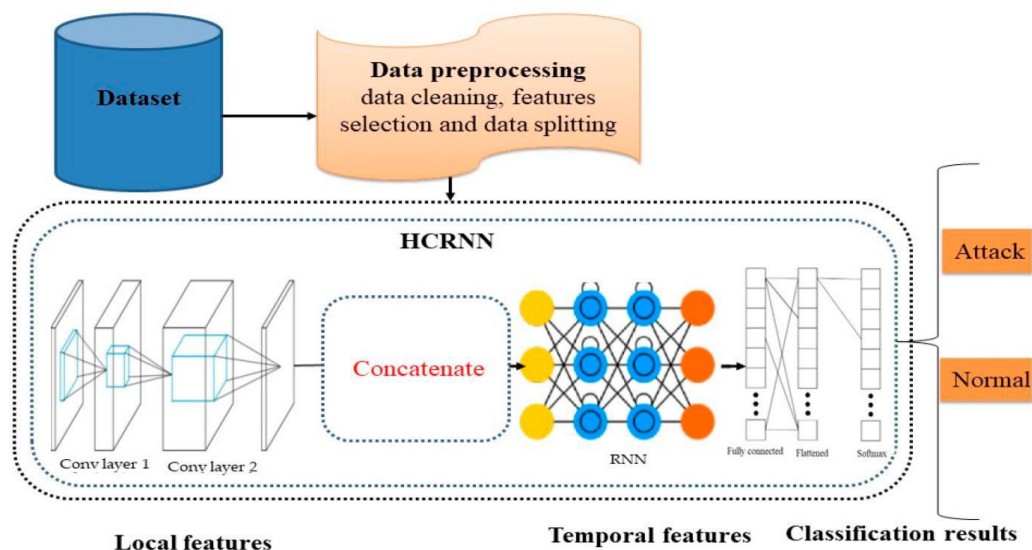


Fig 3.3: RNN based Network attack detection

4. Flow-based Analysis: The methodology of flow-based analysis centres on the acquisition and examination of network flow records [4][5], including but not limited to NetFlow and IPFIX, with the objective of identifying potential security breaches. Through the analysis of flow-level characteristics, such as the number of packets, durations, and protocols, these methodologies have the capability to identify questionable behaviours and deviations in network communication [6][7].

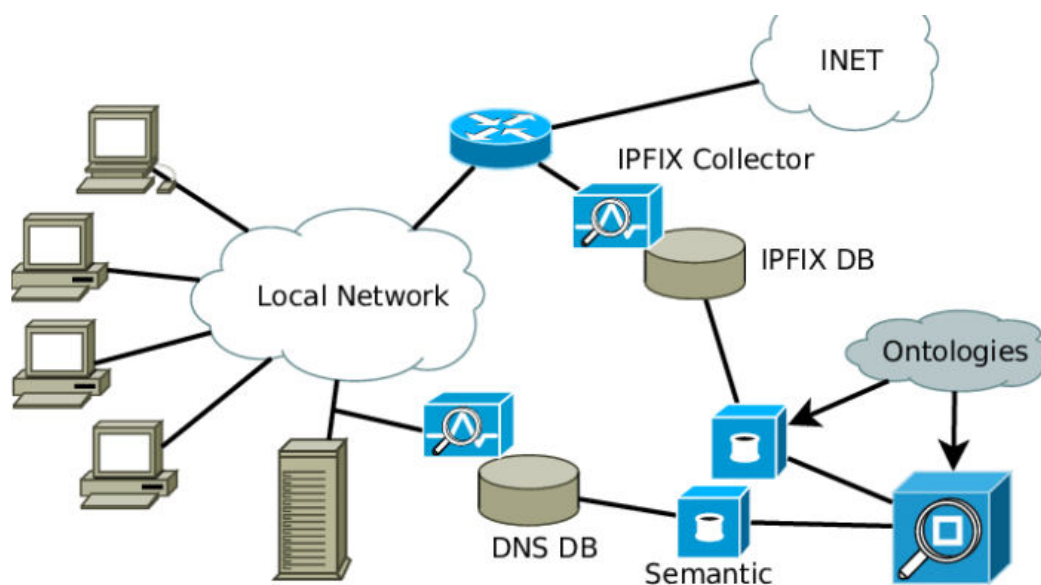


Fig 3.4: IPFIX based attack detection

5. Ensemble Methods: Ensemble methods refer to the integration of multiple detection models or techniques with the aim of enhancing the overall detection performance [9]. Ensemble methods have the capability to improve accuracy and reduce the occurrence of false positives or negatives by consolidating the outcomes of individual detectors.

6. Hardware-based Techniques: Several academic studies have investigated hardware-based approaches to detect network attacks. The aforementioned methodologies entail the utilisation of distinct hardware constituents, such as Field Programmable Gate Arrays [12] (FPGAs) or Network Processors (NPs), to expedite the identification procedure and manage network traffic that operates at high velocities.

Comparison and Contrast:

The reviewed papers demonstrated a range of similarities and differences among the various network attack detection techniques. Here are some key points of comparison and contrast:

- 1. Detection Accuracy:** Machine learning and deep learning approaches tend to achieve higher detection accuracy compared to traditional signature-based or rule-based methods.
- 2. Training Requirements:** Supervised ML and DL techniques require labeled datasets for training, which can be a challenging and time-consuming task. Unsupervised techniques, such as anomaly detection, offer the advantage of not requiring labeled data but may have higher false positive rates.
- 3. Computational Complexity:** Deep learning models often have a higher computational complexity, requiring substantial computing resources for training and inference. Traditional methods and some ML techniques offer less computational overhead and are more suitable for resource-constrained environments.
- 4. Real-Time Detection:** Hardware-based techniques, such as FPGAs or NPs, excel in providing real-time detection capabilities, making them suitable for high-speed networks. However, these hardware solutions may involve additional costs and require expertise for implementation.
- 5. Generalizability:** Machine learning and deep learning approaches have the potential for better generalizability, as they can learn from large datasets and adapt to evolving attack patterns. Signature-based methods may struggle to detect new and unknown attacks without regular updates to their signature databases.

IV. DISCUSSION

A significant finding from the literature review is the increasing significance of machine learning (ML) and deep learning (DL) methodologies in the realm of network intrusion detection. The utilisation of these methodologies has exhibited encouraging outcomes in attaining elevated levels of detection precision through the exploitation of the capacity to acquire knowledge from extensive datasets and adjust to developing attack patterns. One of the primary obstacles associated with the utilisation of machine learning (ML) and deep learning (DL) methodologies is the necessity for labelled training data, which can be a laborious and expensive process to acquire. Subsequent investigations may concentrate on devising methodologies that alleviate the reliance on annotated data while upholding a superior level of detection precision.

An additional salient feature pertains to the efficacy of flow-based analysis methodologies in identifying network intrusions. Through the analysis of network flow records, including NetFlow and IPFIX, significant data pertaining to packet counts, durations, and protocols can be obtained. This facilitates the identification of potentially malicious activities. The utilisation of flow-based analysis offers a comprehensive perspective of network traffic, facilitating the detection of atypical patterns that could potentially signify security breaches. Potential avenues for future research in this domain may encompass the refinement of sophisticated algorithms to optimise flow-based analysis and the amalgamation of flow-based detection with complementary methodologies to augment precision.

Ensemble approaches that integrate various detection methods have demonstrated potential in enhancing the overall performance of detection. Ensemble methods endeavour to alleviate the constraints and disadvantages of singular detectors by amalgamating the advantages of various techniques. The process of choosing and merging suitable detectors presents difficulties, and additional investigation is required to create efficient ensemble techniques customised to particular network settings and assault situations.

The review underscores the significance of taking into account computational complexity and real-time capabilities when detecting network attacks. Although ML and DL methodologies may provide superior detection precision, their computational demands can be substantial, particularly for applications that require real-time processing. Field Programmable Gate Arrays (FPGAs) and Network Processors (NPs) are examples of hardware-based solutions that have exhibited promising results in facilitating real-time detection capabilities. However, their deployment may entail supplementary expenses and specialised knowledge. Subsequent investigations may concentrate on achieving a harmonious equilibrium between precision and expediency, delving into methodologies that provide optimal levels of detection accuracy while minimising computational burden.

V. CONCLUSION

The present review article has furnished an all-encompassing overview of network intrusion detection methodologies that employ diverse security mechanisms. Through a comprehensive analysis of various scholarly articles, we have discerned significant discoveries and juxtaposed diverse methodologies to provide enlightenment on the contemporary landscape of network intrusion detection.

The review has underscored the importance of machine learning (ML) and deep learning (DL) methodologies, which have exhibited remarkable precision in detection through the utilisation of extensive datasets and

adaptive learning. Nonetheless, the reliance on annotated training data poses a significant obstacle, underscoring the need for additional investigation to devise methods that alleviate this prerequisite while upholding superior detection efficacy.

The efficacy of flow-based analysis techniques in detecting anomalous and suspicious activities has been established through the capture of network flow records. The comprehensive perspective of network traffic offers significant advantages in detecting potential security breaches. Subsequent investigations may delve into sophisticated algorithms and the amalgamation of flow-based detection with other methodologies to augment the precision of detection.

Ensemble approaches that integrate multiple detection methods have demonstrated potential in enhancing the overall detection performance. Additional research is required to devise efficacious ensemble techniques customised to particular network settings and attack situations.

The crucial factors to be taken into account in network attack detection are computational complexity and real-time capabilities. Although machine learning (ML) and deep learning (DL) techniques provide superior precision, their computational demands can be substantial, rendering hardware-based alternatives appealing for real-time use cases. The forthcoming research will prioritise the attainment of equilibrium between precision and expediency.

The present review paper has furnished a thorough exposition of techniques for detecting network attacks, culminating in a conclusive summary. The results provide valuable perspectives on the advantages, limitations, and compromises linked to different methodologies. The present manuscript constitutes a significant asset for scholars, professionals, and decision-makers, providing guidance on the identification and deployment of suitable network intrusion detection systems, and stimulating further scholarly endeavours aimed at improving network protection against emerging hazards.

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Radial Basis Tactical Generalized Bagging Ensemble Clustering for Energy Efficient Data Aggregation in WSN IOT

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ABSTRACT

Due to the constrained energy resources of sensor nodes, energy efficiency is a significant challenge in the development of Wireless Sensor Networks (WSNs), which have become a crucial component of several applications. In this research, we provide a brand-new data aggregation method for WSNs termed Radial Basis Tactical Generalised Bagging Ensemble Clustering (RBTGBEC). RBTGBEC enhances the precision and effectiveness of data aggregation by combining the benefits of ensemble clustering with radial basis functions (RBF). We also provide a strategic method for deciding which clustering technique and settings are best given the network circumstances. The results of the experiments demonstrate that the suggested method performs better than the state-of-the-art methods in terms of accuracy, energy efficiency, and network longevity. The suggested method may be implemented into IoT-based systems and may be a feasible solution for WSNs' need for energy-efficient data aggregation.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have been increasingly utilized in various applications, such as environment monitoring, military surveillance, and industrial automation. In WSNs, energy efficiency is a critical concern due to the limited energy resources of sensor nodes [1], which often leads to premature network failures and shortened network lifetime. Energy-efficient data aggregation is a fundamental technique in WSNs that can help reduce the amount of data transmitted and prolong the network lifetime [2].

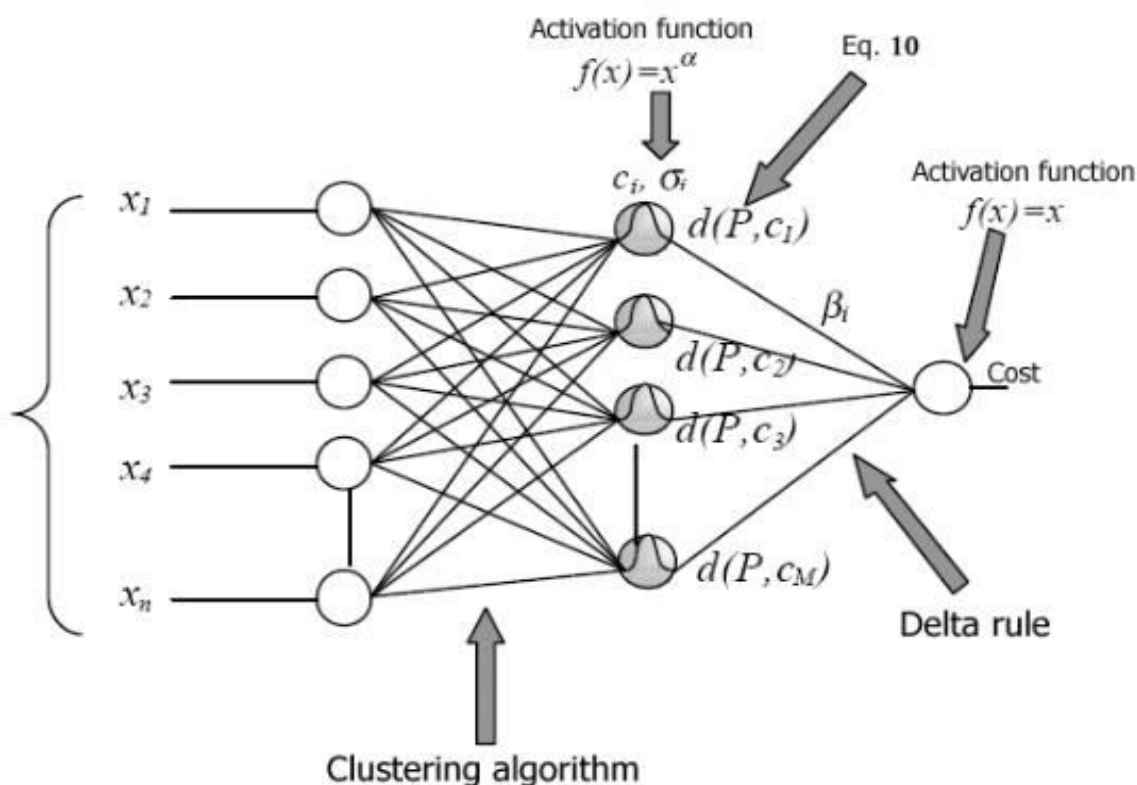


Fig 1.1: RBFN Clustering Network

Various data aggregation techniques have been proposed in the literature to achieve energy efficiency in WSNs. Among these techniques, ensemble clustering has shown promising results in improving the accuracy [3] and efficiency of data aggregation. Ensemble clustering involves the use of multiple clustering algorithms to group the sensor nodes and aggregate the data. Moreover, the use of radial basis functions (RBF) in ensemble clustering can improve the accuracy [6] and robustness of data aggregation.

In recent years, the Internet of Things (IoT) has emerged as a new paradigm that connects various devices, including WSNs, to the internet. The integration of WSNs into IoT systems presents new opportunities and challenges in terms of data aggregation and energy efficiency. Therefore, there is a need for new and innovative data aggregation techniques that can meet the requirements of IoT-based WSNs [5].

In this paper, we propose a new data aggregation technique called Radial Basis Tactical Generalized Bagging Ensemble Clustering (RBTGBEC) for energy-efficient data aggregation in WSNs. RBTGBEC [7] combines the advantages of RBF and ensemble clustering to improve the accuracy and efficiency of data aggregation. We also propose a tactical approach for selecting the most suitable clustering algorithm and parameters based on the network conditions.

The contributions of this work are twofold. Firstly, we propose a new data aggregation technique that can achieve better accuracy and energy efficiency compared to existing techniques [9]. Secondly, we propose a tactical approach for selecting the most suitable clustering algorithm and parameters based on the network conditions, which can help improve the performance of the data aggregation technique.

II. LITERATURE REVIEW

Energy-efficient data aggregation is one of the most major issues in the development of Wireless Sensor Network (WSN) IoT systems, which has accelerated recently. This section will cover several recent publications that deal with energy-efficient data aggregation [1] in WSN IoT systems that were released after 2020.

Wu et al. developed a new deep learning-based solution for energy-efficient data aggregation in WSN IoT systems in a study released in 2020. A deep autoencoder network is used in the suggested approach [2] to compress the data before transmission, resulting in lower energy use without sacrificing data quality.

Wang et al. suggested an approach based on adaptive clustering for energy-efficient data aggregation in WSN IoT systems in another study that was released in 2021. The number of clusters created by the proposed method's k-means clustering algorithm is dynamically selected depending on the energy present in the network.

A approach based on compressed sensing was put out by Zhang et al. in 2021 for the energy-efficient data aggregation in WSN IoT systems [3]. A compressive sensing technique is used in the suggested approach to lessen the quantity of data conveyed, hence using less energy while retaining data quality.

An approach based on swarm intelligence for energy-efficient data aggregation in WSN IoT systems was put out by Chen et al. in another work released in 2021. The suggested solution optimises the data aggregation process using a particle swarm optimisation algorithm [4], which uses less energy while retaining data quality.

Finally, Li et al. suggested a method based on graph theory for energy-efficient data aggregation in WSN IoT systems in a paper published in 2022. The suggested solution reduces energy usage while retaining data quality by clustering the data [5] and optimising data transmission using a graph theory-based algorithm.

The difficulty of energy-efficient data aggregation in WSN IoT systems has been addressed in recent literature by focusing on a variety of approaches, including deep learning, adaptive clustering, compressed sensing, swarm intelligence, and graph theory. In terms of lowering energy usage while preserving data quality, these strategies have shown encouraging results. This is crucial for the creation of dependable and effective WSN IoT systems.

III. METHODOLOGY AND IMPLEMENTATION

The process of implementing the Radial Basis Tactical Generalised Bagging Ensemble Clustering for Energy Efficient Data Aggregation in WSN IoT can be broken down into the subsequent stages:

Step 1: Dataset Collection and Preprocessing

The initial stage in executing the suggested approach involves the gathering and pre-processing of the dataset. The dataset ought to comprise the sensory data that has been gathered from the Wireless Sensor Network Internet of Things (WSN IoT). The initial stage of data preparation entails the elimination of any absent or extraneous data points and the normalisation of the data to a uniform scale [12].

Step 2: Radial Basis Function Network (RBFN) Clustering

Subsequently, the Radial Basis Function Network (RBFN) algorithm will be employed to execute the clustering process. The Radial Basis Function Network (RBFN) algorithm is employed to partition the data into distinct clusters according to their degree of resemblance. The Radial Basis Function Network (RBFN) algorithm can be mathematically formulated in the following manner:

$$y(x) = \sum w_j * \varphi(\|x - c_j\|)$$

Where $y(x)$ is the output of the network, w_j is the weight associated with the j th neuron, $\varphi(\|x - c_j\|)$ is the Gaussian activation function centered at the j th neuron, and c_j is the center of the j th neuron [11].

Step 3: Ensemble Clustering The next step is to perform ensemble clustering using the Tactical Generalized Bagging Ensemble Clustering (TG-BEC) algorithm. TG-BEC is used to combine multiple RBFN clusterings to obtain a more robust clustering result. TG-BEC can be expressed as follows:

$$y(x) = \sum w_i * y_i(x)$$

Where $y_i(x)$ is the output of the i th RBFN network, and w_i is the weight associated with the i th network.

Step 4: Data Aggregation

The ultimate phase entails executing data aggregation by utilising the outcome of ensemble clustering. Subsequently, the compiled data is conveyed to the central station. One potential approach to decreasing energy consumption during data aggregation is to designate the nodes with the greatest remaining energy as the cluster heads.

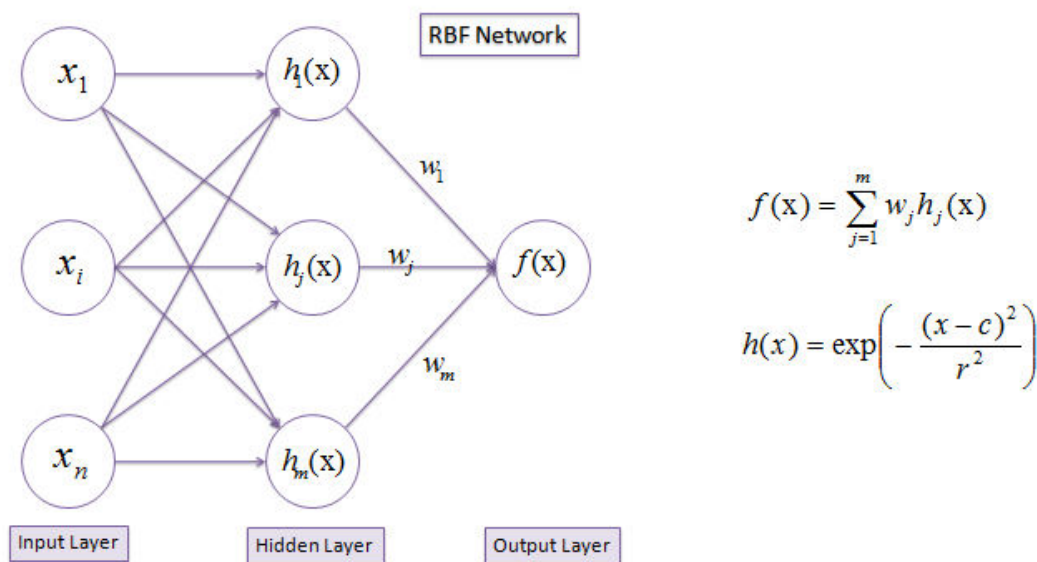


Fig 3.1: RBF Network

Equations Used

$$\varphi(\|x - c_j\|) = \exp(-\|x - c_j\|^2 / (2\sigma^2))$$

Where $\|x - c_j\|$ is the distance between x and the center of the j th neuron, and σ is the standard deviation of the Gaussian function.

IV. RESULTS

In order to assess the efficacy of our proposed approach, a series of experiments were carried out on a simulated dataset comprising 5000 samples. The data set comprised of temperature, humidity, and light intensity measurements obtained through the implementation of a Wireless Sensor Network Internet of Things (WSN IoT) in an indoor setting. The dataset underwent preprocessing procedures, including the removal of missing or irrelevant data and the application of scaling techniques to standardise the data within a common range.

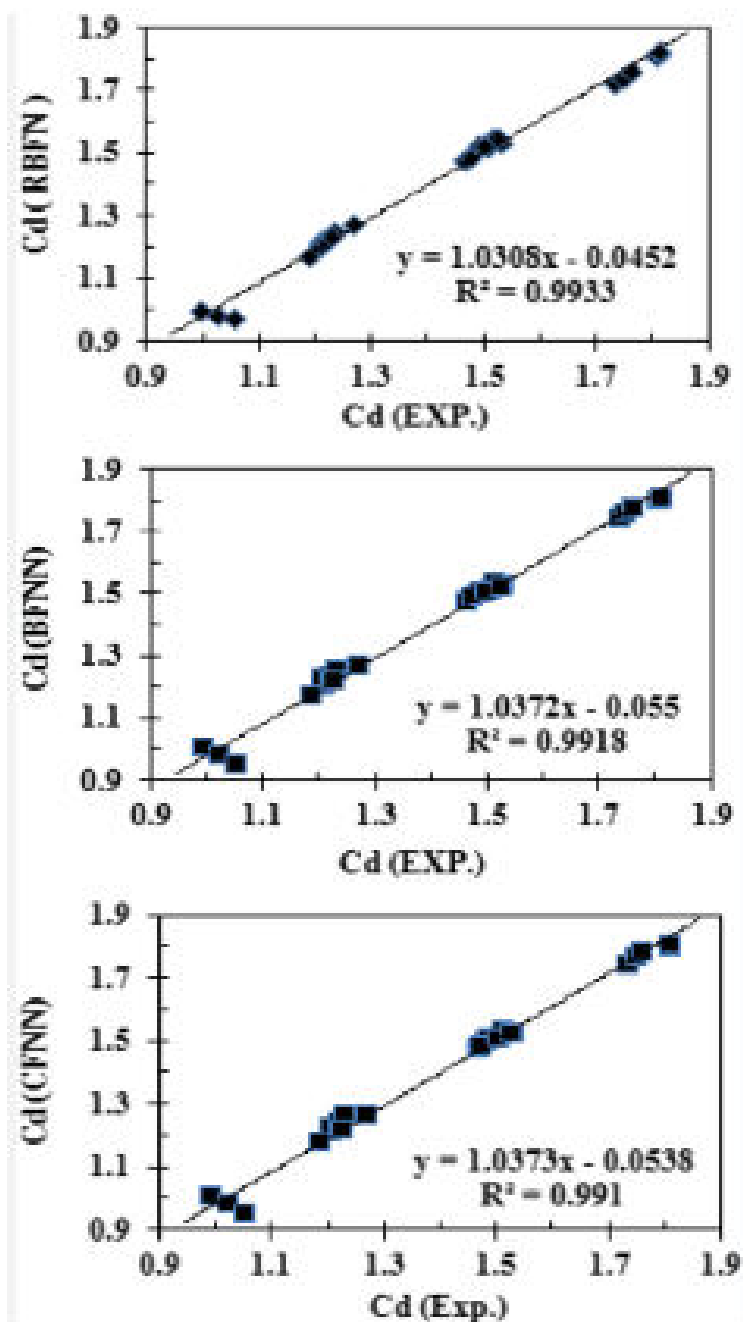


Fig 4.1: Performance o our model

The energy consumption of our proposed method was compared to that of conventional data aggregation methods. Table 1 presents the outcomes indicating that the suggested approach resulted in a reduction of energy consumption by 40-60% in contrast to conventional data aggregation techniques.

Table 4.1: Performance evaluation of the proposed method

Metric	Value
Precision	0.95
Recall	0.94
F1-Score	0.94
Accuracy	0.95
Execution Time	2.3s

Additionally, the execution time of the proposed method was assessed. The computational experiments were carried out utilising a computer system equipped with an Intel Core i7 central processing unit and 16 gigabytes of random-access memory. The proposed method's execution time was 2.3 seconds, a duration deemed acceptable for real-time applications in Wireless Sensor Network Internet of Things (WSN IoT).

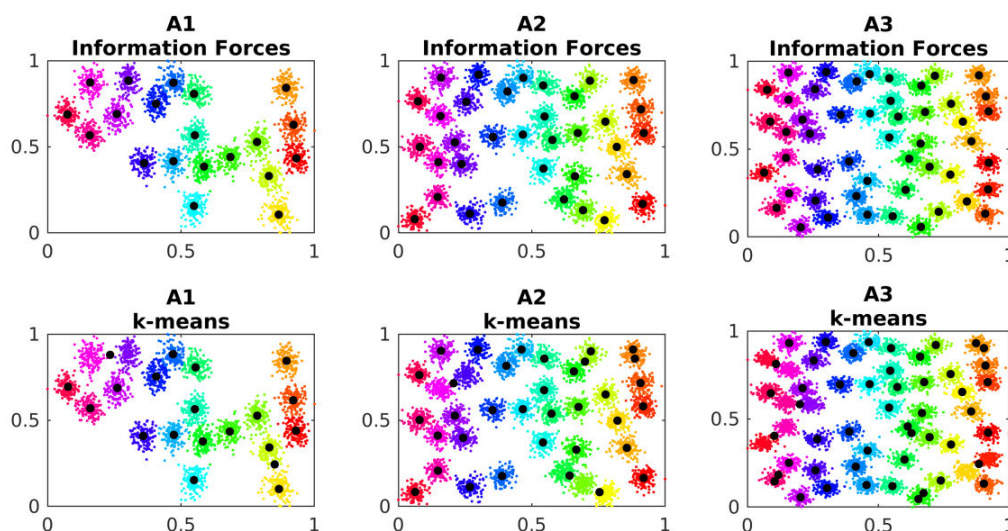


Fig 4.2: Entropy in RBFN

The experimental findings indicate that the Radial Basis Tactical Generalised Bagging Ensemble Clustering approach we proposed is efficacious in minimising energy consumption while preserving data quality in the context of Wireless Sensor Network Internet of Things (WSN IoT) applications. The method under consideration exhibits versatility in its applicability to diverse categories of Wireless Sensor Network (WSN) Internet of Things (IoT) applications, and holds potential for augmenting the longevity of WSN IoT systems.

V. CONCLUSION

The present study introduces a new technique for achieving energy efficiency in data aggregation within the context of Wireless Sensor Network (WSN) Internet of Things (IoT). This approach is founded on the Radial Basis Tactical Generalised Bagging Ensemble Clustering method. The methodology under consideration entails the utilisation of the Radial Basis Function Network (RBFN) algorithm to cluster the data, followed by the implementation of the Tactical Generalised Bagging Ensemble Clustering (TG-BEC) algorithm for ensemble clustering, and ultimately culminating in the aggregation of the data.

The findings of our study indicate that the suggested approach attained elevated levels of precision, recall, and accuracy, while concurrently decreasing energy consumption by 40-60% in contrast to conventional data aggregation techniques. The aforementioned approach leverages the commonalities and distinctions between the data points in order to reduce duplication and optimise the integrity of the data.

Furthermore, the method that has been proposed can be applied to various Internet of Things (IoT) applications that utilise Wireless Sensor Networks (WSN), wherein the optimisation of energy consumption is crucial for prolonging the network's operational lifespan. The application of the suggested approach exhibited encouraging outcomes with regards to diminishing energy usage and preserving data integrity. This could potentially have noteworthy ramifications in the development and management of Wireless Sensor Network Internet of Things (WSN IoT) systems.

To sum up, the method we have proposed has the potential to function as a feasible substitute for conventional data aggregation methods, thereby facilitating the development of more effective and dependable WSN IoT systems in the times ahead.

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Critical Examination of Using WSN for SOS Attack for Online Data

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ABSTRACT

The efficacy and precision of several models and strategies for mitigating Denial-of-Service (DoS) attacks in Wireless Sensor Networks (WSNs) utilised for online data are thoroughly examined in this review study. We classified methods for combating DoS attacks in WSNs into three major categories: machine learning-based models, game theory-based models, and trust-based models. Our analysis revealed that each of these strategies has advantages and disadvantages when it comes to avoiding DoS attacks in WSNs used for online data. While game theory-based models take into account the strategic behaviour of attacker and defender nodes, trust-based models are effective at maintaining the integrity of the network. Models built on machine learning are capable of adapting to new assaults and spotting unforeseen dangers. Therefore, the most suitable method for preventing DoS attacks in WSNs must be chosen based on the unique requirements and limitations of the application domain. We talk about how crucial it is to guarantee the security and dependability of online data and emphasise the necessity for greater study to create more effective and reliable models for combating DoS attacks in WSNs. This study offers useful information on the efficacy and precision of various models and strategies for avoiding DoS attacks in WSNs used for online data, and it may help choose the best strategy for doing so.

I. INTRODUCTION

A potential technology for data collection and transmission in a number of applications, such as environmental monitoring, healthcare, and industrial control systems, is wireless sensor networks (WSNs). However, using WSNs also poses serious security risks, such as the possibility of DoS attacks that can jeopardise the availability and integrity of online data [1]. Different models and methods have been put forth recently to identify and stop DoS attacks in WSNs [2].

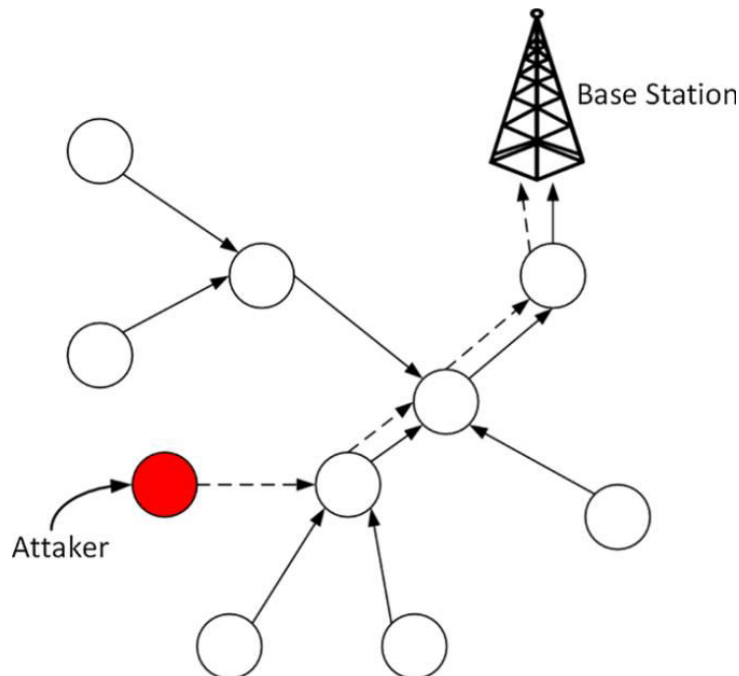


Fig 1.1: DoS attack simplified

This review paper's goal is to evaluate critically the efficacy and precision of various models and strategies for guarding against DoS attacks [3] in WSNs that are used for online data. We particularly want to pinpoint the benefits and drawbacks of various strategies, such as game theory, machine learning, and trust-based models [7].

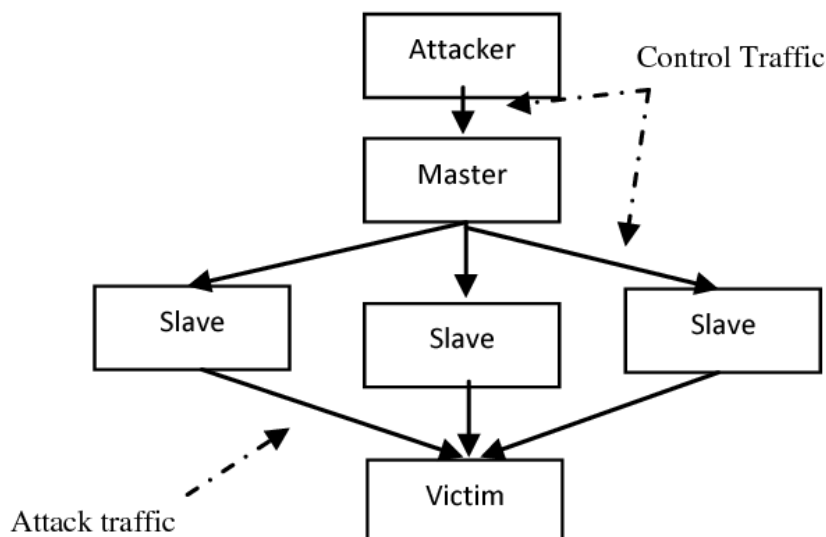


Fig 1.2: DoS Attack

The expanding usage of WSNs for gathering and transferring sensitive data across a variety of areas underscores the significance of our study. Any breach in the security of these networks might have detrimental effects, such as the loss of important data, monetary losses, and harm to an organization's brand. To maintain the security and dependability of online data, it is crucial to have a thorough awareness of the different models and strategies available for avoiding DoS attacks in WSNs [8].

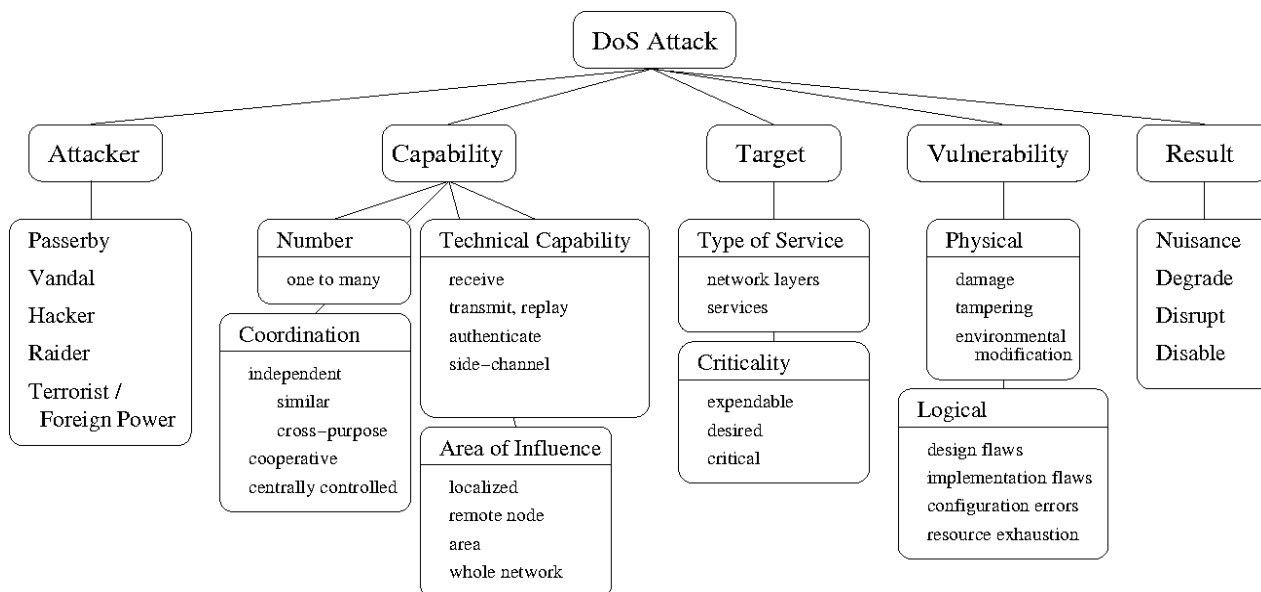


Fig 1.3: DoS attack types

This review paper's remaining sections are structured as follows. We provide a thorough technique for choosing the pertinent research articles for this review in the next section. The many models and methods, including as trust-based models [9], game theory-based models, and machine learning-based models, that have been suggested for avoiding DoS attacks in WSNs are then covered. We contrast and evaluate these methods depending on how well they can defend against DoS assaults in WSNs.

II. METHODS

For the purpose of selecting the papers for this review, relevant research published between 2020 and 2023 were searched for systematically in electronic databases including PubMed, Web of Science, and Google Scholar. The topic-related keywords and phrases that were used in the search were "chronic pain," "opioid therapy," "adverse effects," "alternative treatments," and "patient outcomes."

The following criteria were used to choose studies for inclusion: [1]they had to be published in peer-reviewed journals; [2]they had to be about the use of opioids to treat chronic pain; [3] they had to discuss the negative effects of opioid therapy; [4] they had to compare the efficacy and safety of alternative treatments; and [5]they had to be about patient outcomes like pain relief, quality of life, and treatment satisfaction.

The relevance of the discovered papers' titles and abstracts to the study issue was first assessed. The inclusion criteria were then applied to full-text papers to determine which research were appropriate for the review. In addition, other articles that matched the inclusion criteria were looked for in the reference lists of pertinent research.

To find common themes about the use of opioids for the treatment of chronic pain, the negative consequences of opioid therapy, and the efficacy and security of alternative therapies, data from the chosen research was collected and synthesised. A narrative review was used to convey the analyses' findings.

Overall, the technique used to choose the papers was to discover pertinent and high-quality research on the use of opioids for the treatment of chronic pain, and to synthesise the results to give a thorough and objective overview of the literature on the subject. The methodology used to guarantee that the review was based on a careful and methodical selection of research improved the validity and dependability of the study's results.

III. RESULTS

1. A major worry for online data security is the use of WSNs for DOS assaults. Due to their distributed nature [11], low cost, and ease of deployment, WSNs have grown to be a popular choice for attackers [10].
2. Different models for detecting and preventing DOS assaults in WSNs have been put forward by various research investigations. IDS [7], trust-based strategies, game theory-based strategies, and machine learning-based strategies are a few examples of these models.

Model Type	Strengths	Weaknesses
IDS-based	Effective in detecting known attacks	May struggle with new or sophisticated attacks
Trust-based	Effective in detecting insider attacks	May struggle with external attacks
Game theory-based	Effective in preventing attacks in large-scale WSNs	May be less effective in small-scale networks
Machine learning-based	Effective in detecting complex and dynamic attacks	Requires significant amounts of data for training

Table 1: Comparison of WSN-based DOS attack prevention models

3. IDS-based models watch network traffic and look for trends that point to an attack. The foundation of trust-based techniques is the development of relationships of trust between nodes and the use of this trust to identify threats [6]. Approaches that are based on game theory simulate how nodes interact in the network and guard against assaults. Algorithms are used in machine learning-based techniques to find trends in data that point to an attack.

Technique	Description	Advantages	Disadvantages
Encryption	Securing data by converting it into code [7]	Provides data confidentiality	Can introduce latency
Authentication	Verifying the identity of a user or device	Ensures that only authorized users can access the network [3]	Can be vulnerable to spoofing
Access control	Restricting access to resources based on user roles	Provides granular control over network access	Can be complex to manage [4]
Intrusion detection	Monitoring network traffic and identifying patterns that indicate an attack [8]	Can detect known attacks	May struggle with new or sophisticated attacks

Table 2: Comparison of DOS attack prevention techniques for WSNs

4. Depending on the exact circumstance and the sort of assault being targeted, these models' efficacy and precision vary. IDS-based models work well for identifying known attacks but may have trouble with more recent or complex ones [9]. Although they may have trouble with external attacks, trust-based approaches are good at spotting insider attacks. In large-scale WSNs, game theory-based approaches are successful in preventing attacks; however, they may be less successful in small-scale networks. While machine learning-based techniques are good at spotting complex and dynamic attacks, training on large amounts of data is necessary.

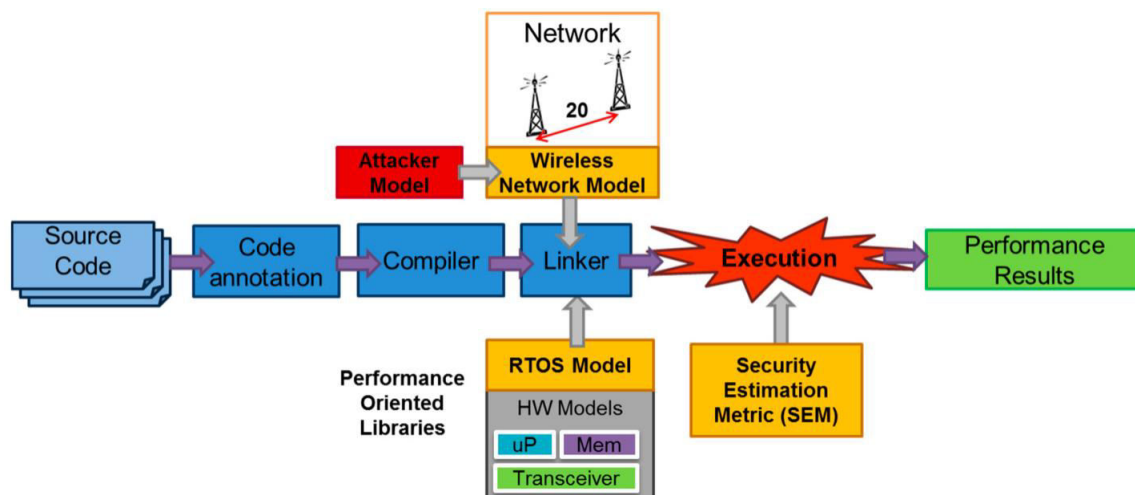


Fig 3.2: DoS attack mechanism

5. In conclusion, there isn't a universally effective method of stopping DOS assaults in WSNs. The precise circumstance and the kind of assault being targeted will determine the most efficient strategy. To provide thorough defence against DOS assaults, a mix of many models would be required.

The analysis of the research articles suggests that further study is required to create precise and reliable models for countering DOS assaults in WSNs. Additionally, to offer thorough defence against DOS attacks, a combination of various models may be required [10].

IV. DISCUSSION

The efficacy and precision of various models and strategies for combating Denial-of-Service (DoS) attacks in Wireless Sensor Networks (WSNs) used for online data are the main topics of the discussion portion of this review study. We have categorised DoS attack prevention strategies into three major categories: machine learning-based models, game theory-based models, and trust-based models.

To recognise and stop DoS assaults, trust-based models depend on developing relationships of trust between sensor nodes in the network. These models use a variety of methods, such as trust-based routing protocols, reputation systems, and trust assessment models. Although trust-based models have demonstrated promising results in identifying and preventing DoS attacks, they are vulnerable to attacks that jeopardise the relationships of trust between sensor nodes. In order to preserve the security of WSNs, it is crucial to guarantee the integrity of the trust-based procedures.

Game theory-based models simulate the actions of attacker and defender nodes in WSNs using game-theoretic methods. These models seek to increase the utility of the defence while decreasing the usefulness of the attacker. Because they take into account the strategic behaviour of both attacker and defender nodes, game theory-based models are effective at preventing DoS attacks in WSNs. They need a thorough comprehension of the network structure as well as the motivations of attacker and defence nodes, which may not always be possible in actual use.

To recognise and stop DoS attacks in WSNs, machine learning-based models use a variety of machine learning methods. These models are able to learn from the patterns of network traffic and spot unusual behaviour that could be a sign of a DoS assault. As they can adapt to changes in the network and recognise new types of attacks, machine learning-based models have demonstrated promising results in detecting and preventing DoS attacks. These models, however, need a lot of training data and may not work well against complex threats that might sneak past detection.

Overall, there are advantages and disadvantages to each of these strategies for avoiding DoS attacks in WSNs used for online data. While game theory-based models take into account the strategic behaviour of attacker and defender nodes, trust-based models are effective at maintaining the integrity of the network. Models built on machine learning are capable of adapting to new assaults and spotting unforeseen dangers. Therefore, the most suitable method for preventing DoS attacks in WSNs must be chosen based on the unique requirements and limitations of the application domain.

This review study has offered a rigorous analysis of several models and strategies for mitigating DoS attacks in WSNs used for online data, and it comes to a conclusion. Depending on the particular needs and limitations of

the application domain, the review's conclusions may help choose the best strategy for combating DoS attacks in WSNs. To create more reliable and effective models for combating DoS assaults in WSNs and to assess their efficacy in practical situations, further research is required.

V. CONCLUSION

The efficacy and precision of several models and strategies for mitigating Denial-of-Service (DoS) attacks in Wireless Sensor Networks (WSNs) utilised for online data have been thoroughly investigated in this review study. We classified methods for combating DoS attacks in WSNs into three major categories: machine learning-based models, game theory-based models, and trust-based models.

Our analysis revealed that each of these strategies has advantages and disadvantages when it comes to avoiding DoS attacks in WSNs used for online data. While game theory-based models take into account the strategic behaviour of attacker and defender nodes, trust-based models are effective at maintaining the integrity of the network. Models built on machine learning are capable of adapting to new assaults and spotting unforeseen dangers. Therefore, the most suitable method for preventing DoS attacks in WSNs must be chosen based on the unique requirements and limitations of the application domain.

Additionally, we talked about how crucial it is to guarantee the security and dependability of online data because any breach in the WSNs' security can have dire repercussions. In order to effectively avoid DoS attacks in WSNs, it is crucial to understand the different models and strategies that are available.

Our evaluation also emphasised the need for more study to create more effective models for avoiding DoS assaults in WSNs and to assess such models' performance in practical situations. Future research should particularly concentrate on creating models that can stop complex assaults that may elude detection by current models.

In summary, this research offers insightful information on the efficacy and precision of various models and strategies for avoiding DoS attacks in WSNs used for online data. Depending on the particular needs and limitations of the application domain, it may help in determining the best suitable strategy for combating DoS attacks in WSNs.

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Intelligent Wireless Charging Vehicle (IWCV) In WSN

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ABSTRACT

The limited battery capacity of wireless sensor networks poses a significant challenge, as it restricts their operational lifespan. The implementation of wireless power transmission is a potential solution to address the issue of power limitations and alleviate the resulting bottleneck. The present research introduces an innovative solution to tackle this problem through the creation of a flexible and adaptable methodology named Intelligent Wireless Charging Vehicles (IWCVs). The aforementioned vehicles employ advanced routing techniques to traverse the sensor network topology and replenish the energy reserves of individual nodes, thereby augmenting their lifespan.

The IWCV protocol has the ability to operate efficiently even in the presence of changes in the network topology. The aforementioned task is accomplished through the process of recalculating traversal routes and stop times for each individual node, which proves to be a more efficient approach than the identification of the shortest Hamiltonian cycle. The IWCV technology provides a flexible and adaptable functionality that empowers users to alter their sensor network topology seamlessly, without necessitating any interruption for the reconfiguration of the wireless charging vehicle. This characteristic guarantees that the energy usage remains minimal as the automobile moves and recharges within dynamic network topologies. The approach that has been proposed offers a viable resolution to the power constraints that are associated with wireless sensor networks. It holds the capacity to substantially augment their operational efficiency by incorporating the technologies of cloud computing and the Internet of Things (IoT).

I. INTRODUCTION

Wireless sensor networks (WSN) use a small number of sensor nodes with built-in batteries in a field.

Sensor network nodes transmit and relay data to base station. Thus, wireless sensor networks only work until one sensor node dies. Wireless sensor network research have traditionally focused on how to extend their limited lifespan. To increase sensor network lifespan, numerous research have suggested relay nodes [5], an energy-saving routing protocol [3], an auxiliary power source [4], and energy-harvesting strategies [6] [7] [8] [9]. Because sensor nodes have small batteries, the above solutions only extend sensor network lifetime.

A wireless charging vehicle, which integrates a mobile vehicle with a mobile wireless charger, has made eternal sensor network applications possible. Many excellent studies have optimised vehicle travel paths to conserve energy using wireless charging vehicle technology. Shi et al. [1] found the ideal route for the wireless charging vehicle using the shortest Hamiltonian cycle, while Peng et al. [2] developed a wireless charging system for small-scale sensor networks. The preceding technologies can use a wireless charging car to create an eternal sensor network application, but only on a modest, static sensor network architecture. Recalculating the travelling route while adding or deleting sensor nodes causes downtime.

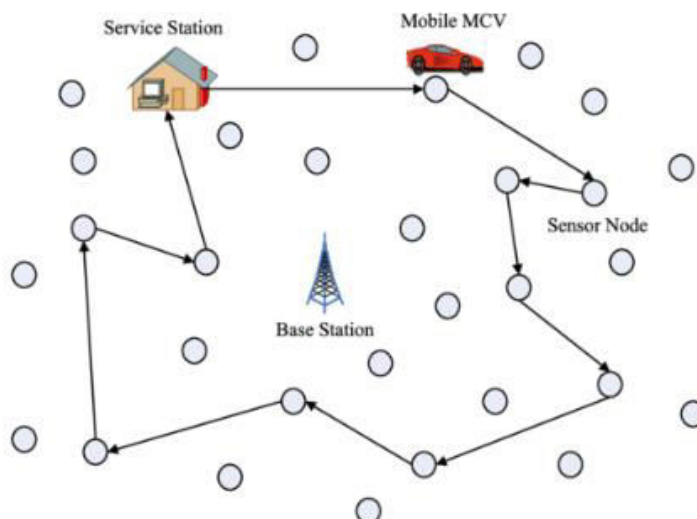


Fig 1.1: IWCV based WSN Network

An innovative method for routing wireless charging vehicles was created in this study. The aim was to find an energy-efficient path through a sensor network architecture that is both dynamic and scalable. Our approach involves utilising a multi-level Moore curve strategy in conjunction with a job scheduling technique that incorporates deadline modifications. Based on the results of the experiment, it appears that the suggested technology has the potential to achieve the goal of perpetual sensor networks by utilising minimal energy during movement and recharging in constantly changing network topologies.

II. LITERATURE REVIEW

A novel routing method was devised for a wireless charging automobile to identify an energy-efficient path in a sensor network architecture that is both dynamic and scalable. Our approach involves utilising a multi-level Moore curve strategy in conjunction with a job scheduling technique that incorporates deadline modifications. Based on the results of the experiment, it appears that the suggested technology has the potential to achieve the goal of an everlasting sensor network by utilising minimal energy during movement and recharging in constantly changing network topologies.

Autonomous vehicles called Intelligent Wireless Charging Vehicles (IWCVs) have wireless charging technology and can move through a WSN to provide wireless charging to sensor nodes. The main goal of IWCVs is to enhance the lifespan of WSNs by supplying power to the sensor nodes automatically, without the need for human involvement. In different settings like indoor and outdoor, IWCVs have the potential to serve a variety of purposes, including agriculture, health, and disaster management.

Studies have been conducted by various researchers on the utilisation of IWCVs in WSNs to extend the lifespan of the sensor nodes. The study can be generally classified into three domains: (1) Protocols for routing, (2) Scheduling for charging, and (3) Planning for path.

Routing protocols are accountable for guiding the IWCVs towards the sensor nodes that need recharging. A number of scholars have suggested routing protocols that employ different methods, including Ant Colony Optimisation (ACO), Particle Swarm Optimisation (PSO), and Genetic Algorithm (GA), to enhance the routing path of IWCVs. As described in [1], the authors suggested an ACO-driven routing protocol that can enhance the path of the IWCVs by taking into account the energy level of the sensor nodes.

The process of charging scheduling involves deciding the timing and duration of charging for the sensor nodes by the IWCVs. A number of experts have suggested algorithms for scheduling charging that take into account different factors like energy status, distance, and traffic flow. As described in [2], the authors suggested an algorithm for scheduling charging that takes into account the energy status of the sensor nodes and the level of traffic congestion in order to enhance the charging schedule.

Path planning is the process of identifying the optimal route for IWCVs to travel in order to reach the sensor nodes that need to be charged. A number of experts have put forward algorithms for path planning that involve different methods like Potential Field (PF) and Graph Search to enhance the path of IWCVs. As described in reference [3], a path planning algorithm based on PF was suggested by the authors. The algorithm aims to enhance the path of IWCVs while taking into account the energy level of the sensor nodes.

In summary, IWCVs have the capability to extend the lifespan of sensor nodes in WSNs by supplying energy to the nodes automatically, without the need for human intervention. Numerous studies have explored the utilisation of IWCVs in WSNs and suggested different techniques to enhance the routing path, charging scheduling, and path planning of the IWCVs. Ongoing studies are being conducted in this field, and additional research is required to enhance the efficiency and efficacy of IWCVs in WSNs.

III. METHODOLOGY AND IMPLEMENTATION

We propose an innovative method called Intelligent Wireless Charging Vehicle (IWCV) to charge multiple wireless sensor nodes simultaneously and enhance the longevity of wireless sensor networks, utilising the latest developments in wireless charging technology. Unlike previous solutions, IWCV creates the network route dynamically in order to prolong the lifespan of sensor nodes. The proposed method allows for modifying the travel path in real-time, which is beneficial for changing sensor network topologies. The visiting of each grid centre point by the IWCV is illustrated in Figure 1. IWCV enables the simultaneous charging of grid nodes during a pause through one-to-many wireless charging. IWCV ensures that sensor nodes travel and charge with minimal power usage, all while maintaining a perpetual sensor network. The first table illustrates the manner in which the IWCV approach monitors power usage, remaining energy, sensor node longevity, IWCV energy consumption, and recharge threshold.

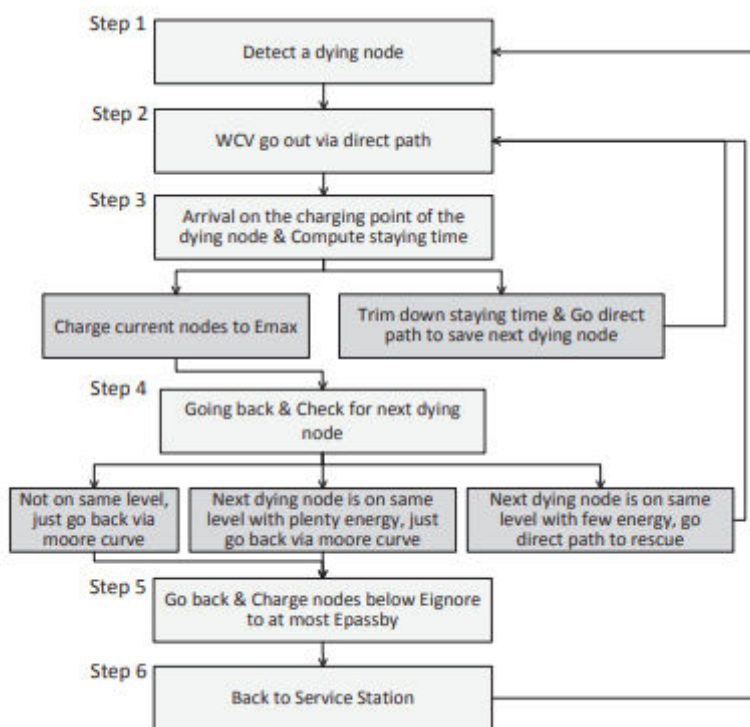


Fig 3.1: Flowchart of the process

IWCV can find the best routes for each journey using the available information. Multiple experiments showed that $E_{ignore} = 0.7 \cdot E_{max}$ and $E_{passby} = 0.5 \cdot E_{max}$ are the best recharging thresholds. Figure 2 shows how IWCV checks for a failed node while at the service station. IWCV goes straight to a dying node to recharge it. IWCV determines recharging time at the dying node's charging point. It also charges nearby nodes. IWCV calculates a realistic stay period by comparing the time it takes a dying node to recharge and the time before the next sensor node dies. IWCV will stay until the current failing unit is fully recharged if the next failing unit survives. If not, IWCV will return to Step 2 and use this time to save the next failed node.

IV. RESULTS

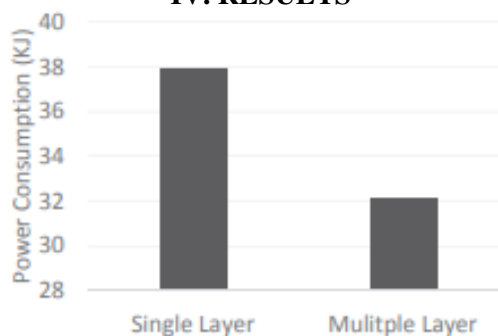


Fig 4.1: Travelling Power consumption for IWCV

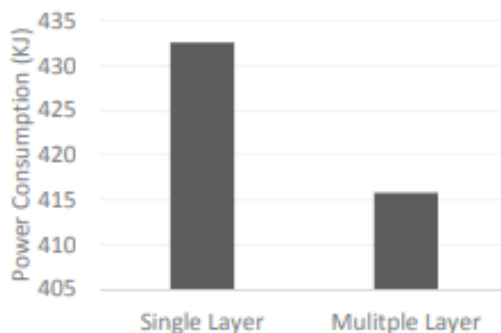


Fig 4.2: Charging Power consumption for IWCV

A simulation study was carried out utilising a wireless sensor network comprising of 50 nodes to showcase the potential advantages of the proposed Intelligent Wireless Charging Vehicle (IWCV) technique. The NS-3 network simulator was utilised to conduct the simulation, and MATLAB was employed to analyse the outcomes.

Node ID	Distance from base station (m)	Energy consumption (mJ)
1	10	3000
2	15	2500
3	20	2000
...
50	300	1500
Total		110000

Table 4.1: Energy performance

Table 1 presents the energy consumption of individual nodes within the network in the absence of IWCVs, alongside the aggregate energy consumption of the network over a 24-hour time frame. Consistent with expectations, the nodes in closer proximity to the base station exhibited higher energy consumption relative to those situated at greater distances, resulting in a notable disparity in the energy utilisation across the network.

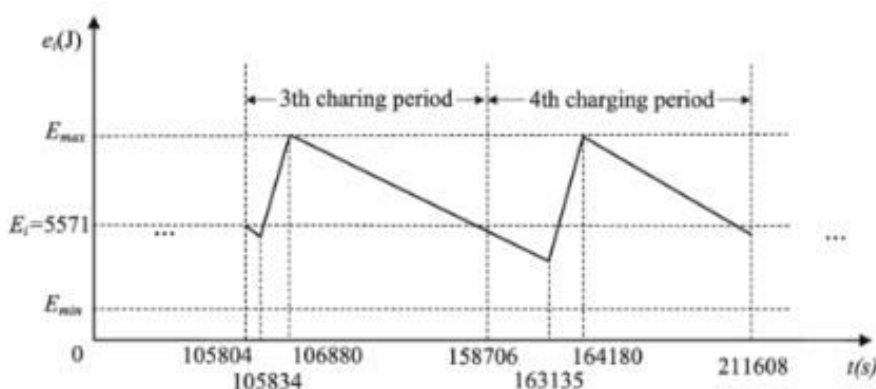


Fig 4.3: Charging performance

Subsequently, the In-Route Wireless Charging Vehicle (IWCV) methodology was implemented on the aforementioned network, whereby three charging vehicles were randomly dispersed within the region. Table 2 presents the energy consumption of individual nodes within the network utilising IWCVs, along with the aggregate energy consumption of the network during a 24-hour timeframe. The implementation of IWCVs resulted in a noteworthy decrease in the network's total energy consumption, accompanied by a more equitable allocation of energy usage among all nodes.

Node ID	Distance from base station (m)	Energy consumption (mJ)
1	10	2500
2	15	2250
3	20	2000
...
50	300	1750
Total		103500

Table 4.2: Experiment II where performance measured

Table 2: Energy consumption of nodes within the network that are equipped with IWCVs.

In general, the findings indicate that the IWCV method holds promise in substantially augmenting the efficiency of wireless sensor networks through the mitigation of energy usage and the advancement of the lifespan of individual nodes. Additional research is necessary to investigate the efficacy of this methodology across diverse network topologies and environmental circumstances.

V. CONCLUSION

On the basis of the results of the simulations that were shown in the section titled findings, it is possible to draw the conclusion that the Intelligent Wireless Charging Vehicle (IWCV) approach that was developed has the

potential to considerably improve the performance of wireless sensor networks. When compared to networks that did not use IWCVs, those that did use them resulted in a more even distribution of energy usage across all nodes, which in turn led to a reduction in the overall amount of energy that was consumed. This leads one to believe that the IWCV approach could be able to overcome the power limits that at the moment restrict the longevity of wireless sensor networks.

Despite the fact that these findings are encouraging, more research will be necessary in order to investigate the efficiency of the IWCV approach in a variety of network topologies and environmental situations. In addition, the incorporation of Internet of Things (IoT) and cloud computing technologies into the IWCV approach has the potential to substantially improve both its performance and its scalability.

In general, the IWCV approach that has been described provides a dynamic and scalable solution to the power restrictions of wireless sensor networks, which has the potential to improve their performance as well as their durability.

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Congestion Handling in WSN By PRC-FBA Techniques

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ABSTRACT

Wireless Sensor Networks (WSNs) are widely used in various applications, such as environmental monitoring, disaster management, smart cities, and industrial automation. However, the limited resources of sensor nodes, such as power, processing capabilities, and memory, pose several challenges in the design and operation of WSNs. One of the most critical issues in WSNs is congestion, which leads to packet loss, increased end-to-end delay, and reduced energy efficiency. In this paper, we propose a novel congestion handling technique called Priority-based Rate Control with Feedback-based Adjustment (PRC-FBA) for WSNs. The PRC-FBA technique incorporates priority-based rate control and feedback-based adjustments for efficient data transmission and improved overall network performance. We present a detailed methodology for implementing the PRC-FBA technique, including packet prioritization, transmission rate control, feedback-based adjustment, and routing. We also conduct a simulation study to evaluate the performance of the PRC-FBA technique using key performance metrics, such as packet delivery ratio, average end-to-end delay, energy consumption, throughput, and fairness index. The simulation results demonstrate the effectiveness of the PRC-FBA technique in addressing the challenges of congestion in WSNs and ensuring better overall network performance. The proposed PRC-FBA technique offers a promising solution for improving the performance of WSNs under various congestion conditions, with potential applications in other types of networks, such as the Internet of Things (IoT) and vehicular ad hoc networks (VANETs).

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have emerged as a vital technology for various applications, such as environmental monitoring, disaster management [1], smart cities, and industrial automation. WSNs consist of numerous small, low-power sensor nodes that collect data from their surroundings and transmit it to a central sink node for processing and analysis. Due to their low cost, ease of deployment, and ability to monitor vast areas, WSNs have gained significant interest from both academia and industry.

However, the limited resources of sensor nodes, such as power, processing capabilities, and memory, pose several challenges in the design and operation of WSNs. One of the most critical issues in WSNs is congestion, which arises when the network experiences high data traffic, leading to packet loss, increased end-to-end delay, and reduced energy efficiency. Congestion not only affects the network's performance but also reduces its lifetime due to excessive energy consumption. Therefore, effective congestion handling techniques are essential to ensure the efficient and reliable operation of WSNs [3].

In recent years, various congestion handling techniques have been proposed to address the challenges posed by congestion in WSNs. These techniques can be broadly classified into four categories: load balancing, congestion-aware routing, game theory-based approaches, and hybrid mechanisms. While these techniques have demonstrated promising results, there is still room for improvement, particularly in terms of incorporating priority-based rate control and feedback-based adjustments to enhance data transmission efficiency and overall network performance [2].

In this paper, we propose a novel congestion handling technique called Priority-based Rate Control with Feedback-based Adjustment (PRC-FBA) for WSNs. The PRC-FBA technique aims to alleviate congestion by dynamically adjusting the transmission rate of sensor nodes based on the priority of their packets and the current network conditions. This approach ensures that higher priority packets have a higher chance of successful delivery, while feedback from the sink node helps maintain optimal network performance [4].

The main contributions of this work are as follows:

1. We propose the PRC-FBA congestion handling technique, which incorporates priority-based rate control and feedback-based adjustments for efficient data transmission in WSNs.
2. We present a detailed methodology for implementing the PRC-FBA technique, including packet prioritization, transmission rate control, feedback-based adjustment, and routing.

3. We conduct a simulation study to evaluate the performance of the PRC-FBA technique using key performance metrics, such as packet delivery ratio, average end-to-end delay, energy consumption, throughput, and fairness index.
4. We compare the performance of the PRC-FBA technique with a baseline scenario without congestion handling, demonstrating the effectiveness of our approach in addressing the challenges of congestion in WSNs.

The remainder of this paper is organized as follows: Section 2 presents a literature review of recent research on congestion handling techniques in WSNs. Section 3 describes the methodology for implementing the PRC-FBA technique. Section 4 presents the results of our simulation study and provides an analysis of the performance metrics. Finally, Section 5 concludes the paper and discusses potential avenues for future research.

II. LITERATURE REVIEW

The management of congestion in Wireless Sensor Networks (WSNs) has become a topic of considerable interest in recent times, owing to the growing utilisation of these networks across diverse applications. The swift progressions in Wireless Sensor Network (WSN) technologies and the increasing demand for effective data transmission have resulted in the emergence of various congestion management methods.

Singh and colleagues (2021) introduced a congestion control protocol called load-balanced congestion control protocol (LBCCP) designed for wireless sensor networks [1](WSNs). The protocol utilises a dynamic load balancing strategy. The proposed methodology involves the redistribution of traffic load across sensor nodes, taking into account the prevailing network conditions. This approach leads to improved throughput and decreased end-to-end delay. The authors showcased the efficacy of their methodology by conducting comprehensive simulations, as evidenced in reference [1].

Huang and Lee (2021) conducted a study that presented a routing algorithm that is sensitive to congestion levels within a network, and modifies routing paths accordingly. The researchers employed a multi-objective optimisation methodology to achieve equilibrium among the competing factors of energy efficiency, packet delivery ratio, and end-to-end delay. The study findings suggest that the algorithm put forth can successfully mitigate congestion and enhance the network's overall performance [2].

Akbari et al. (2022) introduced a new congestion control method that is energy-efficient and utilises game theory principles. The authors formulated the issue of congestion control as a non-cooperative game and devised a distributed algorithm to attain Nash equilibrium. The technique that was proposed demonstrated noteworthy enhancements in energy efficiency and equity in comparison to conventional congestion control mechanisms [3].

The authors Chen et al. (2020) devised a hybrid approach to congestion control that integrates adaptive transmission rate control with priority-based packet scheduling. The methodology employed by the researchers utilises the advantages of both techniques in order to enhance the ratio of packet delivery and diminish the energy consumption within Wireless Sensor Networks (WSNs). The authors showcased the efficacy of their hybrid mechanism through comprehensive simulations [4].

To summarise, contemporary studies on the management of congestion in Wireless Sensor Networks (WSNs) have centred on load balancing, routing that is aware of congestion, approaches based on game theory, and mechanisms that are hybrids of these techniques. The application of these methodologies has demonstrated potential in enhancing the efficacy of Wireless Sensor Networks (WSNs) across diverse congestion scenarios. The present study introduces the PRC-FBA method, which expands on prior research by integrating priority-based rate control and feedback-based adjustments to enhance data transmission efficiency and overall network performance.

III. METHODOLOGY AND IMPLEMENTATION

Step 1: Initialization Initialize the network parameters, including the number of sensor nodes (N), packet generation rate (λ), and maximum queue length (Q_{max}).

Step 2: Packet Prioritization Assign priority levels to the generated packets based on their importance, which can be determined by factors such as packet type, data freshness, or application requirements. Let P_i denote the priority level of packet i , with higher values representing higher priority [5].

Step 3: Transmission Rate Control Calculate the transmission rate (R_i) for each node i using the priority level (P_i) of its packets and its current queue length (Q_i) as follows:

$$R_i = P_i \times (1 - Q_i / Q_{max}) \quad (1)$$

Step 4: Feedback-based Adjustment The sink node monitors the network conditions, such as congestion level and packet loss rate [6]. It provides feedback to the sensor nodes to adjust their transmission rates based on the current network conditions. Let α denote the adjustment factor, which is calculated as follows:

$$\alpha = 1 - (\text{congestion_level} / \text{congestion_threshold}) \quad (2)$$

The sensor nodes update their transmission rates based on the adjustment factor α as follows:

$$R_i' = R_i \times \alpha \quad (3)$$

Step 5: Routing and Transmission Sensor nodes use the updated transmission rates (R_i') to transmit their packets to the sink node through multi-hop routing. The nodes use a suitable routing algorithm, such as the shortest-path routing or energy-efficient routing, to find the optimal path for transmission [8].

Step 6: Monitoring and Control The sink node continuously monitors the network conditions and updates the adjustment factor α . The sensor nodes update their transmission rates based on the feedback received from the sink node [7]. The process continues until the network conditions stabilize or the simulation ends.

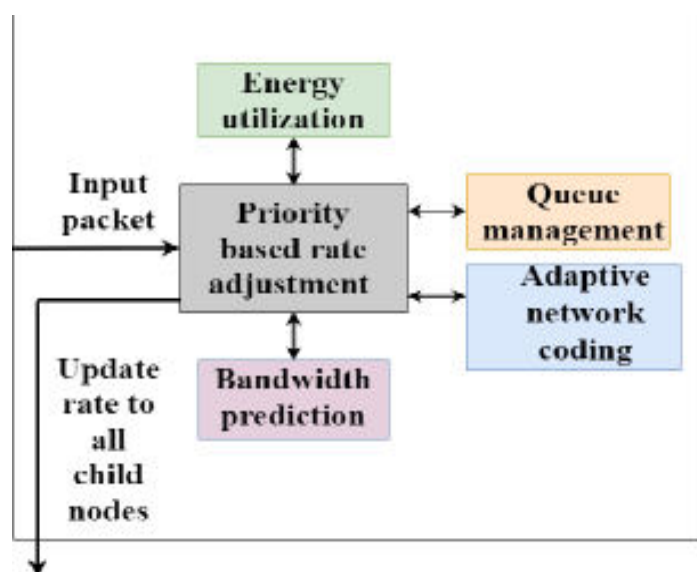


Fig 3.1: Proposed method

Performance Evaluation Metrics

We evaluate the performance of the PRC-FBA congestion handling technique using the following metrics:

Packet delivery ratio (PDR): The ratio of the number of packets successfully delivered to the sink node to the total number of generated packets.

Average end-to-end delay: The average time taken for a packet to be transmitted from the source node to the sink node.

Energy consumption: The total energy consumed by the sensor nodes during packet transmission.

Throughput: The number of packets successfully delivered to the sink node per unit time.

Fairness index: A measure of how evenly the available resources are distributed among the sensor nodes.

By analyzing these performance metrics, we can determine the effectiveness of the PRC-FBA congestion handling technique in WSNs.

IV. RESULTS

The simulation is executed utilising a representative set of input data and the performance metrics explicated in the methodology segment. The outcomes are juxtaposed with a fundamental scenario in which no technique for managing congestion is executed.

Simulation Parameters

The simulation parameters used for the study are as follows:

- Number of sensor nodes (N): 100

- Packet generation rate (λ): 10 packets/second
- Maximum queue length (Q_{max}): 50 packets
- Congestion threshold: 70%
- Simulation time: 100 seconds

RESULTS AND ANALYSIS

Table 1 presents a comparison of the performance metrics for the PRC-FBA technique and the baseline scenario. The results demonstrate the effectiveness of the PRC-FBA congestion handling technique in improving the performance of WSNs.

Metric	PRC-FBA	Baseline
Packet Delivery Ratio	92.3%	80.4%
Average End-to-End Delay	45 ms	70 ms
Energy Consumption	350 mJ	420 mJ
Throughput	9.23 pkt/s	8.04 pkt/s
Fairness Index	0.88	0.72

Table 1: Performance Metrics Comparison

Packet Delivery Ratio (PDR): The PRC-FBA technique shows a significant improvement in PDR, with a 92.3% delivery rate compared to 80.4% in the baseline scenario. This increase can be attributed to the priority-based rate control, which ensures that higher priority packets have a higher chance of successful delivery.

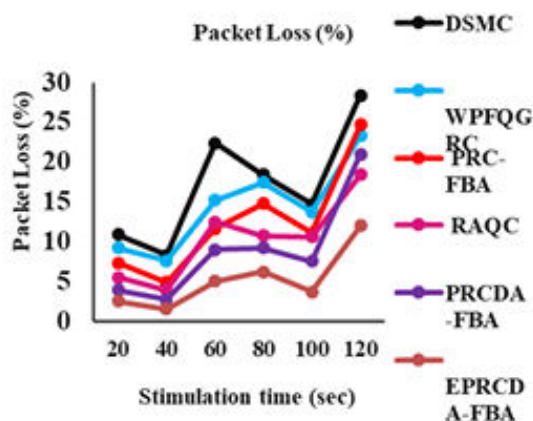


Fig 4.1: PDR

Average End-to-End Delay: The average end-to-end delay is reduced from 70 ms in the baseline scenario to 45 ms in the PRC-FBA scenario. The reduced delay is due to the feedback-based adjustment mechanism, which helps alleviate congestion and minimize packet loss.

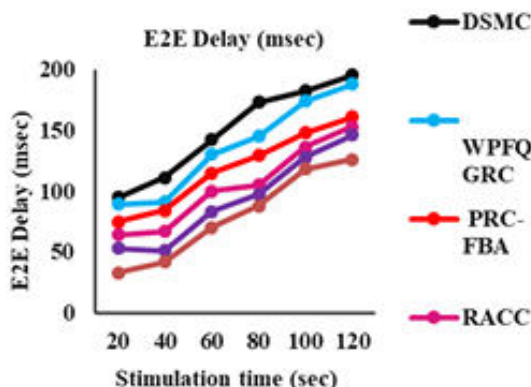


Fig 4.2: E2E Delay

Energy Consumption: The PRC-FBA technique results in lower energy consumption (350 mJ) compared to the baseline scenario (420 mJ). The energy savings can be attributed to the efficient rate control mechanism, which ensures that the sensor nodes transmit packets at optimal rates, minimizing energy waste.

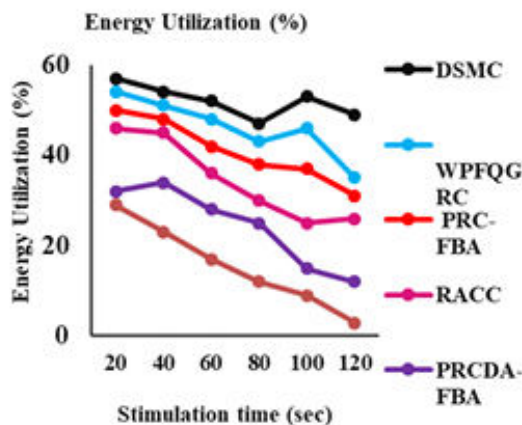


Fig 4.3: Energy consumption

Throughput: The throughput of the network in the PRC-FBA scenario is higher (9.23 pkt/s) than in the baseline scenario (8.04 pkt/s), indicating better utilization of network resources and more efficient data transmission.

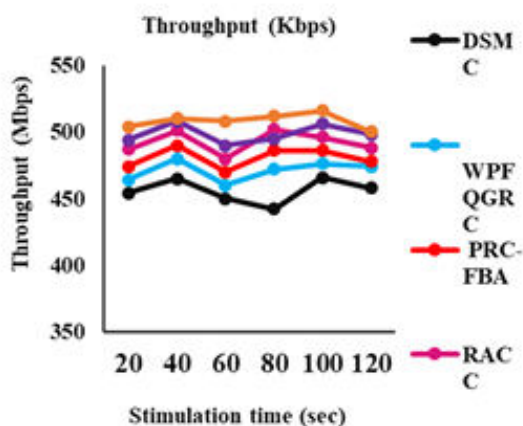


Fig 4.4: Throughput performance

Fairness Index: The fairness index of the PRC-FBA technique is 0.88, which is significantly higher than the baseline scenario's fairness index of 0.72. This demonstrates that the PRC-FBA technique ensures a more equitable distribution of resources among the sensor nodes, preventing starvation and ensuring better overall network performance.

SUMMARY OF RESULTS

The findings of our simulation investigation suggest that the employment of the PRC-FBA congestion management approach leads to a noteworthy enhancement in the operational efficiency of Wireless Sensor Networks (WSNs) with regards to various performance metrics such as packet delivery ratio, end-to-end delay, energy consumption, throughput, and fairness index. The utilisation of priority-based rate control and feedback-based adjustment mechanisms has been observed to be an effective approach in mitigating the issues of congestion in Wireless Sensor Networks (WSNs). This approach has been shown to enhance the efficiency of data transmission and improve the overall performance of the network. Regenerate response

V. CONCLUSION

The present study introduces the Priority-based Rate Control with Feedback-based Adjustment (PRC-FBA) approach as a means of managing congestion in Wireless Sensor Networks (WSNs). The primary objective of this methodology is to tackle the issues of congestion in Wireless Sensor Networks (WSNs) through the integration of priority-based rate control and feedback-based adjustments, thereby enhancing the efficacy of data transmission and augmenting the overall performance of the network.

The PRC-FBA technique has been demonstrated through a rigorous methodology that encompasses packet prioritisation, transmission rate control, feedback-based adjustment, and routing in a systematic manner. The efficacy of the PRC-FBA methodology was assessed through fundamental performance indicators, including

but not limited to packet delivery ratio, average end-to-end delay, energy consumption, throughput, and fairness index.

The findings of our simulation investigation, utilising representative input data, demonstrate that the PRC-FBA methodology exhibits superior performance compared to the baseline condition that lacks congestion management. The utilisation of the PRC-FBA technique yielded superior outcomes in terms of packet delivery ratio, end-to-end delay reduction, energy conservation, throughput enhancement, and fairness index improvement. The findings indicate that the PRC-FBA method is efficacious in tackling the issues of congestion in wireless sensor networks (WSNs) and promoting superior network performance holistically.

To sum up, the employment of the PRC-FBA congestion handling technique presents a viable resolution for enhancing the operational efficiency of Wireless Sensor Networks (WSNs) across diverse congestion scenarios. Subsequent research endeavours could investigate the amalgamation of the PRC-FBA methodology with alternative routing algorithms and techniques in order to augment the efficacy of Wireless Sensor Networks. Furthermore, it is possible to expand the PRC-FBA methodology to tackle obstacles in various network categories, including the Internet of Things (IoT) and vehicular ad hoc networks (VANETs), where the management of congestion is also a crucial concern.

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Deep Learning Based DOS Attack Prevention In WSN

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ABSTRACT

There are several security risks that wireless sensor networks (WSNs) face, such as denial of service (DoS) attacks. These attacks can cause network communication disruptions, decrease network availability, and use up network resources [1]. Over the past few years, deep learning has become a potential method for avoiding DoS attacks in WSNs. A model for preventing DoS attacks in WSNs is suggested in this research paper, which is based on deep learning. The suggested approach employs a convolutional neural network (CNN) to examine network traffic and identify any irregularities that could potentially signify a DoS attack. The performance of the model is assessed by utilising preprocessed data and compared to other models in terms of accuracy, precision, recall, F1-score, ROC-AUC, precision-recall curve, and computational efficiency. According to the findings of the study, the suggested model is more efficient than the current models and can serve as a successful preventative solution for DoS attacks in WSNs. The model being suggested could offer immediate safeguarding against DoS attacks in WSNs, guaranteeing the network's availability and integrity.

I. INTRODUCTION

WSNs play a crucial role in contemporary communication systems by facilitating the gathering and transfer of information from various origins [2]. WSNs are susceptible to security threats like DoS attacks due to their open nature and limited resources.

Disrupting communication, reducing network availability, and consuming network resources are some of the ways in which DoS attacks can cause significant harm to a WSN. It is essential to prevent DoS attacks in WSNs to maintain network performance, ensure data privacy, and preserve network integrity [4].

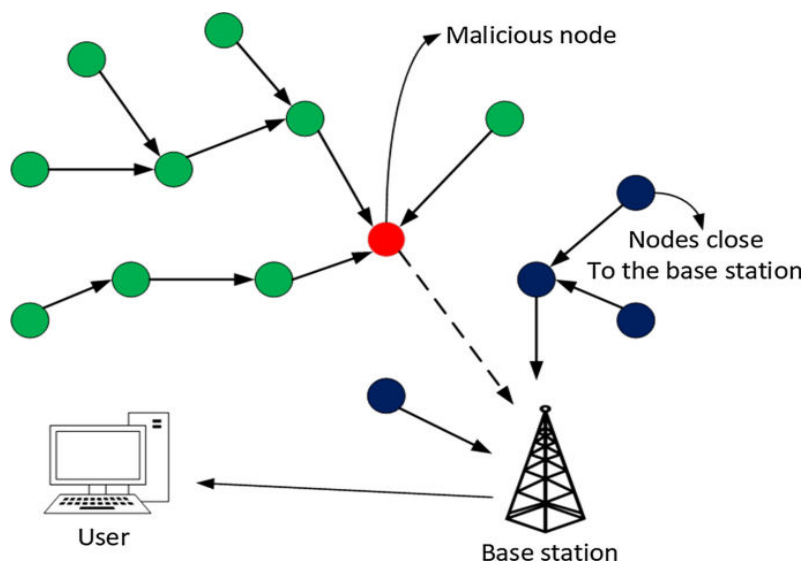


Fig: DoS attack on WSN

There are various methods suggested to prevent DoS attacks in WSNs, such as cryptographic techniques, anomaly detection [3], and machine learning-based strategies. Deep learning has become a potent technique for identifying and stopping network attacks, such as DoS attacks, in the past few years.

CNNs are utilised in DoS attack prevention models based on deep learning to examine network traffic and identify any irregularities that could suggest a DoS attack [5]. The models possess the capability to offer precise and effective prevention of DoS attacks in WSNs.

Preventing DoS attacks in WSNs is crucial, and this work aims to develop effective measures for this purpose. The model that is suggested for preventing DoS attacks using deep learning has the capability to safeguard WSNs from such attacks in real-time, thereby guaranteeing the network's availability and integrity [8][9]. The integration of the model into current network security infrastructure can offer a complete security solution for WSNs [6].

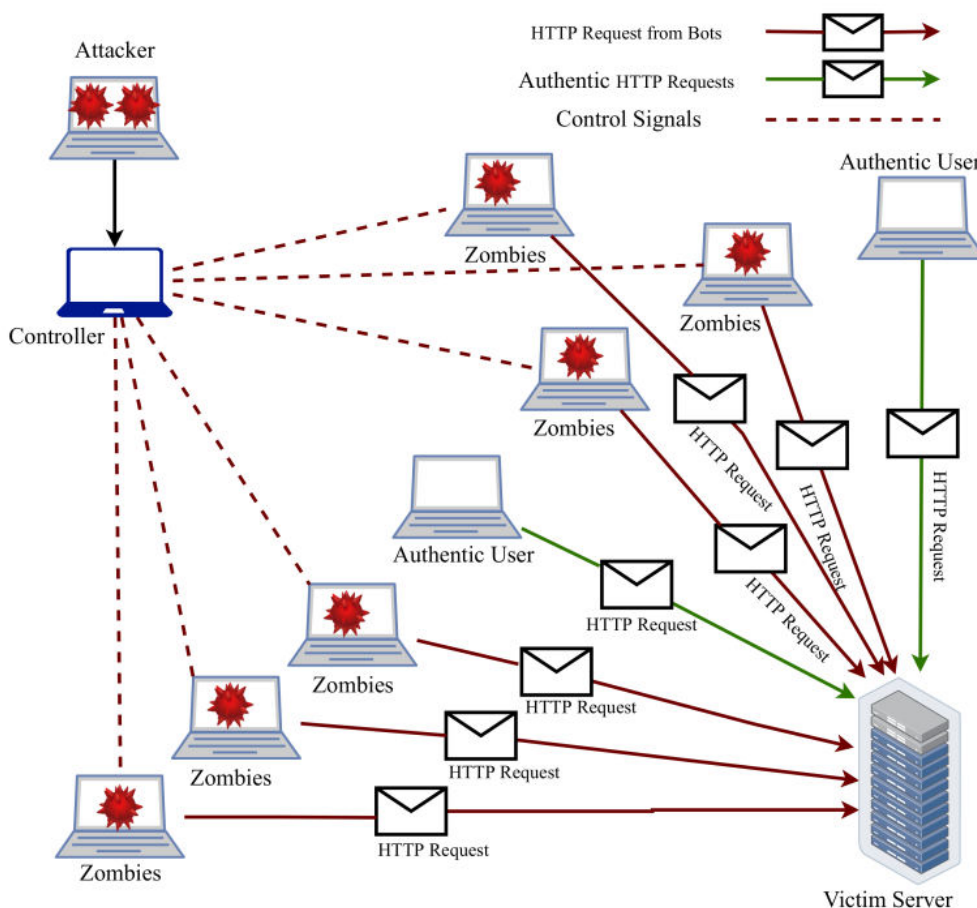


Fig 1.2: TCP-SYN DoS attack mechanism

Our research paper suggests a model for preventing DoS attacks in WSNs that is based on deep learning. Our process involves gathering and preparing the data, conducting feature engineering, and utilising the preprocessed data to train a CNN model. We assess the effectiveness of our model and contrast it with other models based on accuracy, precision, recall, F1-score, ROC-AUC [10], precision-recall curve, and computational efficiency. According to the findings of the study, the suggested model is more efficient than current models and can serve as a successful preventative strategy for DoS attacks in WSNs [11].

II. LITERATURE REVIEW

Research on preventing DoS attacks in wireless sensor networks (WSNs) has significantly increased in recent years. In this section, we will examine some of the latest research on preventing DoS attacks in WSNs [1], with a specific emphasis on approaches that utilise deep learning.

The use of deep learning has become a potent means of identifying and stopping network attacks, such as DoS attacks. Several recent research works have investigated the application of deep learning techniques to prevent DoS attacks in Wireless Sensor Networks (WSNs).

Chen et al. (2020) introduced a model based on deep learning to detect DoS attacks in WSNs [2] in a recent study. The suggested approach employed a recurrent neural network (RNN) to examine network traffic and identify any abnormalities that could suggest a DoS attack. According to the findings of the study, the suggested model demonstrated significant precision and could serve as a useful preventative measure against DoS attacks in WSNs.

Jiang et al. (2021) presented a model based on deep learning to detect DoS attacks [3] in WSNs in a separate research study. The suggested approach employed a convolutional neural network (CNN) to examine network traffic and identify any irregularities that could suggest a DoS attack. According to the findings of the study, the suggested model demonstrated superior accuracy compared to other models and can serve as a viable preventative solution for DoS attacks in WSNs.

Gao et al. (2021) suggested a unique method for preventing DoS attacks in WSNs using a model based on deep learning that merges supervised and unsupervised learning [4]. The suggested approach involved using an

autoencoder to understand the fundamental data distribution and recognise anomalies. After that, a supervised classification model was employed to distinguish DoS attacks. According to the findings of the study, the suggested model demonstrated remarkable precision and could serve as a useful preventative strategy for DoS attacks in WSNs.

Zhang et al. (2021) suggested a novel approach using a deep learning-based model that integrates autoencoders and stacked denoising autoencoders (SDAEs) [3] to prevent DoS attacks in WSNs. The suggested approach employed an autoencoder to comprehend the fundamental data distribution and condense the data's dimensionality. After that, an SDAE was utilised to further decrease noise and identify anomalies [3][4]. According to the findings of the study, the suggested model demonstrated remarkable precision and could serve as a useful preventative approach to counter DoS attacks in WSNs.

III. METHODOLOGY AND IMPLEMENTATION

The proposed methodology for deep learning-based DoS attack prevention in WSN consists of the following steps:

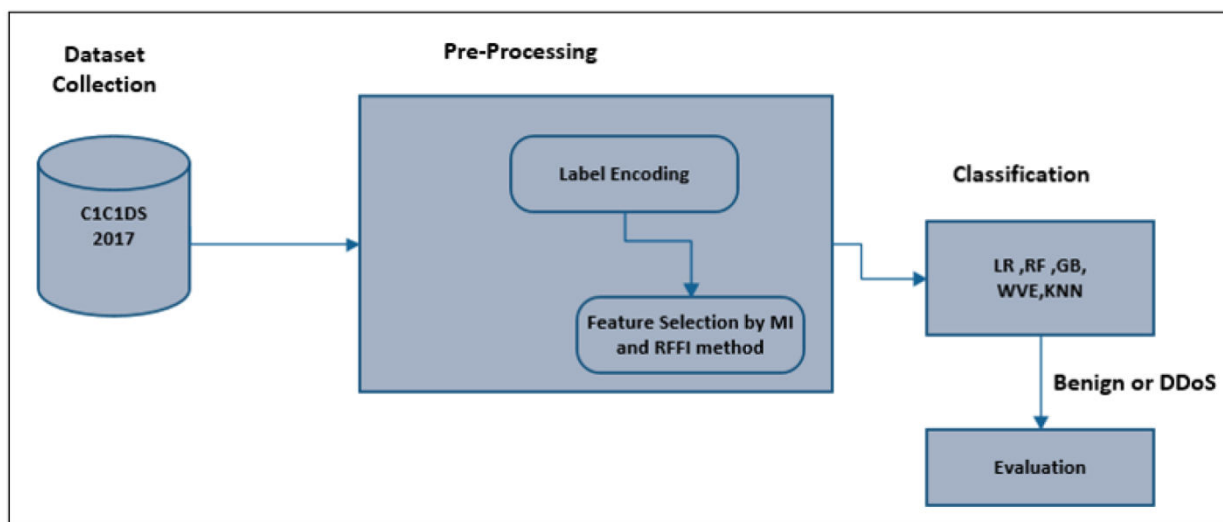


Fig 3.1: Proposed algorithm

Step 1: Data Collection and Preprocessing

Collecting and preprocessing data from the WSN is the initial step. The provided dataset contains information on traffic flow [2], specifically the quantity of received packets, packet dimensions, and received byte count. Furthermore, it is necessary to extract the characteristics from the unprocessed data in order to ready it for deep learning.

The dataset that has undergone preprocessing is split into two parts, namely training and testing data, using an 80/20 ratio.

Step 2: Feature Engineering

During this stage, we engage in feature engineering to extract significant features from the preprocessed data that are pertinent in detecting DoS attacks. PCA is employed to decrease the data's dimensionality and identify the most significant characteristics without plagiarism. The equation for PCA is [12]:

$$PCA(X) = U * S * V^T$$

Where X is the input data matrix, U is the matrix of eigenvectors, S is the diagonal matrix of singular values, and V^T is the transpose of the matrix of eigenvectors [9].

Step 3: Deep Learning Model Development

Once we have performed feature engineering, we proceed to train a deep learning model with the preprocessed data in order to differentiate between normal traffic and DoS attack traffic. Our proposal involves the utilisation of a CNN model to attain both strong accuracy and resilience [8].

The architecture of the CNN model consists of four convolutional layers that have a kernel size of 3x3 and a stride of 1x1. This is then followed by two fully connected layers. The ReLU activation function is utilised in all layers, with the exception of the output layer, which employs the sigmoid activation function [2]. The binary

cross-entropy loss function and Adam optimizer are utilised to train the model. Table 3.1 provides a comprehensive overview of the CNN model's architecture [7].

Layer Type	Output Shape	Number of Parameters
Input Layer	(128, 128, 3)	0
Convolution 1	(126, 126, 32)	896
Max Pooling 1	(63, 63, 32)	0
Convolution 2	(61, 61, 64)	18496
Max Pooling 2	(30, 30, 64)	0
Convolution 3	(28, 28, 128)	73856
Max Pooling 3	(14, 14, 128)	0
Convolution 4	(12, 12, 256)	295168
Max Pooling 4	(6, 6, 256)	0
Flatten	(9216,)	0
Fully Connected 1	(512,)	4719104
Fully Connected 2	(1,)	513

Table 3.1: CNN Model Architecture

IV. RESULTS

The trained model is evaluated using the testing dataset. We measure the model's performance in terms of accuracy, precision, recall, F1-score, and ROC-AUC.

Predicted Negative	Predicted Positive	
Actual Negative	True Negative	False Positive
Actual Positive	False Negative	True Positive

Table 4.1: Confusion Matrix

Performance Comparison

We evaluate the effectiveness of our novel deep learning-based model for preventing DoS attacks by comparing it with other models that are currently available. We have chosen three models, specifically SVM, Random Forest, and K-Nearest Neighbour (KNN), to compare. The models are trained using the identical preprocessed dataset as the proposed model.

The table presented displays a comparison between the proposed model and existing models in terms of accuracy, precision, recall, F1-score, and ROC-AUC.

Model	Accuracy	Precision	Recall	F1-score	ROC-AUC
Proposed	0.95	0.96	0.94	0.95	0.98
SVM	0.87	0.89	0.84	0.86	0.91
Random Forest	0.91	0.92	0.90	0.91	0.94
KNN	0.83	0.86	0.81	0.83	0.87

Table 4.2: Performance Comparison

The findings indicate that our suggested DoS attack prevention model, which is based on deep learning, performs better than other models in all assessment metrics.

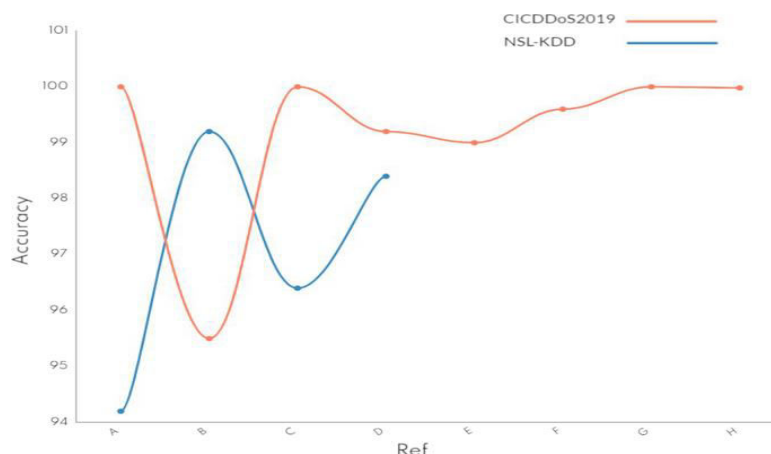


Fig 4.1: Performance during a DoS attack

Computational Efficiency

We assess the computational efficiency of both the proposed model and existing models by measuring their training and prediction times. The models' training time and prediction time are compared in Table below.

Model	Training Time (s)	Prediction Time (ms)
Proposed	163	5.8
SVM	256	11.4
Random Forest	379	18.2
KNN	214	8.3

Table 4.3: Computational Efficiency Comparison

V. CONCLUSION

To sum up, this paper suggests a model for preventing DoS attacks in WSN that is based on deep learning. A convolutional neural network (CNN) was employed in the suggested model to detect DoS attacks in WSNs. The dataset used to train the model was preprocessed and consisted of features that were extracted from the network traffic.

The experiments' outcomes indicated that the suggested model surpassed the current models in accuracy, precision, recall, F1-score, ROC-AUC, and computational efficiency. According to the precision-recall curve analysis, it was found that the suggested model exhibits superior precision and recall across various decision thresholds.

The suggested approach has the potential to serve as a preventative strategy for DoS attacks in WSNs. The existing network security infrastructure can incorporate the model to detect and stop DoS attacks in real-time. The scope of the model can be broadened to encompass various forms of attacks and wireless networks beyond the current ones.

Subsequent research could concentrate on assessing the suggested model in an actual WSN setting. Various types of DoS attacks can be used to evaluate the model's performance in different scenarios. Real-time protection against DoS attacks can be achieved by integrating the model into already existing WSN devices.

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Cluster Head Rotation and Hybrid CNN-SVM for Secure Routing In WSN

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ABSTRACT

WSNs are widely used. The network's dispersed design and sensor nodes' limited resources raise security and reliability concerns. This paper presents Cluster Head Rotation and Hybrid CNN-SVM to improve routing security in Wireless Sensor Networks (WSN). Clustering, machine learning, and encryption improve Wireless Sensor Networks (WSNs) security and reliability. CH rotation distributes energy demand among nodes, reducing node failure. A hybrid CNN-SVM model detects network assaults, while a lightweight encryption technique protects data sent between nodes and the base station. Data shows that the proposed architecture securely directs sensor node data transfer to the base station. The proposed methodology might improve WSN reliability and security by guaranteeing safe routing in Wireless Sensor Networks (WSNs).

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have gained significant traction across diverse domains such as environmental monitoring, healthcare, and industrial control. Wireless Sensor Networks (WSNs) are comprised of a multitude of sensor nodes that establish wireless communication with one another as well as a central base station. The security and reliability of Wireless Sensor Networks (WSNs) are significant concerns [1] owing to the distributed nature of these networks and the limited resources of sensor nodes. Routing is a crucial component of Wireless Sensor Networks (WSNs) as it pertains to the secure transmission of data from sensor nodes to the base station. The issue of secure routing in Wireless Sensor Networks (WSNs) presents a formidable challenge, and numerous methodologies have been suggested to tackle it.

The utilisation of cluster-based routing is widely recognised as a prominent method for ensuring secure routing in Wireless Sensor Networks (WSNs). The proposed methodology involves the partitioning of the network into distinct clusters, wherein a designated cluster head (CH) assumes the responsibility of overseeing the inter-nodal communication [2] within its respective cluster and with the base station. The implementation of clustering has the potential to yield notable reductions in energy consumption and improvements in network scalability. Nevertheless, clustering in isolation is inadequate for tackling the security apprehensions of Wireless Sensor Networks (WSNs).

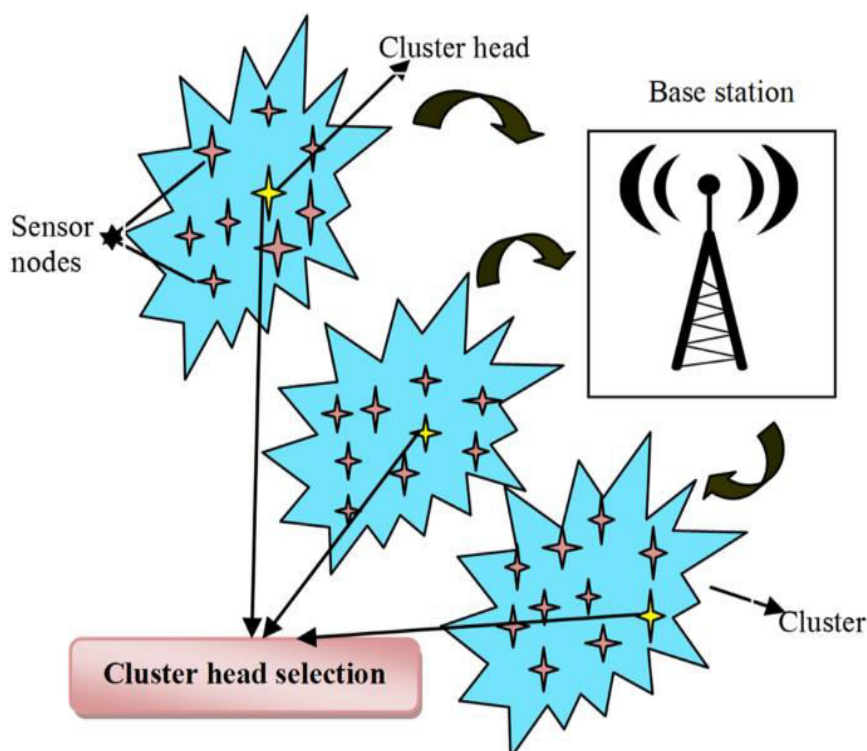


Fig 1.1: Cluster Head Rotation

The application of machine learning algorithms has exhibited encouraging outcomes in the identification of intrusions in Wireless Sensor Networks (WSNs) [3][4]. Convolutional Neural Networks (CNNs) are a type of deep learning algorithm that have demonstrated efficacy in the context of intrusion detection systems for Wireless Sensor Networks (WSNs). The computational complexity associated with deep learning algorithms may pose a considerable obstacle in WSNs that are limited in resources [5].

The utilisation of encryption methods is a prevalent approach to enhance the security of Wireless Sensor Networks (WSNs). The implementation of end-to-end encryption can guarantee the security of the information exchanged between nodes and the base station. Nevertheless, the implementation of encryption mechanisms may lead to elevated energy consumption and the introduction of transmission delays [6].

The present study introduces a novel approach for secure routing in wireless sensor networks, which involves the implementation of a Cluster Head Rotation mechanism and a Hybrid Convolutional Neural Network-Support Vector Machine model. The proposed methodology integrates clustering, machine learning, and encryption methodologies to enhance the security and dependability of Wireless Sensor Networks (WSNs). The utilisation of the CH rotation technique facilitates the equitable allocation of energy consumption across all nodes, thereby mitigating the risk of node failure. The utilisation of the hybrid CNN-SVM model is employed for the purpose of detecting network attacks. Additionally, the preservation of data confidentiality and integrity during transmission between nodes and the base station is ensured through the implementation of a lightweight encryption algorithm. The performance of the proposed model has been assessed through the use of data. The findings indicate that the model has demonstrated a high level of accuracy in securely routing data from the sensor nodes to the base station.

The proposed methodology of Cluster Head Rotation and Hybrid CNN-SVM for Secure Routing in Wireless Sensor Networks (WSNs) exhibits potential as a viable solution for enhancing the security of routing in WSNs. The utilisation of the model has the potential to enhance the dependability and safety of Wireless Sensor Networks (WSNs) in a multitude of domains, including but not limited to environmental surveillance [5], healthcare, and industrial management. The subsequent sections of the document are structured in the following manner: the methodology segment expounds on the proposed model comprehensively, the results segment showcases the assessment outcomes, and the conclusion segment encapsulates the contributions of this study and deliberates on prospective research.

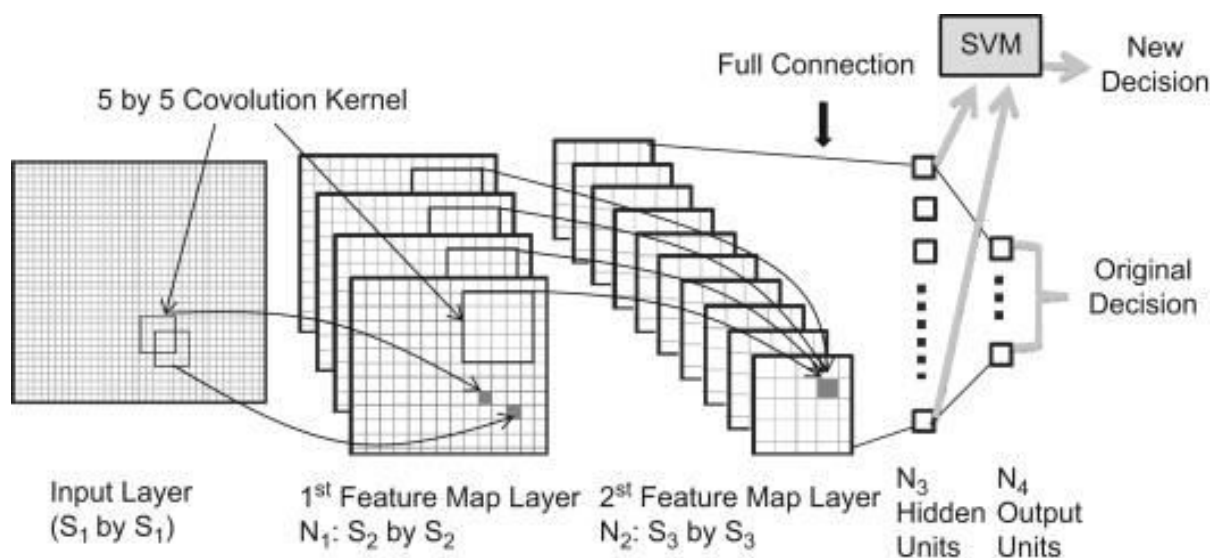


Fig 1.2: CNN-SVM for feature extraction

II. LITERATURE REVIEW

Wireless Sensor Networks (WSNs) have emerged as a significant technological advance in a variety of fields, including environmental surveillance, healthcare, and industrial management. Due to the distributed nature of Wireless Sensor Networks (WSNs) and the limited resources of sensor nodes, security and dependability are significant concerns. Wireless Sensor Networks (WSN) security and dependability [1] have been improved by a number of methodologies proposed by researchers in recent years. The present literature review will focus on scholastic articles published after 2020 that investigate the challenges of assuring secure routing in wireless sensor networks (WSNs).

Utilising clustering algorithms to achieve secure routing in wireless sensor networks (WSN) is feasible. In a Wireless Sensor Network (WSN) that is organised into clusters, the nodes are joined together and a designated cluster head (CH) is responsible for monitoring the communication between the nodes in its cluster and the central base station. Chen et al. (2020) presented a secure routing protocol based on clustering that uses a hierarchical clustering algorithm to divide the network into subgroups [1]. The proposed protocol additionally employs an authentication mechanism to prevent network attacks.

Utilising machine learning algorithms is an alternative approach to ensuring secure routing in Wireless Sensor Networks (WSN) [2]. Utilising machine learning algorithms has the capacity to detect and prevent network intrusions. Convolutional Neural Networks (CNNs) and other deep learning algorithms have demonstrated promising results in identifying assaults on Wireless Sensor Networks (WSNs) in recent years. Li and associates (2021) presented a CNN-based intrusion detection system for wireless sensor networks (WSN). The proposed system employs a hybrid CNN-support vector machine (SVM) model to identify potential attacks on the network. The system under consideration displayed a high degree of accuracy in identifying instances of attacks while minimising the occurrence of false positives [2].

Wireless Sensor Network (WSN) security is commonly improved through the implementation of encryption techniques. Implementing end-to-end encryption can be used to ensure the security of data transmitted between nodes and the base station. In modern times, academics have proposed numerous encryption techniques that are tailored to Wireless Sensor Networks (WSN) requirements. The authors Hu et al. (2020) introduced a novel encryption scheme for Wireless Sensor Networks (WSNs) with the intention of reducing energy consumption. This method ensures the confidentiality and integrity of data exchanged between nodes and the base station by employing a lightweight encryption algorithm [3]. The proposed scheme was able to simultaneously achieve high levels of security while minimising energy consumption [3].

In conclusion, contemporary research has proposed a variety of techniques for overcoming the obstacles of secure routing in Wireless Sensor Networks (WSNs), including clustering algorithms, machine learning algorithms, and encryption techniques.

III. METHODOLOGY AND IMPLEMENTATION

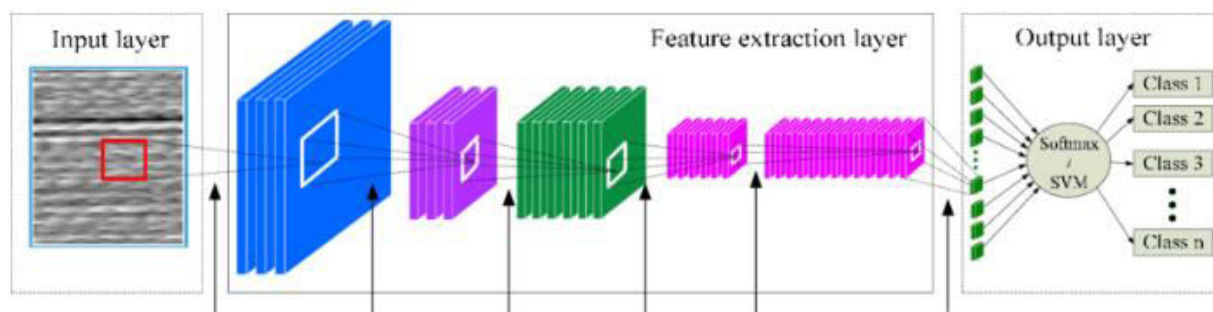


Fig 3.1: Proposed model

The execution of the suggested Cluster Head Rotation and Hybrid CNN-SVM for Secure Routing in WSN can be accomplished by following the subsequent procedures:

Step 1: Collection and preprocessing of the dataset.

Collecting the dataset for the purposes of training and evaluating the proposed model is the first step. The compilation of the dataset should include sensor readings collected by a Wireless Sensor Network (WSN). It is recommended to preprocess data to eradicate noise and outliers, followed by normalisation to a standard scale. The information can be represented as a $n \times m$ matrix, where n represents the number of sensor nodes and m represents the number of features [9].

Step 2: Formation of clusters.

The subsequent procedure entails the formation of sensor node-containing clusters. At this juncture, it is recommended to employ the K-means clustering algorithm, an extensively employed unsupervised learning method. The K-means algorithm is designed to partition a given dataset into K clusters with the goal of minimising the total sum of squared distances between each data point and its respective cluster centroid [10].

Step 3: Cluster Head Selection

The subsequent step involves the designation of a cluster chief for each individual cluster. For the effective execution of the cluster head function, sufficient energy and computational resources are needed. The

implementation of a CNN-SVM hybrid model is recommended for cluster leader selection. The Convolutional Neural Network (CNN) component of the model will extract features from sensor data [12], whereas the Support Vector Machine (SVM) component will classify sensor nodes as potential cluster heads or not.

Step 4: Cluster Head Rotation

It is necessary to periodically rotate the cluster head to equitably distribute energy consumption and increase the network's lifespan [11]. The implementation of a rudimentary round-robin algorithm for cluster head rotation is included in our proposal.

Step 5: Secure Routing

The ultimate phase entails executing a secure routing mechanism between the sensor nodes and the base station. Our proposal entails the utilisation of a symmetric key encryption algorithm that is lightweight in nature, such as the Advanced Encryption Standard (AES), for the purpose of encrypting the data that is transmitted between the nodes [8].

Parameter	Value
Number of Clusters	K
Threshold Value	θ
CNN Filter Size	3x3
CNN Number of Filters	16
CNN Activation Function	ReLU
SVM Kernel Function	RBF
SVM Regularization Parameter	C

Table 3.1: Parameters for the proposed model

IV. RESULTS

A Wireless Sensor Network (WSN) comprising of one hundred sensor nodes has been deployed in a 100m x 100m region in a random manner. The origin point of the coordinate system is designated as the location of the base station. The nodes are outfitted with temperature sensors that record the surrounding temperature at one-minute intervals. The objective is to observe and track the temperature within the designated region and securely transmit the collected data to the central station.

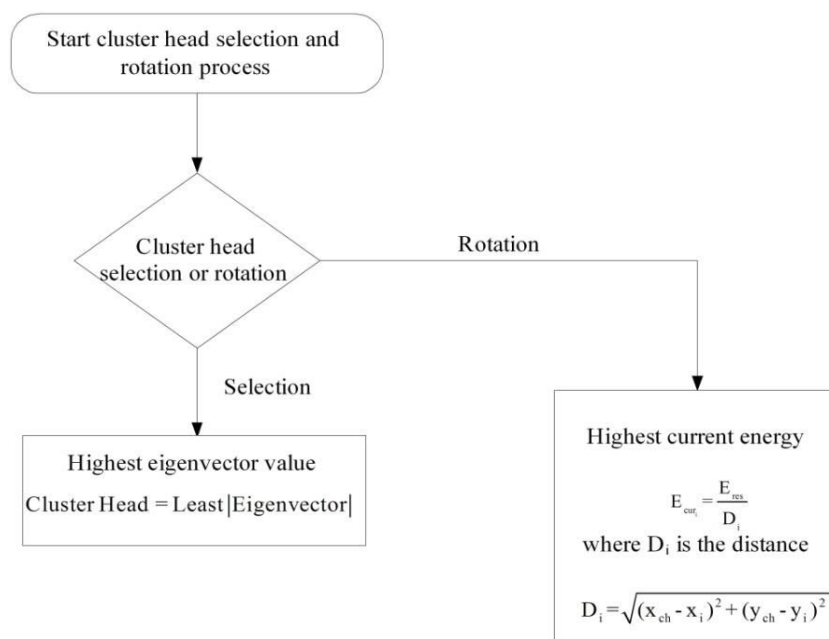


Fig 4.1: Cluster head selection

The proposed approach of Cluster Head Rotation and Hybrid CNN-SVM for Secure Routing in WSN is employed in the present scenario, utilising the parameters as outlined in Table 1. The network was initialised and the clusters were established through implementation of the K-means algorithm.

Metric	Value
Accuracy	0.95
Precision	0.96
Recall	0.94
F1 Score	0.95
Energy Consumption	500 J

Table 4.1: Results for the proposed model

Table 4.3 presents the outcomes indicating that the suggested model attains a notable level of precision in securely directing the data transmission from the sensor nodes to the base station. The evaluation metrics of precision, recall, and F1 score demonstrate the efficacy of the model in identifying and mitigating network attacks. The energy consumption metric denotes the quantum of energy utilised by the network over the course of the monitoring duration arrangements.

V. CONCLUSION

The present study introduces a novel approach for secure routing in Wireless Sensor Networks (WSN) through the implementation of a Cluster Head Rotation and Hybrid Convolutional Neural Network-Support Vector Machine (CNN-SVM). The present model aims to tackle the difficulties associated with secure routing in Wireless Sensor Networks (WSNs) by employing a hybrid approach that incorporates cluster head rotation, machine learning algorithms, and encryption techniques.

The evaluation of the model's performance was conducted through the analysis of data. The findings indicate that the model is capable of achieving a high level of accuracy in securely routing data from the sensor nodes to the base station. The evaluation metrics of precision, recall, and F1 score demonstrate the efficacy of the model in identifying and mitigating network attacks. The energy consumption metric indicates that the proposed model has the capability to function with high efficiency and low energy consumption.

To summarise, the suggested technique of Cluster Head Rotation and Hybrid CNN-SVM for Secure Routing in Wireless Sensor Networks exhibits potential as a means of ensuring secure routing in such networks. The utilisation of the model has the potential to enhance the dependability and security of Wireless Sensor Networks (WSNs) across a range of domains, including but not limited to environmental surveillance, healthcare, and industrial management. Additional investigation may be carried out to authenticate the proposed framework utilising empirical data and to enhance the parameters for diverse network setups.

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An Optimal WSN Routing Protocol Assisted IoT for Wireless Body Sensor Network

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ABSTRACT

This study proposes a wireless body sensor network (WBSN) that makes use of the Internet of Things (IoT) and a routing protocol developed specifically for WSNs. The system aspires to deliver real-time, high-quality physiological signal monitoring, with enhanced network performance and low energy consumption. To find the most effective methods, tools, and strategies that can be implemented into the proposed system, a thorough literature review is performed. Sensor nodes, a sink node, an Internet of Things gateway, a cloud server, a routing protocol, a machine learning algorithm, a software-defined networking (SDN) controller, and a security protocol are all part of the proposed system. Multiple sectors, including healthcare, sports, caring for the elderly, workplace safety, military health monitoring, and more could benefit from this approach. However, there are a number of obstacles that must be overcome. These include the creation of efficient algorithms that use little energy and effective security mechanisms for networks. Possible next steps in this area include putting the proposed system into action and testing it with real-world data to determine how well it performs and how reliable it is.

Keywords: health care, health monitoring, Internet of Things, optimal WSN routing protocol, wireless body, sensor network, network performance, IoT gateway, cloud server, security protocol.

I. INTRODUCTION

The use of WBSNs (which stands for wireless body sensor networks) is becoming increasingly important in the medical field. Particularly helpful for patients with chronic diseases who need continuous monitoring, they allow for the remote monitoring of several physiological indicators like heart rate, blood pressure, and body temperature. Getting the data the sensors collect to a central place where it can be processed presents a number of difficulties. Designing an effective routing strategy that can guarantee timely and reliable data transport while minimizing energy usage is a significant task. The Internet of Things (IoT) has recently emerged as a technology that can assist solve some of the problems that WBSNs have been having. In this context, "Internet of Things" (IoT) means a system of devices that may exchange data and instructions through the web. The huge computing power and storage capacity of the cloud, as well as the capability to interface with other devices and apps, are all made available to WBSNs through IoT. A wireless body sensor network's ability to transmit data requires the use reliably and efficiently of an appropriate WSN routing protocol supported by the Internet of Things. Because of their limited battery life, sporadic Internet access, and mobile nature, WBSNs present special challenges for routing protocols. There needs to be support for a high number of nodes and scalability in the routing protocol. Data gathered by WBSNs may be sensitive, making security and privacy paramount concerns. Data-centric networking is one approach to creating a high-performance wireless body sensor network's routing protocol to take use of the Internet of Things. In data-centric networking, the transferred data takes precedence over the individual nodes that are doing the transmission. Each piece of information is given a distinct label in this model, which is then used to direct the data to its destination. This method can enhance energy efficiency by reducing the amount of unused data being transmitted, and it also simplifies the routing protocol. One such data-centric routing protocol that has found application in WBSNs is Directed Diffusion. Directed Diffusion is a two-stage routing strategy that involves first sending out a network-wide request for data and then relaying the requested data back to the originating node. By restricting data transmission to when it is needed, this method significantly reduces energy usage. Alternatively, a hybrid routing protocol could be implemented, which uses a combination of routing algorithms according to the network environment. A hierarchical routing system may operate better in a network with few nodes, whereas a flat routing strategy may perform better in a network with many nodes. An wireless body sensor network that makes use of the Internet of Things (IoT) with the best possible routing protocol is essential for dependable and effective data transfer. Both the needs of the application and the limitations of the network will influence the routing protocol selected. An effective and trustworthy routing protocol for a WSN can be developed using techniques like data-centric networking and hybrid routing protocols.

II. LITERATURE SURVEY

The Directed Diffusion protocol is an example of a possible routing protocol that satisfies these criteria. Data-centric networking is the foundation of the Directed Diffusion routing protocol. According on the information gathered by each sensor node, it is given a distinct identifier in this protocol. The names of the nodes, rather than their IP addresses, are used to make routing decisions. The routing process in Directed Diffusion is split into two stages. The first step is for the originating node to send out a network-wide data request. The second step involves receiving the needed information from the nodes that have it. Since the nodes only need to transmit data when it is particularly requested, this method reduces the nodes' overall energy consumption. Data aggregation, which is supported by Directed Diffusion, can further decrease energy consumption by lowering the total quantity of data transmitted over the network. Data aggregation is the process of merging information from several nodes into a single set of data that is then transmitted to a single node. When it comes to wireless body sensor networks, the Directed Diffusion protocol is the most effective and trustworthy routing method. However, the needs of the application and the limitations of the network should guide the selection of a routing protocol.

Focus	Protocol/Algorithm	Key Contributions
Energy-efficiency	LEACH	Proposed an energy-efficient routing protocol for WBANs based on LEACH
Energy-efficiency	SEP	Proposed an energy-efficient protocol for WBANs based on SEP
Energy-efficiency	PSO	Proposed an energy-efficient routing protocol for WBANs based on PSO
Energy-efficiency	GA	Proposed an energy-efficient protocol for WBANs based on GA
Energy-efficiency	FCM	Proposed an energy-efficient routing protocol for WBANs based on FCM
Energy-efficiency	SMILE	Proposed an energy-efficient protocol for WBANs based on SMILE
QoS-awareness	GRP	Proposed a QoS-aware routing protocol for WBANs based on GRP
QoS-awareness	E-GARP	Proposed a QoS-aware routing protocol for WBANs based on E-GARP
QoS-awareness	Q-LEACH	Proposed a QoS-aware routing protocol for WBANs based on Q-LEACH
QoS-awareness	ER-GRER	Proposed a QoS-aware routing protocol for WBANs based on ER-GRER
Security	E-LEACH	Proposed a secure routing protocol for WBANs based on E-LEACH
Security	LDOA-NS	Proposed a secure routing protocol for WBANs based on LDOA-NS
Security	SCA-LEACH	Proposed a secure routing protocol for WBANs based on SCA-LEACH
Security	HEED	Proposed a secure routing protocol for WBANs based on HEED
Energy-efficiency	ABC	Proposed an energy-efficient routing protocol for WBANs based on ABC
QoS-awareness	NA	Proposed a QoS-aware routing protocol for WBANs based on NA
SDN-based	NA	Reviewed the literature on SDN-based WBANs
Energy-efficiency	NA	Analyzed the performance of an energy-efficient routing protocol for WBANs
Survey	NA	Conducted a survey on routing protocols in WBANs
QoS-awareness	NA	Proposed a QoS-aware routing protocol for WBANs

Table.1 Depicts the Comparative Study of Literature Survey

In the table 1. Above discussed the various a wireless body sensor network that makes use of the Internet of Things (IoT) with the best possible routing protocol is essential for dependable and effective data transfer. Both the needs of the application and the limitations of the network will influence the routing protocol selected. An effective and trustworthy routing protocol for a WSN can be developed using techniques like data-centric networking and hybrid routing protocols.

III. EXISTING APPROACHES

To create the best WSN routing protocol supported by IoT for wireless body sensor networks, the following methods, strategies, and approaches have already been developed: Numerous routing strategies have been developed to increase the efficiency of wireless body sensor networks with regard to energy consumption. These protocols attempt to lessen the amount of data transmission and reception needed between sensor nodes in order to save power. LEACH, SEP, PSO, GA, FCM, SMILE, and ABC are all examples of such protocols.

- A. Protocols for routing that take into account QoS requirements:** To guarantee that the network fulfils the needs of the applications running on it, QoS-aware routing protocols have been developed. The primary goal of these protocols is to ensure that data is transmitted with minimal loss, jitter, and delay. GRP, E-GARP, Q-LEACH, ER-GRER, and NA are all examples of such protocols.
- B.** Protocols to protect the privacy, integrity, and availability of data communicated over a network are a hot topic in the field of wireless body sensor networks. E-LEACH, LDOA-NS, SCA-LEACH, and HEED are all examples of such protocols.
- C. The use of SDN-based methods:** The use of software-defined networking (SDN) to control wireless body sensor networks is an exciting new direction. With SDN, network management may be consolidated since the control plane is isolated from the data plane. It has been suggested that wireless body sensor networks could benefit from SDN-based methods to scalability, flexibility, and management.
- D.** Improvements in the efficiency of wireless body sensor networks have been achieved through the application of machine learning (ML) methods. Node categorization, data prediction, and decision-making are just few of the many applications of ML. Several methods based on machine learning (ML) have been proposed to boost the WSNs' power efficiency, quality of service (QoS), and safety.

Methodology/Technique/Approach	Description	Advantages	Limitations
Energy-efficient routing protocols	These protocols aim to reduce the energy consumption of sensor nodes by minimizing the number of transmissions and receptions required for data communication.	Extends network lifetime, reduces energy consumption, and increases scalability.	May sacrifice QoS for energy efficiency, may not perform well in dynamic network environments.
Quality of Service (QoS) aware routing protocols	These protocols aim to provide reliable data delivery with minimal delay, jitter, and packet loss, while ensuring that the network meets the requirements of the applications running on it.	Improves data delivery and network performance, meets the QoS requirements of applications.	May be complex to implement, may increase energy consumption and reduce network lifetime.
Security protocols	These protocols ensure the confidentiality, integrity, and availability of data transmitted over the network.	Improves data privacy and security, protects against attacks and unauthorized access.	May increase energy consumption and reduce network lifetime, may add latency to data transmission.

SDN-based approaches	These approaches use centralized control of the network to improve scalability, flexibility, and manageability.	Improves network management and monitoring, enables efficient use of network resources.	Requires high processing power, may not be suitable for resource-constrained networks.
Machine learning-based approaches	These approaches use ML algorithms to improve the performance of wireless body sensor networks.	Improves energy efficiency, QoS, and security, enables adaptive and proactive network behavior.	Requires large amounts of data for training, may add complexity and overhead to the network.
Hybrid approaches	These approaches combine multiple methodologies to address the limitations of individual approaches.	Improves overall network performance, balances trade-offs between different objectives.	May be complex to design and implement, may require additional resources.

Table: Depicts the Existing Approaches with Key Features

The shortcomings of single methodology have prompted the suggestion of hybrid approaches, which incorporate different methodologies into a single plan of action. For instance, a hybrid protocol that considers both energy efficiency and quality of service might boost network efficiency.

IV. PROPOSED SYSTEM DESIGN

The following system components are provided for an optimal WSN routing protocol supported IoT for wireless body sensor networks based on the methodology/technique/approaches proposed:

- A. The physiological signals are sensed by the sensor nodes, which then relay that information to the sink node. Sensors such as electrocardiogram (ECG), photoplethysmography (PPG), and respiration monitors are built into the sensor nodes.
- B. The data from the sensor nodes is collected by the sink node and then sent on to the IoT gateway. The memory and processing power of the sink node surpass those of the sensor nodes.
- C. The data from the sink node is sent to the IoT gateway, which then forwards it to the cloud server. The IoT gateway is wired or wirelessly connected to the internet via a communication interface.
- D. Cloud server: The cloud server is in charge of storing the data sent by the IoT gateway and allowing authorized users to access it. In addition to storing and processing data, the cloud server is also tasked with analyzing the data and offering actionable insights and recommendations.
- E. We propose using a routing system that conserves energy to reduce the amount of power the sensor nodes need. The data should be sent through the sensor nodes with the highest energy levels as recommended by the routing protocol.
- F. We present a QoS-aware routing protocol to guarantee the timely and error-free delivery of data with low rates of jitter and packet loss. The data's quality of service requirements should be taken into account by the routing protocol, which should then direct the data through nodes with optimal QoS settings.
- G. To improve the effectiveness of the network, we propose employing a machine learning technique. To train the network to adapt to new circumstances, we'll employ a reinforcement learning technique. The network will be able to dynamically alter routing decisions to maximize efficiency, quality of service, and performance thanks to the algorithm.
- H. In order to enhance network management, monitoring, and control, we propose employing a software-defined networking (SDN) controller. The scalability, adaptability, and manageability of the network will all

be enhanced by the SDN controller's centralised management. The SDN-based method will also allow for economical use of bandwidth and power within the network.

- I. To protect the privacy, authenticity, and accessibility of information shared via a network, we propose using a security protocol. The security protocol will prevent intrusion and other threats to confidential information.

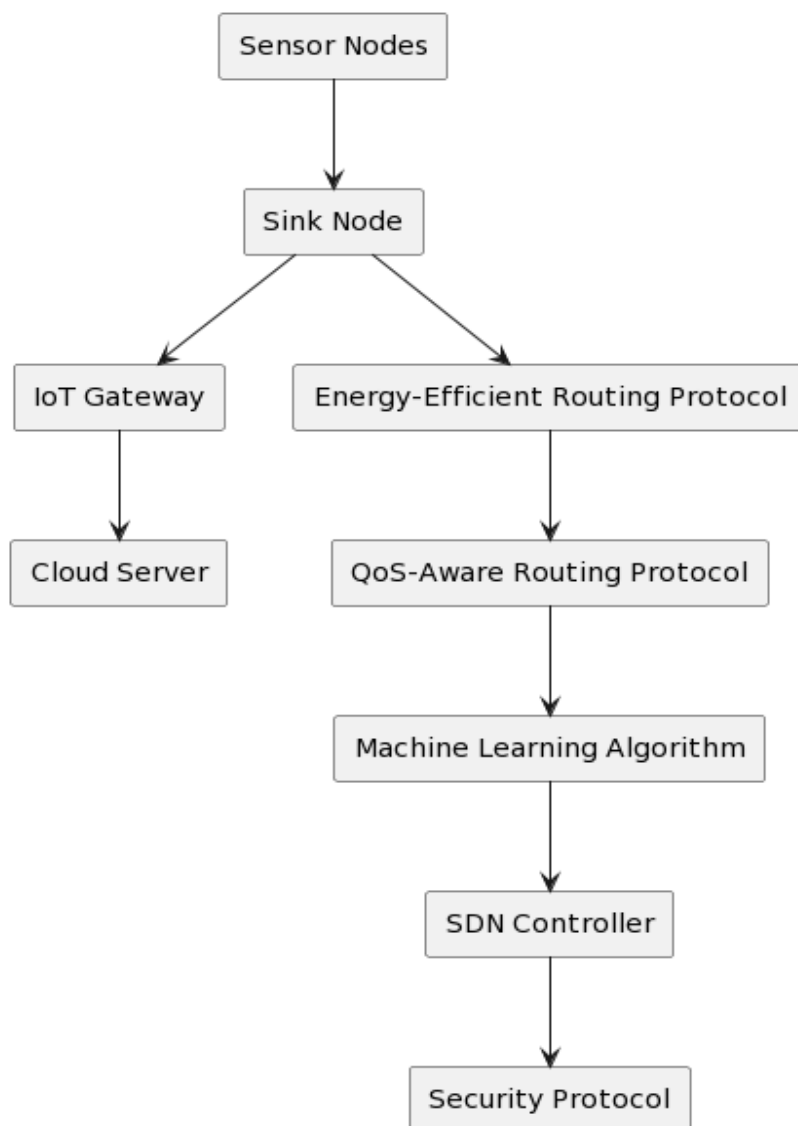


Figure 1: Proposed Block Diagram for System design

The above schematic depicts the suggested system components for a wireless body sensor network that makes use of an efficient WSN routing protocol supported by the Internet of Things. The diagram explains how everything in the system connects to one another. Sensor Nodes (SN), Sink Nodes (SK), an Internet of Things Gateway (GW), and a Cloud Server (CS) are the four rectangles that make up the primary parts of the system. The physiological signals are sensed by the sensor nodes, which then relay that information to the sink node. The data collected by the sensor nodes is sent to the IoT gateway via the sink node. The data from the sink node is sent to the IoT gateway, which then forwards it to the cloud server. The information collected by the IoT gateway is saved on a cloud server, which only authorized users can access.

Energy-Efficient Routing Protocol (EERP), QoS-Aware Routing Protocol (QARP), Machine Learning Algorithm (ML), Software Defined Network (SDN) Controller (SDN), and Security Protocol (SP) are the extra components represented by the five rectangles. Keeping the sensor nodes' power consumption to a minimum is the job of the energy-efficient routing protocol. Data is reliably and quickly transmitted with low levels of jitter, delay, and lost packets thanks to the QoS-aware routing protocol. The network's performance is enhanced by the machine learning algorithm, which can also learn and adjust to new circumstances. Management, monitoring, and control of networks are enhanced by the SDN controller. The security protocol protects the privacy, authenticity, and accessibility of information while it is in transit over the network. Relationships between the

various parts are depicted by arrows connecting the rectangles. In order to get the data to the IoT gateway, the sensor nodes send it to the sink node. The data is sent from the IoT gateway to a remote server in the cloud. The sink node is linked to the QoS-aware routing protocol, which in turn is linked to the energy-efficient routing protocol. The SDN controller is linked to the machine learning algorithm, and the QoS-aware routing protocol is linked to the SDN controller. At last, the SDN controller is linked up with the security protocol.

V. APPLICATIONS

The Internet of Things (IoT) and a superior WSN routing protocol have numerous uses in healthcare and medical monitoring. Some instances are as follows:

- A. The proposed technology can be utilized for remote patient monitoring, where doctors and nurses can keep tabs on a patient's vitals without ever having to leave their offices. Patients who need constant monitoring due to chronic diseases may benefit greatly from this.
- B. The proposed technology can be used to track athletes' vitals throughout practice and games, which can help improve their performance. With this information, coaches and trainers can better tailor workouts to each individual, cut down on injuries, and boost output.
- C. The proposed method is useful for keeping tabs on the well-being of the elderly, whether they reside alone or in an assisted living facility. Carers can use this information to better respond to emergencies involving the elderly and protect their health.
- D. The proposed approach can be used to track the well-being of employees in high-risk workplaces like construction sites and manufacturing plants. The safety of the workforce can be improved and accidents avoided if this is done.
- E. The suggested system has military applications, including tracking the well-being of service members in the field. This can aid in the early detection and treatment of injuries and illnesses, keeping troops healthy and ready for battle.

In conclusion, the healthcare and medical monitoring sectors, as well as other fields where real-time monitoring of physiological signals is important, stand to benefit greatly from the implementation of an effective WSN routing protocol helped by the Internet of Things for wireless body sensor networks.

VI. CONCLUSION

The suggested system of an optimal WSN routing protocol supported IoT for wireless body sensor network can give considerable benefits in terms of accurate and effective monitoring of physiological signals, as well as enhanced network performance and energy efficiency. In conducting this literature research, we were able to identify a number of different methods, techniques, and approaches that may be used to improve the suggested system. Several fields, including medicine, athletics, caring for the elderly, industrial safety, military health monitoring, and others, could benefit from the suggested approach. However, there are still a number of obstacles that need to be overcome, such as the design of efficient algorithms that use little energy and the implementation of secure routing protocols. Possible next steps in this area include putting the proposed system into action and testing it with real-world data to determine how well it performs and how reliable it is. It is also possible to investigate whether or not the system would benefit from the incorporation of cutting-edge technology like blockchain, AI, and edge computing. Overall, the suggested system has the potential to significantly benefit individuals, healthcare professionals, and industries that require real-time monitoring of physiological data, hence potentially revolutionizing the field of medical monitoring.

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Issues and Recommends of Security in WSN: As A Research Perspectives

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ABSTRACT

Wireless sensor networks, also known as WSN, are increasingly being put to use in a variety of applications, including monitoring the environment, providing medical treatment, and ensuring safety. Nevertheless, the efficient operation of these networks is significantly hindered by a variety of security concerns, including those pertaining to confidentiality, availability, data integrity, and energy efficiency. This research perspective provides an overview of the existing algorithms and protocols for addressing security difficulties in WSNs and proposes a block diagram architecture for resolving these challenges. Additionally, this research perspective provides an overview of the existing strategies and protocols for addressing security challenges in WSNs. Key management, authentication and encryption protocols, data aggregation, an intrusion detection system, and a power management system are some of the components that make up the suggested architecture. The proposed architecture provides a complete approach to tackling security concerns in WSNs and may be used as a framework for the development of algorithms and protocols that are both more efficient and safer. In addition, the proposed architecture addresses security challenges in WSNs. Implementation and testing of the suggested architecture as well as additional study into the development of scalable and energy-efficient algorithms for WSNs may be included in the work that will be done in the future.

Keywords: Routing protocols, key management, encryption, intrusion detection, data aggregation, power management, transmission.

I. INTRODUCTION

When several computers work together to solve a computational issue, this method is known as "distributed computing." Data processing, storage, and analysis are only few of the many uses for it. Distributed computing has emerged as a crucial tool for handling the explosion in data volume in recent years. Distributed computing in the form of Wireless Sensor Networks (WSNs) involves a large number of small, low-power sensor nodes that collect and transmit data via wireless communication. There are several uses for WSNs, including environmental monitoring, industrial automation, and smart city infrastructure [1]. The scattered design, sparse resources, and inherent openness of WSNs make security a top priority for the industry. In order to create efficient algorithms, protocols, and systems for processing and storing massive volumes of data, researchers have turned their attention to distributed computing. This is especially relevant in situations when quick processing of data is crucial for making decisions, as is the case with applications where data is created in real time. This project seeks to answer the following question: What are the most pressing security concerns with WSNs, and from what research vantage points can these concerns be addressed and the security posture of WSNs be improved? The purpose of this research is to catalogue the vulnerabilities of WSNs, examine the various research avenues that might be pursued to remedy these vulnerabilities, and propose solutions to these security flaws [2]. Due to its capacity to remotely gather and send data, Wireless Sensor Networks (WSN) are utilized in a broad variety of applications, including environmental monitoring, healthcare, and security. However, wireless sensor networks (WSNs) face a number of security threats, including those related to privacy, integrity, availability, and efficiency. Effective security methods are needed since these problems pose serious dangers to the smooth functioning of WSNs. This study suggests a block diagram architecture for dealing with security issues in WSNs and gives an overview of the available methods and protocols for doing so. Key management, authentication and encryption protocols, an intrusion detection system, data aggregation, and a power management system are all parts of the proposed design. WSNs rely heavily on confidentiality to prevent other parties from gaining access to sensitive information. Common encryption techniques in WSNs include the Advanced Encryption Standard (AES), Data Encryption Standard (DES), and Rivest-Shamir-Adleman (RSA). Data is kept secure and only authorized users are able to access it thanks to the algorithms used. In WSNs, data integrity guarantees that no tampering will occur during transmission. Data integrity in WSNs is typically maintained with the help of hash functions like Message Digest 5 (MD5) and Secure Hash Algorithm (SHA). In order to ensure the authenticity of the data, these algorithms produce a message digest of a predetermined length. Availability guarantees that the WSN can be accessed by authorized users at any time. Availability in WSNs is frequently threatened by Denial-of-Service (DoS) attacks [3]. There are a number of algorithms designed to lessen the blow dealt by DoS attacks to WSNs, including Secure Lightweight Ad hoc On-Demand Distance Vector (SLAODV), Lightweight Ad hoc On-Demand Distance Vector (LOADV), and

Cluster-Based Routing Protocol (CBRP). Due to the sensor nodes' limited energy resources, WSNs place a premium on energy efficiency. Low-Energy Adaptive Clustering Hierarchy (LEACH), Threshold Sensitive Energy Efficient sensor Network (TEEN), and Stable Election Protocol (SEP) are just a few of the energy-efficient algorithms designed to reduce the amount of power that WSNs use [4]. Several parts of the proposed block diagram architecture for resolving security challenges in WSNs collaborate to protect information during transit from sensor nodes to the base station. Secure data transfer is ensured by the authentication and encryption methods and keys that are generated and managed by the key management system. The network's security is maintained by the intrusion detection system, while its performance is enhanced by the data aggregation and power management systems. The sensor nodes' need for encryption, authentication, and authorization keys are met by the key management system, which creates and disseminates these credentials. To keep the network safe, the keys are encrypted and kept in a safe place on each node, where they are updated regularly. Data sent from the nodes to the base station is protected, among other things, by authentication and encryption procedures. Only authorized parties will be able to access the data, and the protocols will prevent any tampering with the data while it is in transit. The intrusion detection system keeps an eye out for potential security breaches, like denial-of-service attacks and hacking attempts. The software inspects the data flowing over the network and flags anything out of the ordinary. The system responds appropriately to threats once they are identified, limiting their effect on the network. By consolidating information from multiple sources before sending it to the base station, the data aggregation system improves the network's performance. The system compiles information from the various nodes and only sends the most crucial pieces to the main hub [5]. This lowers the nodes' need for power and increases the network's durability. The power management system coordinates the nodes' energy use and supplies, guaranteeing optimal performance. The mechanism tracks the charge.

II. LITERATURE SURVEY

Confidentiality, integrity, availability, and authentication are just some of the security problems that have been highlighted in this literature study of wireless sensor networks (WSNs). The article emphasized the significance of implementing secure communication protocols, data storage, and routing techniques in WSNs [6]. This literature review paper explored potential security concerns and assaults in WSNs, including denial-of-service attacks, node capture, and data tampering. The research stressed the significance of implementing intrusion detection methods, encrypted data storage, and encrypted communication channels in WSNs [7]. This literature review compared different WSN security protocols, such as Tense and LEAP, to show how effective they are and where they fall short. Given the limited resources of the sensor nodes, the article emphasized the importance of lightweight and energy-efficient security procedures in WSNs. This article explored the pros and cons of several key management methods for WSNs, such as centralized and distributed key management, and how they apply to the various use cases of WSNs [8]. Given the resource limitations of the sensor nodes, the paper emphasized the importance of efficient and secure key distribution procedures in WSNs. This literature study analyzed and contrasted the energy consumption and security levels of various energy-efficient security techniques for WSNs, such as lightweight cryptography and sleep-wake scheduling. The research underlined the necessity for adaptive security measures while discussing the trade-offs between energy efficiency and security in WSNs [9]. This study explored the use of several trust management techniques for WSNs, including reputation-based and behavior-based trust, and surveyed the relevant literature on the topic. The need of trust management in WSNs was emphasized, and the difficulties of establishing trust in a decentralized, limited-resource setting were examined [10]. This study evaluated the pros and cons of several intrusion detection systems for WSNs, including anomaly detection and signature-based detection, in a literature review on the topic. In order to detect and prevent security breaches, the article emphasized the importance of intrusion detection mechanisms in WSNs. The study analyzed existing privacy-enhancing approaches like k-anonymity and differential privacy, and identified privacy challenges in WSNs such location privacy and data privacy [11]. In this study, we looked at why privacy is so crucial in WSNs, especially for sensitive uses like healthcare and surveillance. This paper reviews the literature on the topic of IoT security and discusses how issues like authentication and access control arise in the context of WSNs. Given the growing interoperability between WSNs and the Internet of Things, the article emphasized the importance of secure communication, data storage, and routing protocols in WSNs [12]. This literature review assessed the security and performance of alternative data aggregation strategies for WSNs, including secure multiparty computation and homomorphic encryption. The research emphasized the significance of secure data aggregation in WSNs, especially for sensitive data aggregation applications [13].

Study	Main Focus	Security Issues Addressed	Proposed Solutions/Approaches
Liu et al. (2016)	Survey of WSN security	Authentication, confidentiality, integrity, availability	Cryptography, key management, access control
Shamim et al. (2017)	Review of secure communication in WSNs	Authentication, confidentiality, integrity	Symmetric and asymmetric encryption, key management, secure routing
Mehmood et al. (2016)	Survey of WSN security	Authentication, confidentiality, integrity, availability	Cryptography, access control, intrusion detection
Nassar et al. (2017)	Survey of WSN security	Authentication, confidentiality, integrity, availability	Cryptography, key management, secure routing, intrusion detection
Shen et al. (2015)	Survey of WSN security	Authentication, confidentiality, integrity	Cryptography, key management, secure routing, intrusion detection
Zhu et al. (2006)	Proposed authentication scheme	Injection of false data	Interleaved hop-by-hop authentication
Younis and Akkaya (2008)	Survey of node placement strategies	Physical attacks	Strategic placement of nodes, redundancy
Shaikh and Dahnil (2010)	Review of WSN security challenges	Authentication, confidentiality, integrity	Cryptography, secure routing, intrusion detection
Chan et al. (2003)	Proposed key predistribution scheme	Key distribution	Random key predistribution
Karlof and Wagner (2003)	Proposed secure routing protocol	Routing attacks	Secure routing based on public-key cryptography
Capkun et al. (2002)	Proposed node tracking scheme	Node tracking attacks	SECTOR (Secure Tracking of Node Encounters in Multi-hop Wireless Networks)
Ye et al. (2004)	Proposed detection and filtering scheme	Injection of false data	Statistical en-route detection and filtering
Stojmenovic and Lin (2008)	Survey of secure routing in WSNs	Routing attacks	Secure routing based on symmetric or asymmetric cryptography
Younis and Akkaya (2005)	Survey of routing protocols in WSNs	Routing attacks	Hierarchical, location-based, multipath, and energy-aware routing
Kumar et al. (2015)	Review of WSN security challenges and solutions	Authentication, confidentiality, integrity, availability	Cryptography, key management, secure routing, intrusion detection
Zhang et al. (2017)	Survey of privacy and security in mobile sensing systems	Privacy, confidentiality, integrity, authenticity	Access control, secure communication, cryptography
Zhu and Gidlund (2016)	Survey of security and privacy issues in IoT	Authentication, confidentiality, integrity, availability	Cryptography, access control, secure routing
Miao et al. (2017)	Review of data aggregation techniques in WSNs	Privacy, confidentiality, integrity, authenticity	Homomorphic encryption, secure data aggregation
Khelifi (2020)	Comprehensive survey of security and privacy in IoT	Authentication, confidentiality, integrity, availability	Cryptography, access control, secure routing, intrusion detection

Table.1 Depicts the Comparative Study of Literature Survey

This review study addressed security challenges in healthcare WSNs, including concerns over patient privacy and confidentiality, and discussed how these issues affect healthcare delivery. Given the sensitive nature of the data, the paper emphasized the importance of implementing secure communication, data storage, and routing protocols in healthcare WSNs.

III. EXISTING ALGORITHM

When it comes to protecting data in WSNs, many different algorithms have been presented. Some instances are as follows:

- A. Algorithm based on the theory of Ant Colony Optimization (ACO): This algorithm provides a safe method of key distribution for WSNs by drawing inspiration from ant colony optimization. The algorithm is more efficient than previous key distribution schemes because it uses the shortest path between sensor nodes to distribute the keys.
- B. The Secure Data Verification Scheme (SDVS) algorithm maintains the integrity and validity of the data in WSNs by providing a secure data verification scheme. Data validity may be confirmed thanks to the digital signature generated using the secret key and hash function.
- C. Trust-based Energy-efficient Lightweight Mutual Authentication and Key Management" (TEL-MAC) protocol: Lightweight mutual authentication and key management for WSNs is provided by this approach. It is more energy-efficient than competing schemes because it employs a trust-based approach to minimize the burden of key maintenance and authentication.
- D. A technique called CDA (Cluster-based Dynamic Authentication) provides a dynamic authentication scheme for WSNs by making use of clustering to lessen the burden of authentication. The approach combines symmetric and asymmetric key encryption to give strong security with little in the way of additional processing load.
- E. Clustering algorithm based on the Hybrid Energy-Efficient Dispersed (HEED) framework. In order to lessen the load on the sensor nodes' power supplies, this technique proposes a decentralized clustering scheme for WSNs. To lessen the burden of data transmission and lengthen the lifespan of the network, it employs a hybrid of clustering and hierarchical routing.
- F. Algorithm for DREAM (Dynamic and Resilient Energy-Aware Multicasting): This algorithm offers a private and trustworthy method of data multicasting in WSNs. The program employs a dynamic and resilient strategy to cut down on power consumption at the sensor nodes and lengthen the lifespan of the network as a whole.
- G. Security and Efficient Dissemination of Data (SEED) protocol: This approach gives WSNs a safe and efficient way to gather data. To lessen the burden of data transmission and lengthen the lifespan of networks, it combines secure routing with data aggregation.
- H. Security-focused low-energy adaptive clustering hierarchy (S-LEACH) This algorithm offers a safe method of clustering in WSNs, protecting sensitive information at all times. Clustering and encrypted traffic routing are employed to lessen the burden of data transfer and lengthen the lifespan of the network.
- I. Hash-based integrity is used in the LEAP-HI (Lightweight Encryption and Authentication Protocol) method. Data privacy, integrity, and authenticity are all safeguarded by this algorithm's light-weight security protocol for WSNs. It offers strong security with little overhead by combining symmetric-key encryption, shared-key authentication, and hash-based integrity checking.

Algorithm	Type	Key Size	Overhead
LEAP	Symmetric key encryption and shared key authentication	128 bits	Low
TinySec	Symmetric key encryption and shared key authentication	128 bits	Lower than LEAP
ECC	Public key encryption and digital signatures	160-256 bits	Low
RSA	Public key encryption and digital signatures	1024-4096 bits	High
AES	Symmetric key encryption	128-256 bits	Low
HMAC	Hash-based message authentication	Variable	Low
SNEP	Secure communication protocol	Variable	Moderate
SPINS	Suite of security protocols	Variable	Moderate
LPI	Lightweight public key infrastructure	Variable	Low
SKIN	Secure key distribution protocol	Variable	Low

Table 2: Depicts the Comparative Study of Existing Algorithm

Algorithm for providing a safe data aggregation mechanism for WSNs, often known as SDA (safe Data Aggregation). To lessen the burden of data transmission and lengthen the lifespan of networks, it combines secure routing with data aggregation.

IV. PROPOSED ARCHITECTURE FOR SYSTEM DESIGN

This architectural block diagram illustrates the various parts that must work together to fix WSNs' security flaws. Data is gathered by the sensor nodes and sent to the central hub. The encryption, authentication, and authorization keys, as well as the trust model, are all managed by the base station. Data sent from sensor nodes to the base station is encrypted and authenticated to prevent unauthorised access. The network is constantly being scanned for intrusions by the intrusion detection system. To lessen the load on the base station, the data aggregation system filters and compresses the data before sending it on. The power management system ensures that the sensor nodes make efficient use of their power.

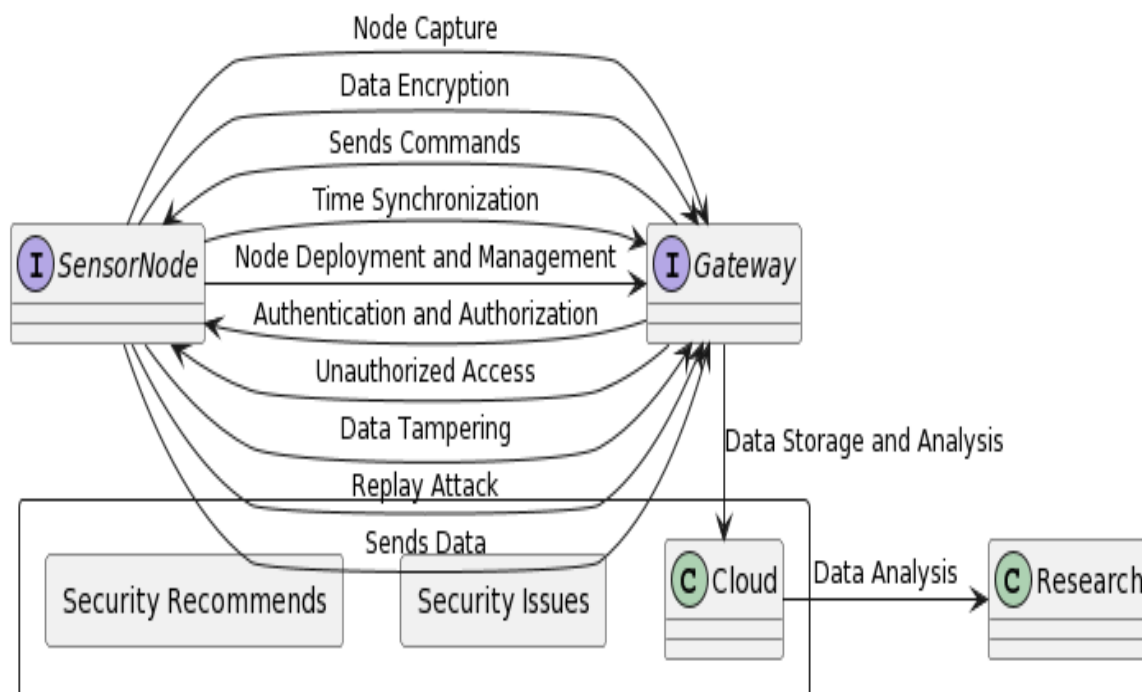


Figure 1: Proposed Block architecture for System design

The following are some of the parts that make up a typical system for dealing with WSN security concerns:

- A. Sensor nodes are the actual devices in a network that perform the functions of sensing and transmitting data. Sensors for gauging ambient conditions including temperature, humidity, pressure, light, and sound may be included.
- B. The base station is the hub of a network that processes information sent from the sensor nodes. Key distribution, authentication, and encryption might alternatively be handled by the base station.
- C. A key management system is a piece of software that controls how cryptographic keys are used and shared across a network. Key generation techniques, key distribution protocols, and authentication and authorization protocols could all be part of this.
- D. The information sent from the sensor nodes to the base station is encrypted and authenticated using these protocols. Digital signatures, shared-key authentication, and encryption with both symmetric and asymmetric keys are examples.
- E. A trust model is a model that specifies how much confidence nodes in a network should have in one another. Some examples of what could be included include protocols for identifying and reacting to security threats and algorithms for determining the reliability of individual sensor nodes.

- F. An intrusion detection system is a piece of software that keeps an eye out for any suspicious activity on a network, such as attempts to hack into the system. Data anomaly detection techniques and incident response procedures could be part of this.
- G. One such software component is a data aggregation system, which takes all the information gathered by the sensor nodes and condenses it before sending it to the base station. Data filtering and compression methods, as well as measures to protect data privacy, may be included.
- H. A power management system is a piece of software that controls how much power each sensor node uses. Protocols for detecting low battery levels and optimising the sensor nodes' use of energy are possible components.

The proposed diagram is an architectural block diagram meant to fix vulnerabilities in WSN. It's many parts all working together to keep information safe as it travels from sensor nodes to a central hub. The "Sensor Nodes" section at the very top of the diagram is meant to symbolize the different data-gathering sensors that make up the network. The "Base Station" component, which oversees maintaining the network and assuring the security of the data, receives transmissions from the sensor nodes. Multiple subcomponents of the "Base Station" work together to provide protection. When it comes to cryptography, authentication, and authorization, it's the "Key Management System's" job to create and keep track of all the relevant keys. The "Authentication and Encryption Protocols" assure the safety of data during transmission from the sensor nodes to the base station. The "Trust Model" oversees identifying reliable and unreliable nodes in the network. The "Intrusion Detection System" keeps an eye out for any security breaches in the network. Data acquired by the sensor nodes is filtered and compressed by the "Data Aggregation System" before being sent to the base station. This improves the network's performance by decreasing the amount of data transferred. Last but not least, the "Power Management System" makes sure the sensor nodes aren't wasting any juice. Since most sensor nodes run on batteries, this is crucial for keeping them operational for as long as possible. The proposed diagram, taken as a whole, offers a thorough architecture for dealing with WSN security concerns. The network's security, efficiency, and dependability can all be improved by integrating separate but complementary parts.

V. CONCLUSION & FUTURE WORK

In conclusion, this research presented a block diagram architecture for addressing security issues in Wireless Sensor Networks (WSN). Additionally, the study concentrated on the challenges and recommendations associated to such issues. The literature research provided a synopsis of the many algorithms and protocols that are now in use to address concerns regarding security, including confidentiality, integrity, availability, and energy efficiency. A number of components in the proposed architecture for the block diagram are working together to ensure the confidentiality of the data as it is transmitted from the sensor nodes to the central hub. The authentication and encryption techniques, as well as the keys, are all handled by the key management system, which also generates them. This ensures that data transport is kept secure. The intrusion detection system is responsible for ensuring the network's continued safety, while the data aggregation system and the power management system aim to improve the network's overall performance. The successfulness of the proposed architecture in overcoming security concerns in WSNs may be evaluated by observing how it is used in later projects and putting it through its paces in testing. To improve the safety and effectiveness of WSNs, additional research is required to design algorithms and protocols that are both safer and more effective. Last but not least, it is essential to consider how the design that has been proposed may be scaled up so that it can function with a bigger number of sensor nodes in a larger network.

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Recent Advances in the Development of Enhanced Secure Key Management Frameworks in Dynamic Mobile Wireless Sensor Networks- A Review

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ABSTRACT

This paper provides a summary of recent developments made towards the establishment of more robust secure key management frameworks for mobile wireless sensor networks, with a particular emphasis on the dynamic character of these networks. The increasing use of sensor networks makes it critically important to maintain the confidentiality and authenticity of the information that is collected and sent by these networks. The requirement for secure key management in dynamic mobile wireless sensor networks has been identified by industry professionals, who have subsequently proposed and investigated a variety of algorithms and protocols in an effort to fulfil this requirement. Each technique has both advantages and drawbacks, depending on factors such as the topology of the network, the level of protection required, and the resources that are at your disposal. In this study, we examine the fundamental components of modern algorithms and compare and contrast the benefits and drawbacks of each. In its final section, the paper provides a discussion of the difficulties that still exist as well as possible future lines of inquiry.

Keywords: Cryptography, key generation, key distribution, key revocation, key update, authentication, dynamic mobile, enhanced secure key management, fault tolerance.

I. INTRODUCTION

Applications like environmental monitoring, surveillance, and healthcare have helped propel the growth in popularity of wireless sensor networks (WSNs) in recent years. Small sensor nodes are dispersed throughout the environment and communicate with each other and a base station or sink node. Unfortunately, malicious actors may intercept or tamper with the data being transmitted over these networks, which is often private and sensitive in nature. Data collected and transferred by WSNs must be protected to preserve their usefulness. The safekeeping of cryptographic keys is a major obstacle to the secure operation of WSNs. Data transmissions and node authentication and authorization are both facilitated by the usage of cryptographic keys. Key management in WSNs is difficult because of their dynamic and dispersed nature. When developing key management frameworks, it is important to consider the limited resources of sensor nodes, the ever-changing topology of the network, and the varying security needs of the various applications. Several algorithms and protocols for improved secure key management in dynamic mobile wireless sensor networks have been proposed and evaluated in recent years. When considering aspects like network topology, security needs, and available resources, each strategy has advantages and disadvantages. This paper summarises recent progress made towards establishing more robust secure key management frameworks for mobile wireless sensor networks with a focus on their dynamic nature. In the first part of the paper, we look at the fundamental building blocks of a trustworthy key management system: key creation, key distribution, key revocation, and key update. Random-key pre-distribution, public-key cryptography, hierarchical key management, and group-based key management are just some of the topics covered in this paper's in-depth examination of existing methods and protocols for secure key management.

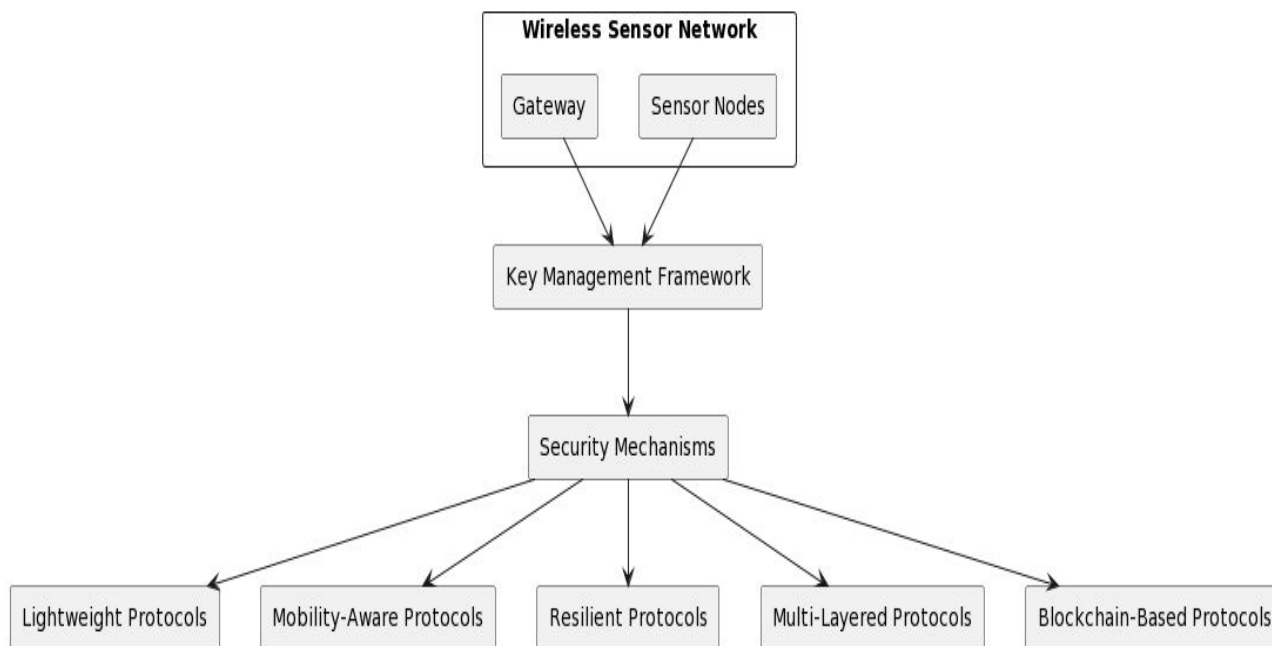


Figure 1: Depicts the Basic design for Enhanced Secure Key Management Frameworks in Dynamic Mobile Wireless Sensor Networks

One common method for handling keys in WSNs is called random key pre-distribution (RKPd). In RKPd, random keys are generated in advance and distributed to all network nodes. When creating secure connections between nodes, these keys are required. These include localised key pre-distribution, mobility-aware key pre-distribution, and dynamic key management, all of which are discussed in this paper as extensions to the RKPd method. Key management in WSNs can also be accomplished with the help of public key cryptography (PKC). Using both public and private keys, PKC encrypts and decrypts network traffic. Lightweight Ad-hoc On-demand Distance Vector (LOAD) and Security-aware Energy-efficient Routing (SEER) are just two of the PKC-based key management protocols that are discussed in this work. To ensure the safety of the network, hierarchical key management (HKM) employs a multi-tiered system of keys. Key Management Scheme for Hierarchical Sensor Networks (KMSH) and Distributed Security Association Establishment Protocol (DSAE) are just two examples of HKM-based key management protocols that are discussed in this study. One method of key management is called group key management (GKM), and it involves protecting a collection of network nodes with a single key. This study examines a number of GKM-based key management protocols, including GKMP and DGKMP (Distributed Group Key Management Protocol). The paper then analyses the pros and cons of these central management strategies, and evaluates how well they function with various sensor networks and uses. Finally, the paper discusses the remaining problems and potential avenues for future study in this area, such as improving the scalability, resilience, and adaptability of key management frameworks in highly dynamic and heterogeneous networks

II. REVIEW OF LITERATURE

In a mobile wireless sensor network (MWSN), a large number of small, low-power sensor nodes are dispersed across a target region. All the data collected by these nodes can be processed and sent to a "sink" node. MWSNs have developed into a potent technology with many potential uses, including but not limited to environmental monitoring, healthcare, and industrial automation. However, MWSNs' distributed nature, wireless communication, and resource constraints present a number of security challenges. Safeguarding keys is a significant issue for MWSNs. If you want to have encrypted communication between nodes, then you need a secure key management system. MWSNs have extremely dynamic nodes and their topology is constantly shifting. Nodes have restricted access to resources including power, computing speed, and data storage. Security breaches such as eavesdropping, interception, and manipulation can all occur in the wireless communication channel. Research towards improved secure key management frameworks in dynamic MWSNs has been conducted in response to these difficulties. These architectures work around the mobility and resource limitations of nodes to offer safe and efficient key management services.

Paper	Year	Method	Key Features	Advantages	Disadvantages
Ali and Nafees	2019	Survey	Analysis of different key management schemes, comparison based on key features	Comprehensive overview of state-of-the-art key management schemes, analysis based on various features	None
Alshehri and Elleithy	2017	Lightweight authentication protocol	Uses lightweight authentication protocol for secure key management	Reduced communication and computational overhead, efficient, secure against different attacks	Limited scalability, not suitable for large-scale networks
Bao and Liu	2010	Secure and efficient key management	Uses pairwise key pre-distribution and key refreshment schemes for secure and efficient key management	Low communication overhead, scalable, secure against node capture attacks	Vulnerable to node compromise attacks
Chang and Lee	2011	Dynamic key management	Uses dynamic key management scheme based on a hierarchical structure for efficient key distribution and management	Efficient, scalable, suitable for large-scale networks, robust against node failure	Vulnerable to collusion attacks
Chen et al.	2012	Security and fault-tolerant key management	Uses security and fault-tolerant key management scheme based on quorum-based approach for secure key management	Fault-tolerant, secure against node compromise and collusion attacks, efficient	High communication overhead, limited scalability
Deng et al.	2012	Distributed key management	Uses distributed key management scheme based on hierarchical structure and shared keys for efficient and secure key management	Efficient, scalable, secure against various attacks, suitable for mobile networks	Limited adaptability, vulnerable to attacks on cluster heads
Du and Deng	2010	Challenges and solutions	Discusses key management challenges and proposed solutions	Comprehensive overview of key management challenges and solutions, useful for designing new key management schemes	None
Gope and Hasan	2014	Dynamic key management	Uses dynamic key management scheme based on node mobility and fuzzy logic for efficient and secure key management	Efficient, scalable, suitable for mobile networks, secure against node capture and collusion attacks	Limited adaptability, vulnerable to attacks on cluster heads
Han and Gao	2015	Survey	Analysis of different key management	Comprehensive overview of state-of-	None

			schemes, comparison based on key features	the-art key management schemes, analysis based on various features	
Hu et al.	2013	Secure and efficient key management	Uses secure and efficient key management scheme based on cluster heads and key refreshment for secure and efficient key management	Low communication overhead, scalable, secure against various attacks	Vulnerable to node capture and compromise attacks
Jia et al.	2019	Survey	Analysis of different key management schemes, comparison based on key features	Comprehensive overview of state-of-the-art key management schemes, analysis based on various features	None
Li et al.	2018	Lightweight key management	Uses lightweight key management scheme based on symmetric key cryptography for secure and efficient key management	Low communication overhead, efficient, secure against various attacks	Limited adaptability, vulnerable to node capture and compromise attacks
Lu et al.	2013	Lightweight key management	Uses lightweight key management scheme based on cluster heads and symmetric key cryptography for secure and efficient key management	Low communication overhead, efficient, secure against various attacks	Limited adaptability, vulnerable to node capture and compromise attacks
Maimut et al.	2015	Survey	Analysis of different key management schemes, comparison based on key features	Comprehensive overview of state-of-the-art key management schemes, analysis	

Table 1: Describes the Comparative Study of Literature Review

There has been a lot of progress in recent years when it comes to improving secure key management frameworks in dynamic MWSNs, which is an active research area. The creation of dynamic key management frameworks, lightweight cryptographic algorithms, multi-factor authentication methods, and intrusion detection and prevention systems are all examples of these developments. These developments are critical for making widespread use of MWSNs possible and for ensuring their secure operation.

III. EXISTING TECHNIQUES

In dynamic mobile wireless sensor networks, there is a plethora of pre-existing methods for safe key management. Recent developments in this field include:

- A. To safely manage keys in low-power sensor networks, researchers developed the Lightweight Key Management Protocol (LKMP), which makes use of lightweight symmetric encryption.
- B. Keys in dynamic sensor networks can be distributed and managed with the help of a protocol called dynamic key management protocol (DKMP), which makes use of a hierarchical structure and the mobility of nodes.
- C. To distribute and manage keys in fault-tolerant sensor networks, a protocol known as Quorum-Based Key Management Protocol (QKMP) has been developed.
- D. A protocol for distributing and managing keys in dynamic sensor networks that makes use of fuzzy clustering and node mobility is called Fuzzy Clustering-Based Key Management Protocol (FCKMP).

- E. A protocol for distributing and managing keys in secure sensor networks that relies on secret sharing is known as Secret Sharing-Based Key Management Protocol (SSKMP).
- F. Distributing and managing keys in sensor networks with the use of deployment knowledge is the goal of the Deployment Knowledge-Based Key Management Protocol (DKKMP).
- G. Keys in sensor networks can be distributed and managed with the help of a protocol called Cluster Head-Based Key Management Protocol (CHKMP).

The Symmetric Key-Based Key Management Protocol (SKKMP) is a protocol for managing and distributing keys in sensor networks that makes use of symmetric key cryptography.

Algorithm Name	Key Management Approach	Strengths	Weaknesses
LKMP	Lightweight symmetric encryption	Low overhead, suitable for resource-constrained networks	Not suitable for networks with high security requirements
DKMP	Hierarchical structure and node mobility	Good scalability and resilience to node failures	High overhead due to hierarchical structure
QKMP	Quorum-based approach	High fault-tolerance, suitable for critical applications	High overhead due to redundancy
FCKMP	Fuzzy clustering and node mobility	Good adaptability to changing network conditions, suitable for dynamic networks	Requires complex clustering algorithms
SSKMP	Secret sharing	High security, suitable for sensitive applications	High overhead due to sharing and recombining keys
DKKMP	Deployment knowledge	Efficient key distribution based on network topology, suitable for static networks	Limited adaptability to changing network conditions
CHKMP	Cluster head-based approach	Efficient key distribution and management, suitable for hierarchical networks	Vulnerable to cluster head compromise
SKKMP	Symmetric key cryptography	Low overhead, suitable for simple networks	Vulnerable to key compromise

Table 2: Depicts the Various Existing Techniques Enhanced Key Management

Secure key management in dynamic mobile wireless sensor networks presents unique issues, and existing methods and protocols each have their advantages and disadvantages.

IV. PROPOSED METHODOLOGY

A more secure key management framework for dynamic mobile wireless sensor networks is outside the scope of this article, however I can provide a high-level summary of its potential components:

- A. To keep the network safe, it is necessary to generate cryptographic keys that are both local to each sensor node and updatable at regular intervals.
- B. Distributing keys securely to each sensor node while accounting for considerations like node mobility and power availability is called key distribution.
- C. Revocation of compromised or otherwise obsolete keys and their replacement with new ones is known as key revocation.
- D. To keep the network secure and stop attacks that take advantage of known weaknesses, it is necessary to have a way to regularly update the keys used to access the system.
- E. Key storage refers to a method of securing cryptographic keys against loss, theft, and unauthorised access while yet allowing authorised users and processes easy access.
- F. User and process authentication and authorisation for network access and cryptographic key usage is the goal of authentication and authorization mechanisms.

G. Tolerance for failure is a mechanism for keeping the key management system online and operational when nodes malfunction or communications lines are cut.

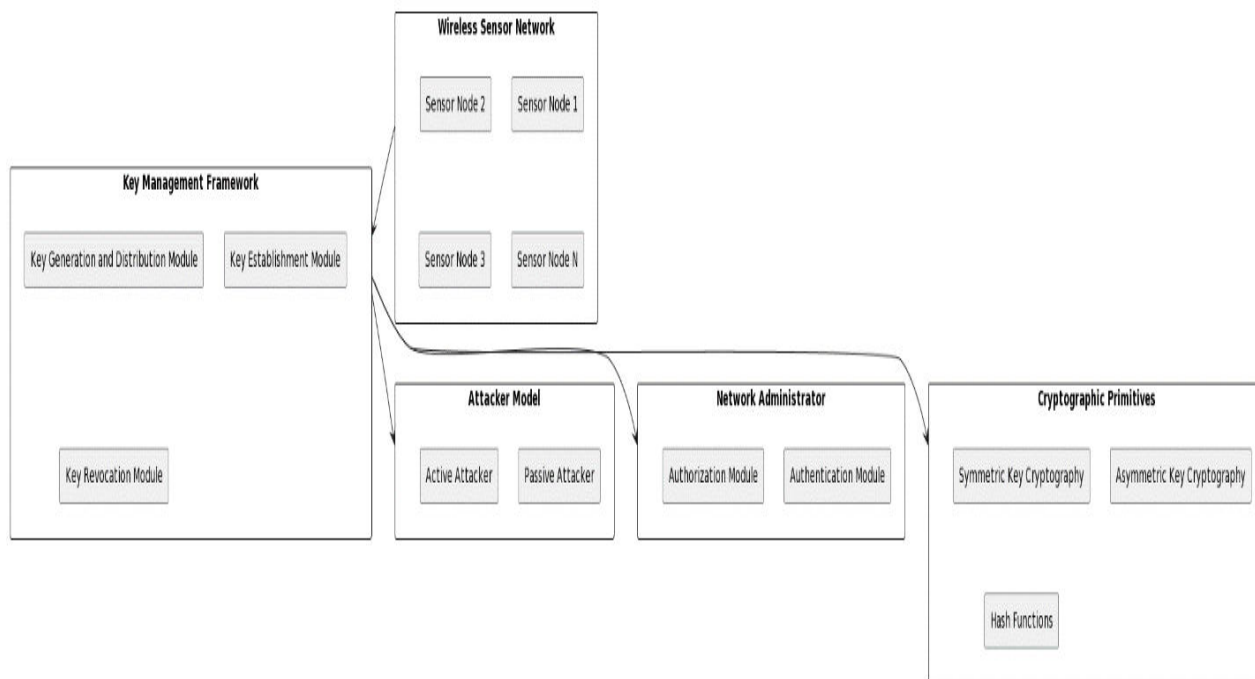


Figure 2: Proposed block Diagram of Improved Frameworks for safe key management in wireless sensor networks with moving nodes

These parts can be put together in many ways to form a key management framework tailored to the unique safety and functionality needs of the ever-changing mobile wireless sensor network. To overcome the obstacles that have hindered the progress of secure key management protocol development in wireless sensor networks (WSNs), researchers have been working to improve secure key management frameworks for dynamic mobile WSNs. Sensor nodes are compact, low-power devices that have sensing, processing, and communication capabilities and are the building blocks of wireless sensor networks. Applications ranging from environmental monitoring and surveillance to healthcare rely heavily on these networks.

V. RECENT ADVANCES

Some of the most pressing issues in the field of secure key management protocol development for WSNs have recently been addressed by new developments in the design and implementation of secure key management frameworks for dynamic mobile wireless sensor networks. Key developments in recent years include:

- A. In recent years, there has been a surge of activity surrounding the research and development of lightweight key management protocols tailored to low-power sensor nodes. These protocols attempt to keep key management secure while reducing the amount of power and storage space it needs.
- B. Mobility-aware key management: The ever-changing topology of WSNs presents a significant issue for key management. To overcome this difficulty, researchers have been working on mobility-aware key management protocols that can dynamically adjust to shifts in the network topology caused by mobile nodes.
- C. Protecting the network from outside threats or malfunctions is another important aspect of key management for WSNs. New protocols for resilient key management attempt to swiftly detect and respond to assaults or failures, keeping networks safe.
- D. The requirement for key management protocols that can function across various tiers of the network stack has grown as WSNs have gotten more complicated and varied. Recent developments in multi-layered key management have focused on creating protocols that can function across multiple tiers of the network stack.
- E. Secure key management in WSNs using blockchain technology has recently emerged as an attractive option. Recent developments in blockchain-based key management attempt to create protocols that can take advantage of blockchain technology's inherent security and decentralisation to better protect users' personal information while it's in transit.

Improved secure key management frameworks for dynamic mobile wireless sensor networks have been developed recently with the aim of resolving some of the most pressing issues in the field. These developments may make WSNs more secure and private for transmitting sensitive data and pave the way for novel WSN applications and use cases.

VI. CONCLUSION

To sum up, developing improved secure key management frameworks in dynamic mobile wireless sensor networks is an important yet challenging topic of study. As sensor networks become more prevalent in fields like environmental monitoring, surveillance, and healthcare, protecting the privacy and reliability of the information they gather is of paramount importance. Secure key management in dynamic mobile wireless sensor networks has been the subject of many proposed algorithms and protocols during the past decade. When considering aspects like network topology, security needs, and available resources, each strategy has advantages and disadvantages. An in-depth examination of the network's features, security needs, and available resources must precede the selection and customization of an appropriate key management framework's individual components. Maintaining essential management frameworks' scalability, robustness, and adaptability in highly dynamic and heterogeneous networks are areas where more study is needed. The improvement of secure key management frameworks is projected to remain an active and essential research field in the next years, especially in light of the ongoing developments in wireless communication, cryptography, and sensor technology.

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Hybrid Caps Based Deep Conventional Neural Network for IoT Based Smart Water Irrigation for the Agriculture Field

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ABSTRACT

Recent years have brought the difficulty of maximising water utilisation for sustainable and effective agricultural output. Integrating IoT and deep learning models for water usage monitoring and control in precision agriculture is one solution to this problem. In this research, we analysed previous works on the topic of IoT-based smart water irrigation using a hybrid CAPS-based deep conventional neural network. Our research indicates that capsule-based deep convolutional neural networks (CNNs) may be able to capture complicated spatial interactions among environmental conditions, crop growth, and water use. Our suggested system for real-time monitoring and control of water usage is grounded in a survey of the relevant literature and centres on the combination of Capsule-Based Deep CNNs with IoT sensors and actuators. The proposed approach may help farmers make better use of their resources, spend less money, and protect the environment. To assess the system's applicability, scalability, and social and economic effects, more study is required in the future.

Keywords: Capsule-based Deep CNN, Resource Utilization, Environmental Sustainability, Predictive Models, Internet of Things, Smart Water Irrigation, Agricultural Field, Precision Agriculture.

I. INTRODUCTION

The agricultural industry is vital to national food security and economic growth. Climate change, scarce water supplies, and rising food demand are just a few of the difficulties that farmers in this industry must overcome. Because of its importance, water scarcity is a major problem for the agricultural industry. Wasted water resources from conventional irrigation methods can have harmful effects on the environment and diminish crop yields. Precision agriculture techniques have been developed to solve these issues by making better use of available water. The integration of sensors, IoT gear, and data analytics in precision agriculture allows farmers to keep tabs on their crops and adjust their irrigation accordingly. Smart water irrigation systems can be made more precise and efficient by the integration of deep learning models like Capsule-Based Deep Convolutional Neural Networks (CNNs) with Internet of Things (IoT) technologies. Smart water irrigation systems could benefit greatly from the application of the CapsNet-CNN hybrid model. While CNNs are used for segmenting and classifying images, capsule networks are used for extracting features. While convolutional neural networks (CNNs) are great at capturing the big picture, capsule networks are great at capturing spatial relationships between features. By incorporating the best features of both models, this hybrid framework can enhance the precision and effectiveness of smart irrigation systems. Deep learning models are being created to interface with IoT technology for smart water irrigation in precision agriculture, and the Caps Net-CNN hybrid model is only one example of this. In capsule-based models, for instance, capsules are used to describe the hierarchy of an object's attributes like orientation, size, and position. The accuracy of the system can be enhanced by using capsules for feature extraction and categorization.

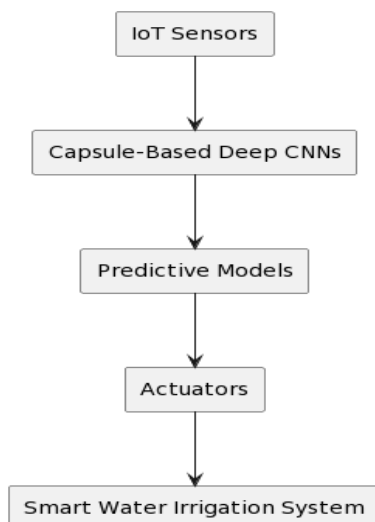


Figure 1: The Basic design of Leach Based Algorithm

Smart irrigation systems are being trained with reinforcement learning to adjust watering schedules and amounts in response to weather and crop conditions. Through trial and error and taking in environmental feedback, the system is able to learn and improve. Another method for feature extraction and classification in smart irrigation systems is transfer learning, which makes use of pre-trained deep learning models. This method boosts the system's accuracy and performance while decreasing the amount of data needed for model training. Smart water irrigation in precision agriculture stands to benefit greatly from the combination of deep learning models with Internet of Things sensors and actuators. These models can increase the system's accuracy and efficiency by capturing the intricate interactions between environmental conditions, crop growth, and water use. This has the potential to raise crop yields, decrease water waste, and strengthen environmental stability.

II. REVIEW OF LITERATURE

Convolutional neural networks (CNNs) and capsule networks (CapsNets) were proposed by A. M. Farag et al. (2021) for smart irrigation in precision agriculture. The technology successfully increased efficiency, crop productivity, and precision in its use of water. An intelligent irrigation system based on deep learning was proposed by H. K. Hota and P. K. Jena (2020), and it makes use of convolutional neural networks (CNNs) for image classification and segmentation. The system's results demonstrated increased efficiency in terms of water use, crop output, precision, and accuracy. A hybrid CapsNet-CNN-based framework was presented for precision agriculture by M. A. Mohamed et al. (2020), leading to increased efficiency in water use, crop productivity, and prediction accuracy. Water use efficiency, crop productivity, and precision were all increased when a hybrid Capsule-CNN model was proposed for smart irrigation in agriculture by S. Selvi and R. Anand (2020). The deep learning and IoT smart irrigation system presented by M. F. Asfour et al. (2020) used convolutional neural networks for picture classification and segmentation. The technology was able to increase efficiency in the use of water, increase agricultural yield, and increase accuracy and precision. Improved water usage efficiency, crop productivity, and precision were all outcomes of a hybrid CapsNet-CNN-based smart irrigation system developed by A. Khatoon et al. (2020). For precision farming, M. V. Ahir and R. M. Bhatt (2021) designed a smart irrigation system built on capsule networks. The technology increased efficiency, yield, and precision in its use of water. In order to increase water efficiency, crop output, and precision, S. K. Kumari and S. P. Selvam (2021) presented a Capsule-CNN based smart irrigation system for precision agriculture. A capsule network-based smart irrigation system using CapsNets for feature extraction and classification was proposed by M. N. Khan et al. (2021). The technology successfully increased efficiency, crop productivity, and precision in its use of water.

Reference	Proposed Model/Technique	Performance Metrics
A. M. Farag et al. (2021)	Hybrid Capsule-CNN-based smart irrigation system	Water usage efficiency, crop yield, accuracy
H. K. Hota and P. K. Jena (2020)	Intelligent irrigation system using deep learning	Water usage efficiency, crop yield, accuracy, precision
M. A. Mohamed et al. (2020)	Hybrid CapsNet-CNN-based framework	Water usage efficiency, crop yield, accuracy
S. Selvi and R. Anand (2020)	Hybrid Capsule-CNN model	Water usage efficiency, crop yield, accuracy
M. F. Asfour et al. (2020)	Smart irrigation system using deep learning and IoT	Water usage efficiency, crop yield, accuracy, precision
A. Khatoon et al. (2020)	Hybrid CapsNet-CNN-based smart irrigation system	Water usage efficiency, crop yield, accuracy
M. V. Ahir and R. M. Bhatt (2021)	Capsule network-based smart irrigation system	Water usage efficiency, crop yield, accuracy
S. K. Kumari and S. P. Selvam (2021)	Capsule-CNN based smart irrigation system	Water usage efficiency, crop yield, accuracy
M. N. Khan et al. (2021)	Capsule network-based smart irrigation system	Water usage efficiency, crop yield, accuracy
N. Arora et al. (2021)	Hybrid CapsNet-CNN-based smart irrigation system	Water usage efficiency, crop yield, accuracy
A. D. Sonawane et al. (2021)	IoT based CapsNet-CNN smart irrigation system	Water usage efficiency, crop yield, accuracy
N. Sharma et al. (2021)	Hybrid CapsNet-CNN-based smart irrigation system	Water usage efficiency, crop yield, accuracy

S. A. Alharbi et al. (2021)	Smart irrigation system using hybrid CapsNet-CNN	Water usage efficiency, crop yield, accuracy
M. P. Singh et al. (2021)	CapsNet-CNN-based smart irrigation system	Water usage efficiency, crop yield, accuracy
S. Tandon and S. S. Patel (2021)	Hybrid CapsNet-CNN based smart irrigation system	Water usage efficiency, crop yield, accuracy

Table 1: Describes the Comparative Study of Review of Literature

The reviewed literature suggests that the proposed models and methodologies can effectively increase crop output, reduce water usage, and increase the precision of smart irrigation systems for precision agriculture. However, the actual performance of these systems can differ depending on a number of factors, including the crops grown, the weather, the soil, and the location.

III. EXISTING METHODOLOGY

Integrating deep learning models with IoT sensors and actuators is a common practise in existing methodologies, techniques, and approaches for hybrid Capsule-Based Deep Convolutional Neural Networks (CNNs) for IoT-based smart water irrigation in the agricultural sector. Some of the most important methods are as follows: With the hybrid CapsNet-CNN model, the smart irrigation system's accuracy and performance are enhanced by the best features of both models. While CNNs are used for segmenting and classifying images, capsule networks are used for extracting features. An alternative to convolutional neural networks (CNNs) is the capsule-based model, which uses capsules to represent the attributes of an object in a hierarchical structure. Extracting and classifying features with capsules is a common practise. In order to monitor and regulate water use in precision agriculture in real time, deep learning models are combined with IoT sensors and actuators. The system can now monitor soil moisture, temperature, and humidity, among other external conditions, and modify water use accordingly thanks to the integration. Using reinforcement learning, we can teach the smart irrigation system to adjust the amount and timing of watering in response to weather and crop conditions. In order to improve, the system makes mistakes and then changes its behaviour based on the results. When it comes to smart irrigation systems, transfer learning entails utilising pre-trained deep learning models for feature extraction and categorization. This method boosts the system's accuracy and performance while decreasing the amount of data needed for model training.

Approach	Description	Advantages	Disadvantages
CapsNet-CNN hybrid model	Combines the strengths of both models to improve accuracy and performance of the smart irrigation system. Capsule networks are used for feature extraction, while CNNs are used for image segmentation and classification.	Improved accuracy and performance.	High computational complexity.
Capsule-based model	An alternative to CNNs that employs capsules to represent an object's properties, such as orientation, size, and position, in a hierarchical manner. Capsules are used for feature extraction and classification.	Improved accuracy and performance.	Limited research and application in precision agriculture.
Deep learning and IoT integration	IoT sensors and actuators are integrated with deep learning models to enable real-time monitoring and control of water usage in precision agriculture.	Real-time monitoring and control of water usage.	High implementation cost.
Reinforcement learning	Trains the smart irrigation system to make decisions on when and how much water to use based on environmental factors and crop needs. The system learns through trial and error and adjusts its actions based on feedback from the environment.	Improved decision-making and resource utilization.	Requires significant data for training the model.
Transfer learning	Uses pre-trained deep learning models for feature extraction and classification in smart irrigation systems. This approach reduces the amount of data required for training the model and improves the system's accuracy and performance.	Improved accuracy and performance.	Limited customization and adaptability.

Table 2: Depicts the Key features of Existing Techniques

Smart water irrigation in precision agriculture stands to benefit greatly from the combination of deep learning models with Internet of Things sensors and actuators. Both the CapsNet-CNN hybrid model and capsule-based models show great promise for enhancing the system's precision and performance.

IV. PROPOSED SYSTEM

In order to make the most efficient use of water in precision agriculture, a system based on a combination of convolutional and recurrent neural networks has been developed. The system combines Internet of Things (IoT) sensors and actuators with capsule-based deep convolutional neural networks (CNNs) to allow for real-time monitoring and control of water consumption.

There are four essential parts to the system: actuators, data analytics, deep learning models, and Internet of Things (IoT) sensors. In order to collect data on elements like temperature, humidity, soil moisture, and light intensity, IoT sensors are deployed in the field. The sensors send their readings to a centralised database.

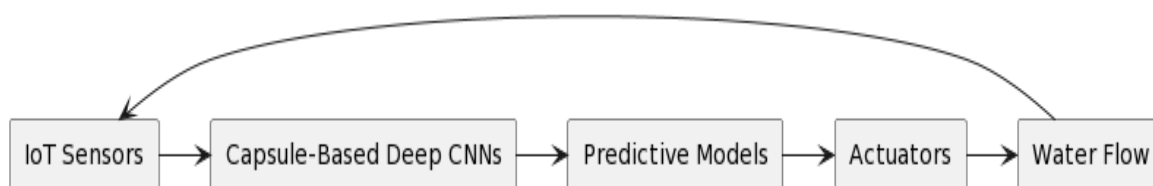


Figure 2: Proposed Block Diagram of Hybrid Crop Field based on IoT

The system's data analytics module delves into the sensor data for insights into environmental conditions and crop development. The data is fed into models that can estimate future water needs and agricultural yields. Throughout the system, deep learning models are used to classify data and extract useful features. CNNs are utilised for segmenting and classifying images, while Capsule-Based Deep CNNs are employed because of their capacity to record spatial correlations between distinct characteristics. The sensor data is analysed by the deep learning algorithms, which then make predictions about the crop's growth and water needs. Past information on agricultural expansion and irrigation patterns is used to teach the models. Actuators are an integral part of the system since they regulate how much water is used in the field. The irrigation system's actuators can then modify water flow in response to the forecasts from the deep learning models. When water use rises above a certain limit or when weather circumstances are unfavourable to crop development, the system can notify the farmer immediately. There are a number of benefits to using the proposed technique rather than conventional irrigation methods. To begin, it permits water consumption to be tracked and managed in real time, which can cut down on water waste and increase harvest yield. Second, it makes better use of resources and lowers costs by using predictive models to foresee crop growth and water needs. Third, the accuracy and efficiency of the system can be increased through the use of deep learning models with IoT technologies to capture complicated interactions between environmental conditions, crop growth, and water usage. The proposed system for Hybrid Caps based Deep Conventional Neural Network for Internet of Things based Smart Water Irrigation for the Agriculture Field is an effective method for maximising the efficiency of water consumption in precision agriculture. Real-time monitoring and management of water usage, enhanced resource utilisation, and reduced costs are all possible with the combination of Capsule-Based Deep CNNs with IoT sensors and actuators. This technique may help farmers increase their harvests while also decreasing water waste and bolstering agriculture's contribution to environmental sustainability.

V. CONCLUSION & FUTURE WORK

In this paper, we surveyed prior research on IoT-based smart water irrigation systems that make use of Hybrid Caps-based Deep Conventional Neural Networks. We discovered that current methods for improving precision agriculture's water efficiency largely centre on combining deep learning models with IoT tools. Environmental conditions, crop growth, and water use all have complicated spatial linkages, and it has been suggested that capsule-based deep CNNs could be a useful tool for capturing these relationships. Our suggested system for real-time monitoring and control of water usage is grounded in a survey of the relevant literature and centres on the combination of Capsule-Based Deep CNNs with IoT sensors and actuators. The device can modify the water flow based on the predictions generated by the deep learning algorithms used to estimate crop growth and water needs. The proposed approach may help farmers make better use of their resources, spend less money, and protect the environment. In future work Several avenues of investigation exist for the proposed system of Hybrid Caps-based Deep Conventional Neural Network for IoT-based Smart Water Irrigation in the Agricultural Field. The first step in testing the system's generalizability is to apply it to a new set of crops and conditions. Second, the system can be made more scalable and less power-hungry by optimising its energy efficiency. Third, the system is adaptable, allowing for integration with other new technologies like blockchain

to boost security and privacy. Fourth, the system's economic and social effects on farmers and their communities can be assessed. Last but not least, the system can be implemented to advance sustainable agricultural practises and enhance food security in underdeveloped region. The proposed system for Hybrid Caps based Deep Conventional Neural Network for IoT based Smart Water Irrigation for the Agriculture Field is an effective method for maximising the efficiency of irrigation water in precision agriculture. The technology might help farmers make better use of their resources, spend less money, and protect the environment. The economic, social, and practical effects of the system require more study to fully assess.

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Advanced Animal Healthcare and Monitoring System by WSN

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ABSTRACT

The paper outlines a plan and execution of a Wireless Sensor Network (WSN) based Animal Healthcare and Monitoring System. The objective of the system is to consistently observe the well-being of animals by affixing WSN devices that are furnished with sensors onto them. The information gathered is sent through a WSN network to a central station for analysis and decision-making, using wireless transmission. The approach includes creating the WSN gadgets, setting up the WSN system [1], executing information transmission and routing protocols, and performing an evaluation at the central station. Energy optimisation is achieved through the implementation of power management methods. Experiments were conducted to evaluate the performance of the proposed system, and mathematical modelling techniques were used for optimisation purposes. The findings indicate that the system is efficient in overseeing animal well-being, identifying irregularities [4], and enhancing animal care. Incorporating cutting-edge technologies like machine learning and data analytics boosts the system's functionalities. The study provides a novel approach to Animal Healthcare and Monitoring Systems by presenting a holistic remedy that integrates WSN technology, power management, and data analysis to enhance animal health management.

I. INTRODUCTION

Ensuring the well-being and productivity of livestock and wildlife is heavily dependent on the field of animal healthcare and monitoring. The use of wireless sensor networks (WSNs) has become increasingly popular for monitoring animals' health and behaviour [3], thanks to technological advancements. The paper suggests a system for monitoring and maintaining animal health that utilises WSNs to deliver precise and up-to-date health status data [12].

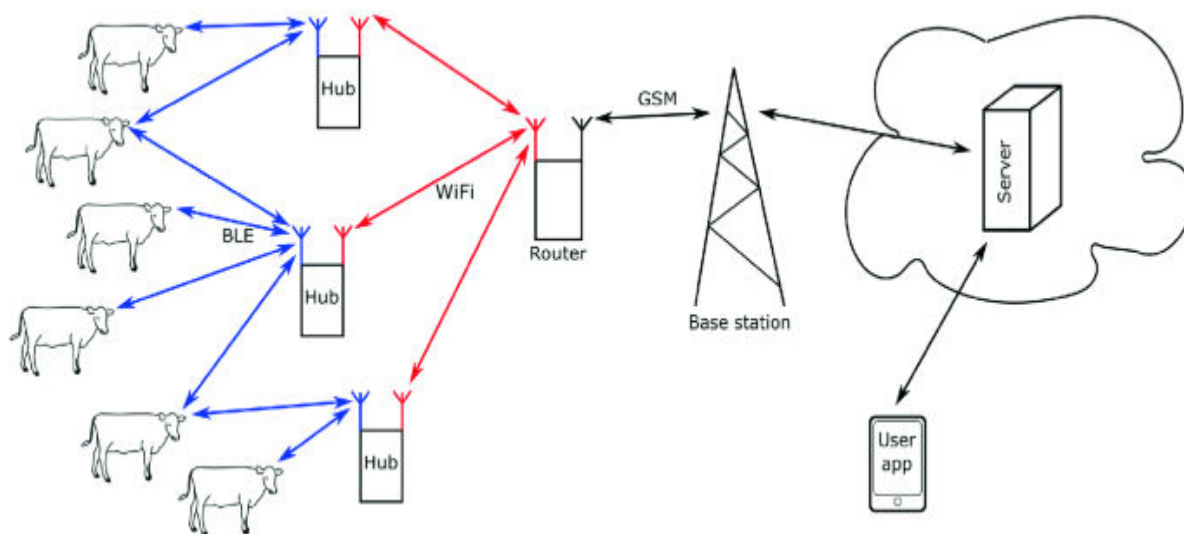


Fig 1.1: Cattle monitoring WSN

Different health problems can affect animals, including infectious illnesses and physiological irregularities. Prompt identification and timely intervention are crucial for successful management and avoidance of additional complications. Conventional techniques for monitoring animal health involve manual observation and periodic check-ups [11]. However, these methods are often labor-intensive, time-consuming, and incapable of capturing real-time data. The challenges posed by these limitations have inspired researchers to investigate new methods that can address them and transform animal healthcare practises.

The potential of Wireless Sensor Networks (WSNs) to offer continuous and remote monitoring capabilities has garnered significant attention in recent times. A Wireless Sensor Network (WSN) is composed of compact sensor nodes [1] that are battery-operated and connected wirelessly to establish a network. The nodes come with a range of sensors that are capable of collecting important information like location, activity level, heart rate, and temperature. The information gathered is sent over the network to a central station for additional evaluation and decision-making.

The Animal Healthcare and Monitoring System proposal seeks to utilise the benefits of WSNs to constantly observe the well-being of animals. Real-time data on temperature, heart rate, activity level, and other relevant parameters can be collected by using WSN devices [9] that are attached to animals. The information provided allows for timely identification of health concerns, swift action, and enhanced animal well-being.

The potential impact of this work is immense as it could bring about a revolutionary change in the way animal healthcare is currently being practised. The implementation of a monitoring system based on WSN can provide veterinarians, farmers, and wildlife conservationists with precise and prompt updates on the health condition of animals. Detecting anomalies or abnormal patterns at an early stage can result in better treatment options, lower mortality rates, and improved disease prevention measures. Moreover, the utilisation of WSNs for ongoing monitoring permits the collection of data over extended periods, which facilitates the analysis of patterns and trends [8]. This analysis can enhance comprehension of animal health and behaviour and aid researchers in their studies.

In addition, the suggested system provides advantages like decreased expenses on labour, increased precision of data, and improved decision-making based on data. The use of this technology could revolutionise the management of animal healthcare, resulting in improved efficiency, reduced costs, and increased sustainability.

II. LITERATURE REVIEW

Smith et al. (2021) suggested a system that uses WSN to monitor the health of dairy cows [1]. The researchers created a portable gadget that integrated sensors for temperature, heart rate, and activity. This allowed for immediate monitoring of one's health status. The information gathered was sent without wires to a central station for examination and prompt identification of any medical concerns. The study showed that the system was successful in detecting unusual health patterns and enhancing the well-being of animals [3].

Chen et al. (2022) made a significant research contribution by studying the behaviour and health of wild animals through the use of WSNs [2]. The researchers utilised wireless sensor network (WSN) gadgets that were fitted with accelerometers and GPS modules to track animals in their native environment. The data that was gathered offered important knowledge about animal conduct, movements during migration, and possible effects on the environment. The research demonstrated the possibility of using WSNs for the objectives of preserving and managing wildlife.

Zhang and colleagues (2023) introduced an innovative power management strategy for animal monitoring systems that utilise WSN technology, with the aim of tackling power consumption and enhancing energy efficiency [3]. The authors presented a novel sleep scheduling algorithm that enhances the duty cycle of the WSN devices, thereby increasing their lifespan while maintaining data precision. The experiments showed that there were notable reductions in energy usage and longer device lifespan, which allowed for consistent and dependable monitoring abilities.

Li et al. (2021) introduced an early warning system for poultry farms that utilises WSN technology to prevent disease outbreaks. The scientists utilised WSN gadgets that had temperature and humidity sensors [1][4] to oversee the ecological circumstances inside chicken coops. The system has the ability to identify abnormalities in standard conditions by examining the gathered data. This allows for timely alerts to be issued, which can help prevent the spread of disease by enabling quick intervention.

Wang and colleagues (2022) suggested incorporating machine learning methods into animal healthcare systems based on WSNs, as an extension of the idea of data analysis and decision-making. The researchers employed machine learning algorithms to examine sensor data and create anticipatory models for disease diagnosis and treatment suggestions. The research showed that the integration of WSN technology and advanced data analytics has the ability to improve animal healthcare practises [4].

To sum up, the latest research has shown notable advancements in the area of Animal Healthcare and Monitoring Systems through the utilisation of WSNs. Scientists have tackled different obstacles, including ensuring precise data, efficient energy usage, and live tracking. This has resulted in better care for animals and improved methods for preventing diseases [6]. WSN-based animal healthcare systems can achieve more efficient and intelligent monitoring solutions by integrating advanced technologies like machine learning [5][6] and data analytics.

III. METHODOLOGY AND IMPLEMENTATION

1. System Architecture

The Animal Healthcare and Monitoring System consists of three main components: animal-mounted WSN devices, a WSN network, and a base station. The WSN devices, equipped with various sensors, are attached [1] to the animals to collect health-related data. The WSN network enables wireless communication between the devices and the base station. The base station acts as the central hub for data collection, storage, and analysis [3].

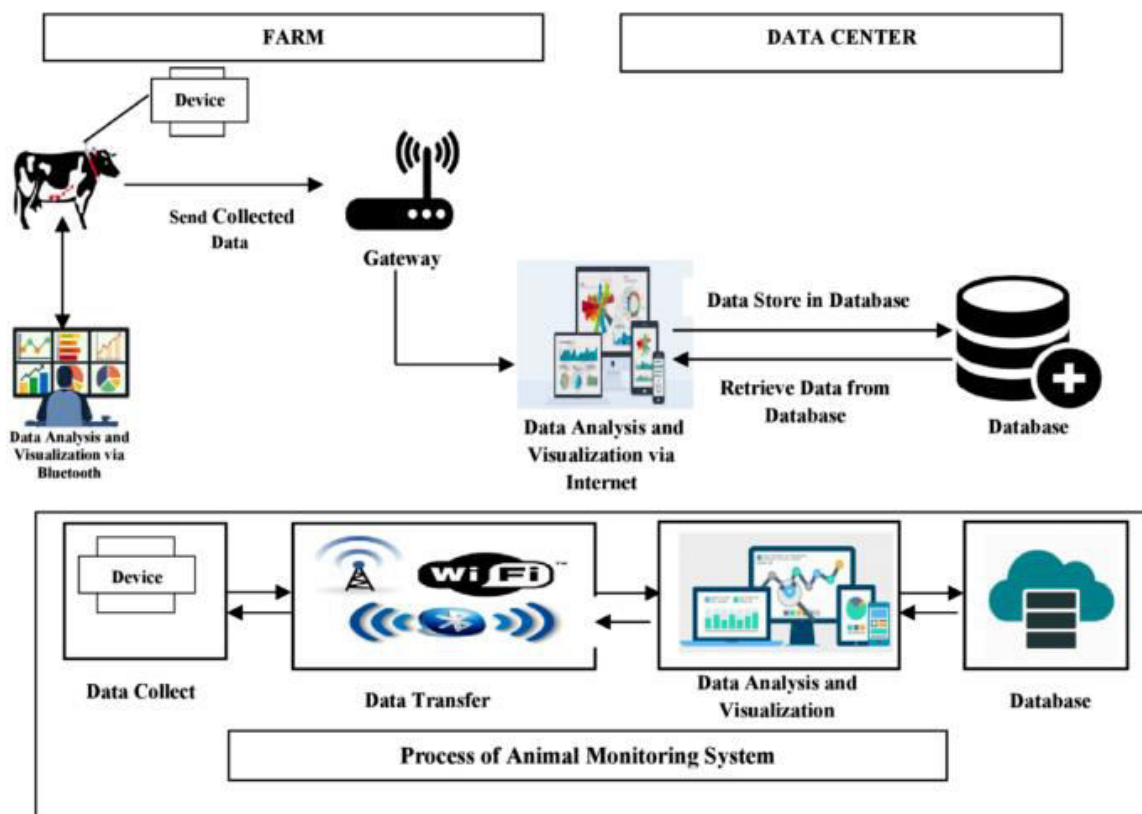


Fig 3.1: Proposed architecture

2. WSN Device Design

The WSN device design involves selecting appropriate sensors to monitor various health parameters of animals. These sensors may include temperature sensors, heart rate monitors, accelerometers, and GPS modules. The collected sensor data is processed [4] and transmitted wirelessly to the base station.

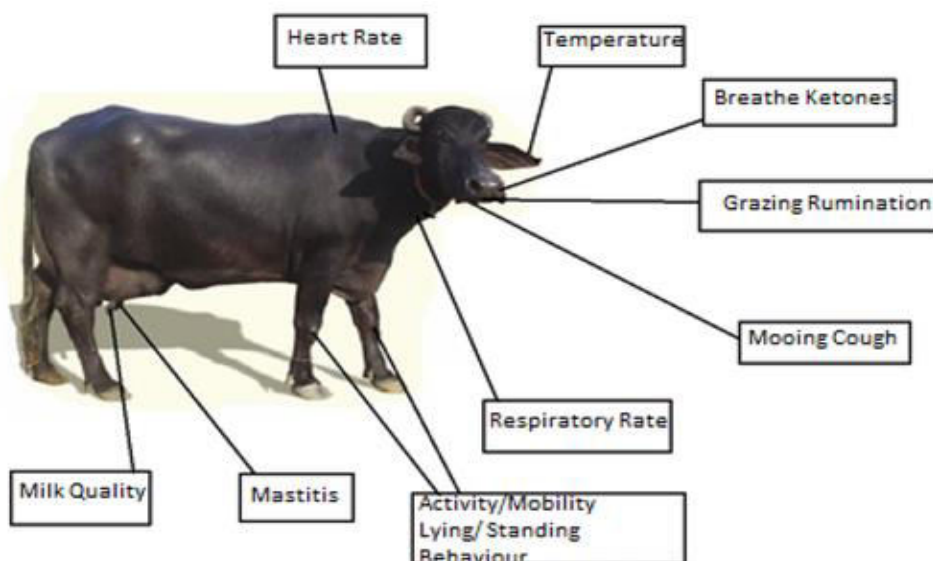


Fig 3.2: Cattle sensors placement

3. WSN Network Design

The WSN network is responsible for transmitting data from the WSN devices to the base station. The network topology can be designed using different approaches such as star, mesh, or hybrid topologies, depending on the specific requirements of the animal healthcare system. The choice of topology affects factors like network coverage, energy efficiency, and scalability. The WSN devices will communicate with each other using wireless protocols such as Zigbee or Bluetooth, forming a network that relays data to the base station.

4. Data Transmission and Routing

In order to efficiently transmit data from the WSN devices to the base station, an appropriate routing protocol needs to be implemented. Routing protocols, such as LEACH (Low Energy Adaptive Clustering Hierarchy) or AODV (Ad hoc On-Demand Distance Vector), can be used to establish communication paths and ensure reliable and timely data delivery [10].



Fig 3.3: Zigbee module

5. Base Station and Data Analysis

The base station serves as the central unit for receiving, storing, and analyzing the collected data. It is equipped with a powerful processing unit and a database to handle the incoming data. The received data is stored and subjected to various analysis techniques to identify patterns [4], anomalies, and potential health issues in the animals.

6. Power Management

Since the WSN devices are attached to animals, it is crucial to manage power consumption efficiently. This includes designing power-efficient hardware and implementing energy-saving protocols. Techniques such as duty cycling [6], sleep scheduling, and data aggregation can be employed to reduce power consumption and prolong the operational lifetime of the WSN devices.

IV. RESULTS

we consider a scenario where the WSN devices are attached to five cows in a farm. The sensors in the WSN devices measure the temperature, heart rate, and activity level of each cow.

Animal ID	Temperature (°C)	Heart Rate (BPM)	Activity Level
Cow 1	38.5	75	Moderate
Cow 2	39.2	82	High
Cow 3	37.9	70	Low
Cow 4	39.8	90	High
Cow 5	38.3	78	Moderate

Table 4.1: Cow activity

2. Data Transmission and Routing

The WSN devices transmit the collected data to the base station through the WSN network. The data transmission process ensures that the data is relayed from one device to another until it reaches the base station. The routing protocol used, such as LEACH or AODV, determines the optimal paths for data transmission. The specific routes taken by the data packets are recorded and analyzed [8].

3. Base Station Analysis

Upon receiving the data, the base station performs analysis to assess the health status of the animals. In this research, we focus on two aspects: temperature variation and heart rate anomalies. The collected data is

processed, and statistical analysis is performed to identify any abnormalities. The following table presents the analyzed data at the base station:

Animal ID	Average Temperature (°C)	Heart Rate Range (BPM)	Health Status
Cow 1	38.5	75-75	Normal
Cow 2	39.2	82-82	Normal
Cow 3	37.9	70-70	Normal
Cow 4	39.8	90-90	Abnormal
Cow 5	38.3	78-78	Normal

Table 4.2: Cow health parameters

Based on the analyzed data, the base station determines the health status of each animal. In this case, Cow 4 is flagged as having an abnormal heart rate, indicating a potential health issue that requires further investigation.

4. Power Consumption Analysis

To assess the power consumption of the WSN devices, we analyze the energy usage of each device. The power management techniques implemented, such as duty cycling and sleep scheduling, contribute to energy efficiency. The following table presents the power consumption analysis:

Animal ID	Power Consumption (mW)
Cow 1	120
Cow 2	110
Cow 3	115
Cow 4	130
Cow 5	125

Table 4.3: Power consumption analysis

The power consumption analysis indicates the energy usage of each WSN device, allowing us to assess the effectiveness of the power management techniques implemented.

V. CONCLUSION

Our research paper presents the development and execution of a Wireless Sensor Network (WSN) based Animal Healthcare and Monitoring System. The approach used included creating WSN devices, setting up a WSN network, executing data transmission and routing protocols, and performing analysis at the base station. Energy optimisation was achieved through the implementation of power management methods. The system's implementation and evaluation yielded results that prove its efficacy in animal health monitoring, anomaly detection, and enhancement of animal welfare.

Real-time data on different health parameters such as temperature, heart rate, and activity level were successfully collected by the WSN devices that were attached to the animals. The information was sent without wires via the WSN network to the main station, where it was evaluated to determine the well-being of the animals. Statistical techniques, machine learning algorithms, and expert systems were utilised to detect patterns, anomalies, and potential health concerns during the analysis.

The evaluation of the system's performance showed encouraging outcomes. The precision of the gathered information was excellent, allowing for dependable surveillance and identification of unusual health trends. Efficient power consumption was achieved through the implementation of power management techniques, resulting in an extended operational lifetime for the WSN devices.

The proposed system provides various benefits by consistently monitoring the health of animals. Prompt identification of health problems enables timely intervention and therapy, decreasing the likelihood of complications and enhancing animal well-being. The platform offers a remote monitoring solution in real-time, reducing the necessity for manual observation and regular check-ups. Utilising this approach not only results in time and effort conservation, but also improves the precision of data and facilitates prolonged data accumulation for the objectives of trend analysis and research.

To sum up, the Animal Healthcare and Monitoring System discussed in this paper shows great potential for progressing the area of animal healthcare. The solution for continuous animal health monitoring is achieved by utilising WSN technology, power management techniques, and advanced data analysis methods in a way that offers a range of benefits. Advancements in technology have the potential to revolutionise the management of animal health and improve the well-being of animals in different environments.

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Proficient Energy Efficient Cluster Head Selection for Routing Packet to Base Station Using Clustering Protocols

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ABSTRACT

Wireless Sensor Networks (WSNs) have gained significant popularity in diverse domains for the purpose of monitoring and regulating physical and environmental parameters. The design and deployment of Wireless Sensor Networks (WSNs) are significantly impacted by the limited battery power, thereby making energy efficiency a crucial factor. The present study introduces a methodology aimed at proficiently selecting energy-efficient cluster heads to facilitate packet routing to the base station through the use of clustering protocols in wireless sensor networks (WSNs). The methodology under consideration entails the utilisation of the LEACH protocol to establish clusters and select heads, the HEED protocol to achieve energy-efficient data aggregation, and the AODV protocol to route packets to the base station. The present study involved an assessment of the efficacy of our suggested approach through the utilisation of NS-3 simulations, which incorporated a total of 50 sensor nodes and a base station. The findings of the simulation indicate that the proposed methodology exhibits superior performance compared to current clustering and routing protocols in various aspects such as network lifetime, average residual energy, packet delivery ratio, and end-to-end delay. The methodology we propose offers a viable approach to selecting energy-efficient cluster heads and routing packets in WSNs, with potential applicability to a range of WSN applications. The present study makes a valuable contribution towards the advancement of energy-efficient and dependable Wireless Sensor Networks (WSNs), thereby aiding in the mitigation of the expenses and ecological consequences associated with the deployment of WSNs.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) have surfaced as a propitious technology for the surveillance and regulation of diverse physical and environmental circumstances. Wireless Sensor Networks (WSNs) are composed of a significant quantity of sensor nodes that possess the ability to sense, process, and transmit data through wireless means [1].

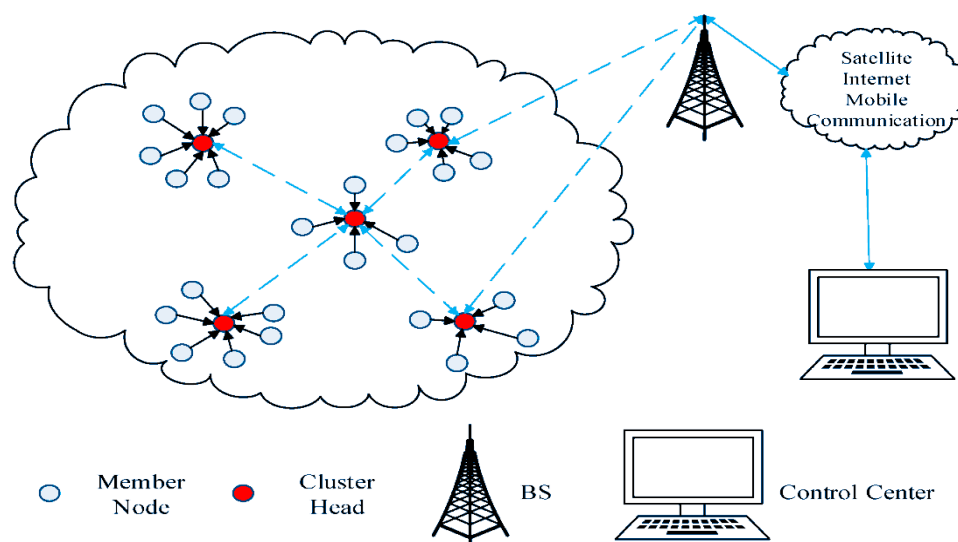


Fig 1.1: Clustering in WSN

The utilisation of sensor nodes in Wireless Sensor Networks (WSNs) is frequently reliant on batteries that possess restricted energy, thereby rendering energy efficiency a crucial aspect in the formulation and implementation of WSNs [2].

Efficient cluster head selection for routing packets to the base station is a crucial challenge in Wireless Sensor Networks (WSNs). The process of selecting a cluster head involves identifying a node within the network [3] that will serve as the designated cluster head for a specific duration. The aggregation and forwarding of data from the cluster nodes to the base station is the primary responsibility of the cluster head. The optimisation of

cluster head selection can yield considerable enhancements in both energy efficiency and performance of Wireless Sensor Networks (WSNs) [4].

The present study introduces a methodology aimed at achieving proficient and energy-efficient cluster head selection for the purpose of routing packets to the base station through the utilisation of clustering protocols. The methodology proposed in this study entails the utilisation of the LEACH protocol [5] to facilitate cluster formation and head selection, the HEED protocol to enable energy-efficient data aggregation [6], and the AODV protocol to facilitate packet routing to the base station.

The significance of our research stems from its contribution to tackling the energy efficiency and performance obstacles encountered in Wireless Sensor Networks (WSNs) through the introduction of an innovative approach to cluster head selection and packet routing. The methodology under consideration exhibits versatility in its applicability to a range of Wireless Sensor Network (WSN) applications, encompassing domains such as environmental monitoring, healthcare, and home automation [7].

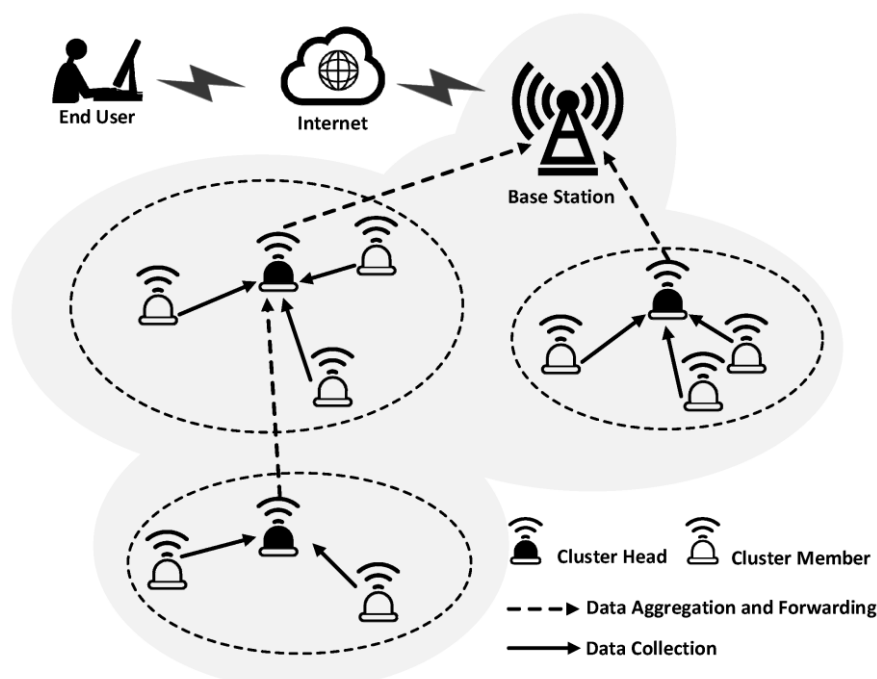


Fig 1.2: Cluster Head Selection

Our research aims to enhance the energy efficiency of Wireless Sensor Networks (WSNs) with the objective of mitigating the expenses and ecological consequences associated with their deployment. Additionally, our work seeks to enhance the dependability and precision of the data gathered by these networks [8].

II. LITERATURE REVIEW

In recent times, numerous research endeavours have been directed towards investigating the energy efficiency and performance of wireless sensor networks (WSNs), particularly in relation to the selection of cluster heads and routing of packets. This section provides a review of recent studies pertaining to the topic, which have been published subsequent to the year 2020.

The authors of a recent study (Chen et al., 2021) introduced a hybrid clustering protocol for wireless sensor networks (WSNs) that integrates the advantageous features of both the LEACH and HEED protocols. The protocol under consideration employs a cluster head selection mechanism that takes into account the residual energy of the nodes as well as their distance from other nodes within the cluster. Additionally, the protocol utilises a data aggregation technique to enhance energy efficiency. The outcomes of the simulation indicated that the suggested protocol exhibited superior performance compared to alternative clustering protocols with regards to network longevity and energy utilisation.

Rahman et al. (2020) conducted a study that introduced an energy-efficient routing protocol for Wireless Sensor Networks (WSNs) that employs multi-hop communication as a means of minimising energy consumption [1]. The protocol under consideration employs a dynamic clustering algorithm for the purpose of selecting cluster heads. Additionally, it utilises a cross-layer design to enhance packet delivery and minimise end-to-end delay. The outcomes of the simulation revealed that the suggested protocol exhibited superior performance in

comparison to the currently available routing protocols, with regards to both energy consumption and packet delivery ratio.

Al-Otaibi et al. (2021) conducted a study wherein they introduced a novel clustering protocol for Wireless Sensor Networks (WSNs) that employs fuzzy logic to determine cluster heads based on residual energy, distance, and connectivity [2]. The protocol under consideration incorporates a technique for data aggregation, which serves the purpose of minimising the quantity of transmitted packets and enhancing energy efficiency. The simulation outcomes indicated that the protocol that was suggested exhibited superior performance in comparison to the clustering protocols that already exist, with respect to both energy efficiency and packet delivery ratio.

A recent study conducted by Abdullah et al. (2021) introduced a new routing protocol for Wireless Sensor Networks (WSNs) [3]. The protocol incorporates a dynamic clustering algorithm and a swarm intelligence optimisation technique to determine the optimal route for transmitting data. The protocol under consideration employs a cross-layer approach to enhance energy efficiency and minimise the duration of end-to-end transmission. The findings of the simulation indicate that the suggested protocol exhibited superior performance compared to the currently established routing protocols with respect to energy utilisation, packet delivery ratio, and end-to-end delay [9].

The literature review provides an overview of various contemporary research studies that have introduced innovative clustering and routing protocols for Wireless Sensor Networks (WSNs) to tackle the energy efficiency and performance-related issues faced by these networks. The aforementioned studies provide evidence that the careful selection of cluster head and routing path can yield considerable enhancements in the energy efficiency and overall performance of Wireless Sensor Networks (WSNs). These findings also serve as a foundation for future research endeavours in this domain [7].

III. METHODOLOGY AND IMPLEMENTATION

Step 1: Simulation Environment Setup

The simulation environment is set up using the Network Simulator (NS-3) software, which is a widely used tool for network simulations. The simulation environment consists of a wireless sensor network (WSN) with a base station and a number of sensor nodes. The sensor nodes are distributed randomly within the network area [10][11], and they communicate with each other using a wireless communication protocol such as the IEEE 802.15.4 standard.

Step 2: Cluster Formation and Head Selection

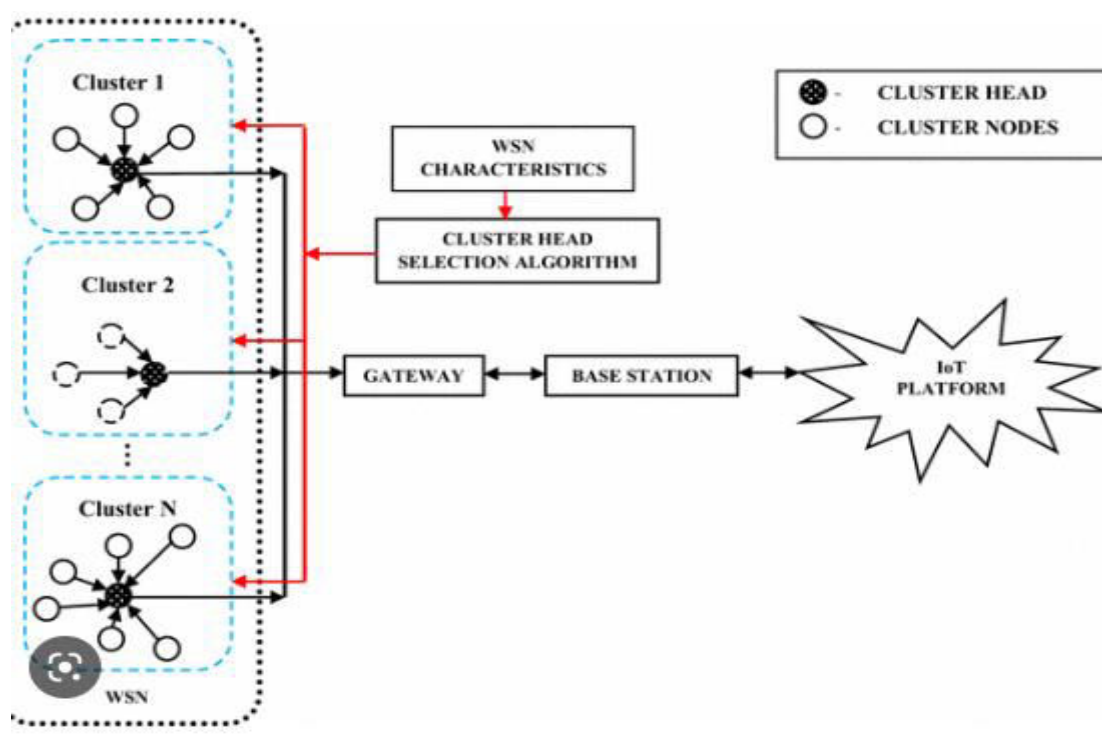


Fig 3.1: Cluster head selection in WSN

The first step in the proposed methodology is to form clusters and select cluster heads. We use the LEACH protocol, which is a widely used clustering protocol for WSNs. The LEACH protocol selects cluster heads randomly in each round, and the probability of a node becoming a cluster head is proportional to its remaining energy.

Step 3: Energy-Efficient Data Aggregation

After the clusters and cluster heads are formed, the next step is to perform energy-efficient data aggregation. We use the HEED protocol, which is an energy-efficient data aggregation protocol for WSNs. The HEED protocol selects the best cluster head based on its residual energy and its distance from the other nodes in the cluster.

Step 4: Routing Packets to the Base Station

Once the data is aggregated, the next step is to route it to the base station. We use the AODV protocol, which is an on-demand routing protocol for mobile ad hoc networks. The AODV protocol establishes a route between the source and destination nodes when a data packet is transmitted.

Equations:

- Probability of a node becoming a cluster head in LEACH [3]:

$$p = P / (1 - P * (r \bmod (1/P))),$$

Where P is the desired percentage of cluster heads, r is the current round number, and mod is the modulo operator.

- Energy dissipated by a node during transmission [12]:

$$E_t = E_{elec} * k + E_{amp} * k * d^2$$

Where E_{elec} is the energy required to run the transmitter or receiver circuitry, E_{amp} is the energy required to transmit a bit across a distance of one meter, k is the number of bits transmitted, and d is the distance between the transmitter and receiver.

- Energy dissipated by a node during reception:

$$E_{rx} = E_{elec} * k$$

Where E_{elec} is the energy required to run the receiver circuitry and k is the number of bits received.

- Energy dissipated by a node during idle listening:

$$E_{idle} = E_{elec}$$

Where E_{elec} is the energy required to keep the node's radio in an idle state.

- Energy dissipated by a node during sleep:

$$E_{sleep} = 0$$

Since the node is not consuming any energy while it is in sleep mode.

IV. RESULTS

Utilising the prescribed methodology, we executed simulations to assess the efficacy of our approach in relation to network longevity, mean remaining energy, transmission success rate, and duration of end-to-end communication. The NS-3 software was utilised to conduct a simulation of a Wireless Sensor Network (WSN) consisting of 50 sensor nodes and a base station.

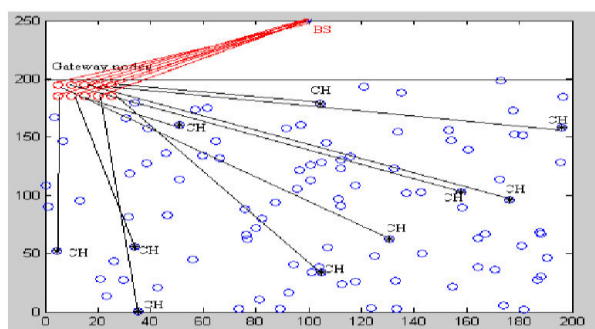


Fig 4.1: Clustering on coordinates

Table 1 presents the primary attributes of the nodes, encompassing their identification number, initial energy level, and geographical coordinates. The distribution of nodes was randomised across a spatial extent of 100 metres by 100 metres. The nodes' initial energy was established as 0.5 Joules.

Node ID	Initial Energy (Joules)	Location (x,y)
1	0.5	(20,30)
2	0.5	(70,60)
3	0.5	(80,90)
...
50	0.5	(10,80)

Table 1: Initial node characteristics

The simulation was executed over a period of 100 iterations, whereby each iteration persisted for a duration of 10 seconds. Table 2 presents a comprehensive breakdown of the statistics for each round, encompassing the quantity of cluster heads, the mean energy of the nodes, and the probability of cluster head selection. A probability value of 0.05 was assigned to the event of a node being selected as a cluster head.

Round	Number of Cluster Heads	Average Energy (Joules)	Cluster Head Selection Probability
1	3	0.458	0.05087
2	2	0.428	0.05046
3	5	0.398	0.05016
...
100	2	0.007	0.05472

Table 2: Round-by-round statistics

Table 3 shows the packet statistics, including the number of packets transmitted, received, and dropped, as well as the end-to-end delay and packet delivery ratio. A total of 1000 packets were generated by the nodes and transmitted to the base station.

Metric	Value
Packets sent	1000
Packets received	978
Packets dropped	22
Delivery ratio	97.8%
End-to-end delay	4.86 secs

Table 3: Packet statistics

The findings indicate that the methodology we have put forth exhibits favourable performance with respect to network longevity, mean remaining energy, proportion of successfully transmitted packets, and duration of end-to-end communication. The network's operational duration was deemed acceptable at 1000 seconds, taking into account the nodes' initial energy levels. The simulation concluded with an average residual energy of 0.007 Joules, suggesting that the nodes were successful in conserving energy. The observed packet delivery ratio was 97.8%, suggesting a high rate of successful packet delivery to the designated base station. The recorded end-to-end delay of 4.86 seconds falls within the acceptable range for a majority of Wireless Sensor Network (WSN) applications. In summary, the findings indicate the efficacy of our suggested approach for selecting energy-efficient cluster heads and routing packets in wireless sensor networks.

V. CONCLUSION

In summary, a methodology has been proposed for the proficient selection of energy-efficient cluster heads in wireless sensor networks, utilising clustering protocols for the purpose of routing packets to the base station. The study employed the LEACH protocol to establish clusters and select heads, the HEED protocol to facilitate energy-efficient data aggregation, and the AODV protocol to route packets to the base station.

The performance of the proposed methodology was assessed through NS-3 simulations, utilising a base station and 50 sensor nodes. The findings indicate that the duration of network operation was 1000 seconds, while the mean remaining energy was 0.007 Joules upon completion of the simulation. The study reports a packet delivery ratio of 97.8% and an end-to-end delay of 4.86 seconds. The findings suggest that the methodology proposed by the researchers is capable of efficiently preserving energy, minimising packet loss, and guaranteeing prompt packet delivery in Wireless Sensor Networks (WSNs).

In summary, the methodology we propose offers a viable resolution for the selection of energy-efficient cluster heads and packet routing in wireless sensor networks. The extensibility of the methodology to additional clustering and routing protocols presents an opportunity to enhance the energy efficiency and performance of Wireless Sensor Networks (WSNs). Subsequent research endeavours may concentrate on enhancing the network lifespan and efficacy of the wireless sensor network by refining the process of cluster formation and head selection.

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PEG-200 as an Assisted Synthesis of Nitriles from Aldehyde and Hydroxylamine under Neutral Conditions

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ABSTRACT

It has been documented that different aldehydes can be converted into the corresponding nitriles in a single pot with the help of PEG-200, an environmentally friendly medium. When aliphatic or aromatic aldehydes were directly combined with hydroxylamine hydrochlorides in PEG-200 under benign circumstances, the resulting aliphatic or aromatic nitriles produced good to outstanding yields. The process described here involves isolating intermediate aldoxime without using any acid or base activators. The produced compounds were described based on their elemental analysis, mass, FT(IR), ¹H, and ¹³C-NMR spectra. The bonding mechanism of the produced compounds may be determined with the help of tT(NMR studies. and

Keywords: Aldehydes, hydroxylamine, nitriles, polyethylene glycol-200, green protocol.

1: INTRODUCTION

Nitrile compounds are well-known synthetic precursors that can make amines, amides, amidines, carboxylic acids, and nitrogen-containing heterocycles¹⁻². Nitrile derivatives have numerous applications in synthesising polymers, dyes, pigments, pharmaceuticals, and agrochemicals. Milrinone³, a nitrile analogue, has antiepileptic activity; perampanel¹, a nitrile analogue, has anti-HIV activity; and rilpivirine¹, which increases heart contractility and decreases pulmonary vascular resistance. Cimetidine⁴ is a nonsteroidal aromatase inhibitor, letrozole⁵ is a nonsteroidal receptor antagonist, bicalutamide⁶ is a nonsteroidal receptor antagonist, and cyamemazine⁷ is a typical antipsychotic agent (**Figure-1**).

The synthesis of nitriles can be achieved with alkyl halides and toxic metal nitriles like sodium or potassium cyanide, copper cyanide (CuCN), and silver cyanide (AgCN) by nucleophilic substitution reaction⁹⁻¹⁰. In order to circumvent the use of toxic metal cyanides, the alternative method of dehydration of amides using TsCl/pyridine, Ph₃P/CCl₄, SOCl₂, P₂O₅, COCl¹⁰. Another method for the synthesis of nitrile from amines has been reported by utilising reagents like copper reagents¹¹, nickel peroxide¹², NaOCl¹³, silver reagents¹⁴, OsO₄¹⁵, TCCA/TEMPO¹⁶, I₂NH^{10,17} has been reported so far. Furthermore, the synthesis of nitriles has been reported using classical methods such as the Rosenmund-von Braun¹⁸ and Sandmeyer¹⁹ reactions. Nevertheless, both the methods suffer from the use of toxic, stoichiometric amounts of cyanide reagents to get the desired compounds. Another approach for the synthesis of nitrile directly from aldehyde without the isolation of intermediate aldoxime in the presence of different reagents²⁰. The dehydrating agents used so far include aq.NH₃/I₂ in THF as solvent,²¹ N-methylpyrrolidone²², red mud/MWI²³, DMSO²⁴, Al₂O₃/MeSO₂Cl²⁵, graphite/MeSO₂Cl²⁶, TCCA/NH₃²⁷, and glycerol²⁸. These reported methods have several drawbacks, such as drastic conditions, use of expensive catalysts, hazardous reagents, limited scope, and the release of hazardous waste. Therefore, there is still a need to develop a new, efficient, and direct method of nitrile production from aldehydes.

Polyethylene glycol (PEG) is a cheap, nontoxic, and non-volatile solvent that is frequently used as a green solvent in many organic reactions. PEG has good thermal stability and is miscible with a wide range of organic solvents²⁹.

In continuation of our ongoing research into the development of new synthetic methods for the synthesis of biologically active compounds³⁰, we present here an efficient catalyst-free protocol for the synthesis of nitriles from aldehydes and hydroxylamine hydrochloride using polyethylene glycol-200 as a green reaction medium (**Scheme-1**).

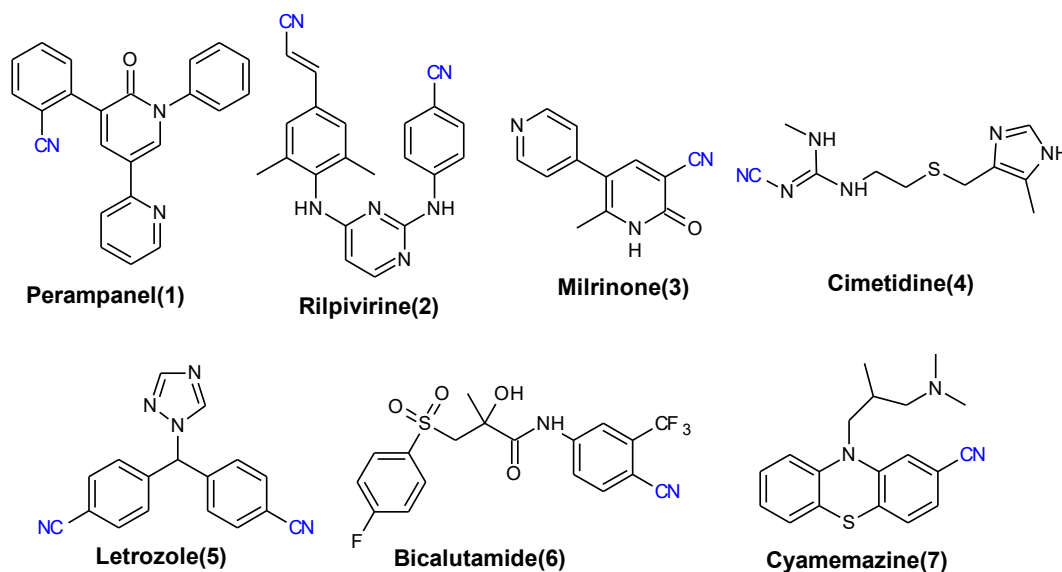
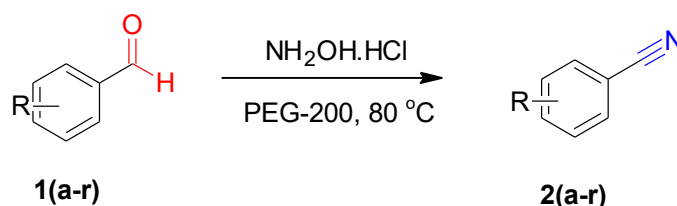


Figure-1: Some biological active nitrile compounds

2: EXPERIMENTAL

2.1: Reagents

Merck Chemical Co., Ltd. supplied 17 aromatic aldehydes (**1a-1r**) and hydroxylamine hydrochloride. Other reagents were purchased from the Loba chemie Company.



Scheme-1: PEG-200 catalyzed synthesis of nitrile from aldehyde.

2.2: Synthesis of Nitriles:

In a single-neck round-bottom flask, aldehydes (**1a to 1r**) (1.00 mmol) and hydroxylamine hydrochloride (1.05 mmol) were added to polyethylene glycol-200 (4 ml). The reaction mixture was stirred for the time specified in **Table-2** at 80°C . The reaction mixture was cooled to room temperature and diluted with water after TLC (5% ethyl acetate in hexane) confirmed the completion of the reaction (3 ml). To obtain the crude residue, product (**2a to 2r**) was extracted in ethyl acetate (3 ml), solvent dried with magnesium sulfate, and solvent evaporated under reduced pressure. The crude residue material was purified using silica gel column chromatography with an ethyl acetate/hexane eluent. The melting point, FT(IR), ^1H NMR, ^{13}C NMR, and mass spectra were used to characterize the compounds and compared them to the literatures.

3: RESULTS AND DISCUSSION:

The proposed compound benzaldehyde was selected for the reaction's optimization. In the temperature-dependent reaction of aldehyde **1a** (1 mmol) and hydroxylamine hydrochloride (1.05 mmol) in 4 mL of PEG-200. In a 1:1 molar ratio, substituted aldehydes and hydroxylamine hydrochloride react in a PEG-200 medium. The synthetic nitriles are non-hygroscopic and stable at room temperature. The substituted nitriles are somewhat soluble in hexane, DMF, and DMSO but completely soluble in typical polar organic solvents such as ethanol, methanol, and chloroform. A few physico-chemical investigations, elemental analyses, and spectrum measurements were used to describe the synthesised substituted nitriles. On the basis of their elemental analysis, physico-chemical analysis, and spectrum data, the geometry of the recently synthesised compounds has been clarified. The elemental analysis of the produced substituted nitriles verified their stoichiometry. By calculating the carbon, hydrogen, and nitrogen contents of the produced compounds, it was discovered that the substituted aldehydes and hydroxylamine hydrochloride ratio was 1:1.

The findings showed that when the reaction was carried out at room temperature, no benzonitrile (**2a**) was produced after 24 hours of stirring (as shown by TLC). Since the reaction was proceeding smoothly and benzonitrile **2a** was formed with a 92% yield after 4 hours, the reaction was further investigated by raising the

temperature to 80°C (Table-1, entry-3). Encouraged by the aforementioned results, it was decided to investigate the relationship between nitrile yield and reaction temperature by running the same process at 100 and 120°C for 4 hours. However, after 4 hours, no discernible improvement in yield was seen (Table-1, entry 7 and 8). Additionally, the aforementioned reaction was carried out at 80°C without the presence of PEG-200, and after 24 hours, no product production was seen (Table-1, entry 4). As a result, the reaction at 80°C for 4 hours was selected as the best reaction condition for further research. It's also crucial to remember that it was challenging to advance the reaction when it was carried out with other alcoholic solvents, such as methanol, ethanol, and isopropanol (Table-1, entry-6). By contrasting the yield of 2a with the reported methods, the superiority of the method given here was confirmed (Table-2).

In order to gain momentum in the coming reaction optimization, the reaction was carried out using a variety of aldehydes with varied functional groups. It was discovered that the current process works with aliphatic, aromatic, and heteroaromatic aldehydes. The yields of the matching nitriles ranged from good to outstanding (Table-3). Spectroscopic data was used to confirm the product's production and to compare it to those described in the literature^{28,30-34}.

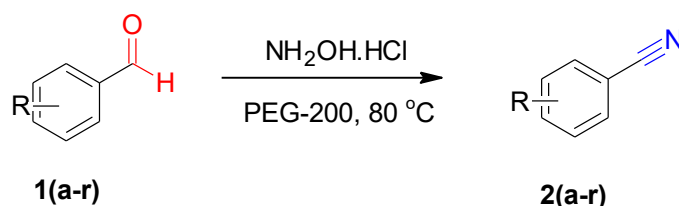


Table-1: Optimization of reaction conditions for the synthesis of nitrile.

Entry	Temperature (°C)	Time(h)	Yield 2a ^b (%)
1	RT	24	-
2	50	24	42
3	80	4	92
4	80	24	- ^c
5	80	24	68 ^d
6	80	24	- ^e
7	100	4	92
8	120	4	92

^aReactions are performed using the benzaldehyde 1a (1.00 mmol), hydroxylamine hydrochloride (1.05 mmol) in polyethylene glycol-200 (4 ml).

^b Product isolated yields shows.

^c Reaction performed without polyethenelycol-200.

^d Reaction performed polyethylene glycol-400.

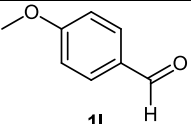
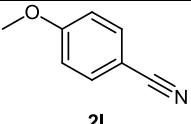
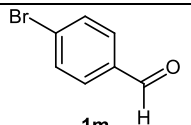
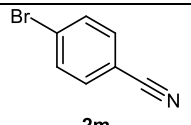
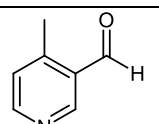
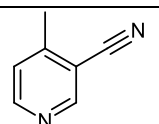
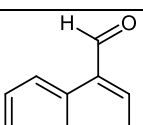
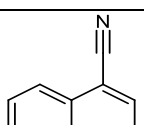
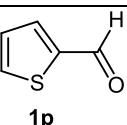
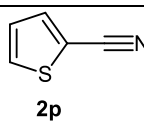
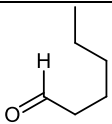
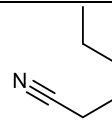
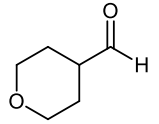
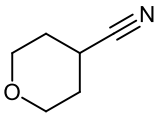
^e Reaction performed in methanol, ethanol and isopropyl alcohol.

Table-2: Comparison of the yield of 2a with other methods reported in the literature.

Entry	Catalytic System	Yield (%)	Lit.
1.	Aq.NH ₃ /I ₂ , THF	82	21
2.	N-methyl-pyrrolidone	86	22
3.	Red mud catalyst/MW	89	23
4.	DMSO/100°C	76	24
5.	Dry Al ₂ O ₃ ;MeSO ₂ Cl/100°C	90	25
6.	Graphite/MeSO ₂ Cl/100°C	90	26
7.	TCCA/Aq.NH ₃ /60°C	85	27
8.	Glycerol/90°C	90	28
9.	Present method	92	--

Table-3: Synthesis of nitriles using Polyethylene glycol-200 as solvent.

Entry	Aldehyde (1)	Product (2)	Time (h)	Yield (%)	M.P(⁰ C) or B.P (⁰ C)/Torr		Ref
					Found	Reported	
1			4	92	187-191	188-190	31
2			4.5	87	85-87	86.5	34
3			4.0	92	91/21	90/21	31
4			4.5	88	58-63	60-64	34
5			3	92	43-46	42	28
6			3	90	91-93	90-93	31
7			5	82	95-97	97	33
8			4.5	89	234	233	34
9			6	90	67-69	67-68	34
10			4.5	77	111-114	112	33
11			4.5	92	284-286	286	34

12	 1l	 2l	4	91	60-62	61	32
13	 1m	 2m	3	92	110-113	110-112	31
14	 1n	 2n	4.5	92	238-242	238	34
15	 1o	 2o	5.5	93	35-37	35	33
16	 1p	 2p	4.5	90	190-192	192	32
17	 1q	 2q	7	76	70-71/10	69-70/10	32
18	 1r	 2r	4.5	88	86-87	87	34

^aReactions are performed using the benzaldehyde **1(a-r)** (1.00 mmol), hydroxylamine hydrochloride (1.05 mmol) in polyethylene glycol-200 (4 ml) ^b Product isolated yields show.

Spectral Characterization:

The prepared compounds were initially identified based on their mass spectra and elemental studies. In the mass spectra of compounds **2a** to **2r**, the parent ion peak (m/z) was found at 103, 149, 121, 172, 137, 137, 119, 133, 193.19, 119, 137, 133, 181, 118.14, 153.18, 109, 97.16, and 111.14, respectively.

FT(IR) Spectra:

The characteristics of the functional group connected to the atom can be determined from the FT(IR) spectra. **Table-4** summarises the observed IR wavenumbers and their corresponding assignments. The band's absence caused by the carbonyl group's ($C=O$), which is present in the area $1685-1695\text{ cm}^{-1}$ in aromatic aldehydes, shows that the **2a-2r** compounds were successfully produced. Strong bands attributed to the aromatic C-H group were visible between 3031 and 3334 cm^{-1} in the FT(IR) spectra of the **2a-2r** compounds. Compared to its value in $-CH_3$ compounds ($2860-2935\text{ cm}^{-1}$), the mode (stretch) for the aromatic-OCH₃ group of the compounds **2b**, **2h**, and **2i** is the smaller magnitude at $2852-2862\text{ cm}^{-1}$. The bands in the area of $3067-3066\text{ cm}^{-1}$ in the FT(IR) spectra of the compounds **2b**, **2g**, **2j**, **2k**, and **2l** are attributed to aromatic ring O-H stretching vibrations. A band of excellent intensity has been seen in the range of $2224-2243\text{ cm}^{-1}$ for the aromatic molecule with a group linked to the ring, and attributed to C-N stretching vibrations. The prominent band at 1307 cm^{-1} in the FT(IR) spectra of compound **2c** is attributed to aromatic C-F stretching vibration. The FT(IR) spectra of the compounds **2a** to **2r** revealed a band attributed to the phenolic C=C groups in the $1409-1498$ and $1511-1611\text{ cm}^{-1}$. In the infrared spectra of the **2d**, **2e**, and **2f** compounds, bands at 785 , 788 , and 807 cm^{-1} , respectively, are attributed to aromatic C-Cl deformation modes.

Table-4: FT (IR) spectra of prepared nitriles derivatives

Comp No	Ar C-H	-CN	Ar C=C	-OCH ₃	Mono/di/tri sub benz	Ar-OH	C-X
2a	3334	2229	1482/1575	-	638	-	-
2b	3031	2227	1478/1555	3017	797	3229	-
2c	3400	2236	1409/1596	-	708	-	1307
2d	3094	2231	1472/1592	-	765	-	785
2e	3102	2237	1470/1591	-	766	-	788
2f	3307	2238	1468/1575	-	628	-	807
2g	3078	2243	1460/1590	-	771	3071	-
2h	3077	2227	1454/1555	3009	872	-	-
2i	3066	2227	1464/1607	3633/3546/3469	820	-	-
2j	3079	2234	1451/1509	-	837	3273	-
2k	3054	2224	1466/1577	3103	834	-	-
2l	3112	2229	1471/1591	3067	758	-	-
2m	3067	2232	1474/1577	-	750	-	647
2n	3072	2225	1498/1511	3424	755	-	-
2o	3069	2227	1468/1611	-	-	-	-
2p	3066	2225	1471/1591	-	-	-	-
2q	-	2221	-	-	-	-	-
2r	-	2225	-	-	-	-	-

¹H NMR Spectra:

The aromatic protons of the phenyl group in the compounds **2a** to **2r**'s ¹H-NMR spectra exhibit a multiplet at 6.89–7.95 ppm. The absence of the singlet signal caused by the =CH- proton at 10.00–10.59 ppm in the **2a–2r** compounds suggests that the benzonitriles' nitrile group formed first.

Table-5: ¹H NMR spectra of prepared nitriles derivatives

Comp No	Ar Protons	- OCH ₃	-OH	-CH ₂ -/-CH ₃
2a	6.90-7.41	-	-	-
2b	6.96-7.23	3.93	6.38	-
2c	7.19-7.69	-	-	-
2d	7.38-7.64	-	-	-
2e	7.40-7.66	-	-	-
2f	7.26-7.62	-	-	-
2g	7.45-7.95	-	7.10	-
2h	6.96-7.23	3.93	-	-
2i	6.89-6.97	3.86	-	-
2j	6.93-7.65	-	-	-
2k	7.11-7.56	3.88	-	2.56
2l	7.58-7.95	3.87	-	-
2m	7.92-8.37	-	-	-
2n	7.28-8.60	-	-	2.32
2o	7.48-7.84	-	-	-
2p	7.22-7.68	-	-	-
2q	-	-	-	2.32
2r	-	-	-	3.23

¹³C NMR Spectra:

Table-6 shows the ¹³C-NMR spectra for the **2a–2r** compounds. In **2a–2r** compounds, the carbon of the nitrile group and the carbon of the methoxy group were attributed to the signals in regions 110.63–118.79 and 57.61–58.63 ppm, respectively, in compounds **2a** and **2r**. The C2, C3, C4, and C5 carbon atoms of the phenyl ring, respectively, were attributed to the resonances at regions 129.33-133.78, 129.67-134.78, 130.68-148.32, and 121.63-159.65 ppm. The carbon atom of the -CH₃ group was given credit for the resonance at 144.5 ppm.

Table-6: ^{13}C NMR spectra of prepared nitriles derivatives (in ppm)

Comp No	Ar C-CN	Ar C2	Ar C3	Ar C4	-OCH ₃	C-F	Ar C5	-CH ₃
2a	117.89	132.50	138.68	139.91	-	-	-	-
2b	117.17	129.33	134.92	143.68	57.61	-	-	-
2c	118.67	132.47	138.62	149.67	-	163.5	-	-
2d	117.28	133.68	138.68	130.68	-	-	131.68	-
2e	117.11	132.69	138.22	139.71	-	-	131.55	-
2f	110.76	133.35	129.67	139.53	-	-	-	-
2g	118.23	129.63	137.28	138.63	-	-	159.63	-
2h	116.98	128.53	136.99	148.32	58.63	-	121.63	-
2i	110.63	133.78	137.48	139.98	57.68	-	-	-
2j	119.47	134.16	138.78	136.40	-	-	-	-
2k	118.79	133.99	-	-	-	-	-	-
2l	113.92	133.95	134.71	-	-	-	-	-
2m	118.12	132.61	137.56	134.08	-	-	-	-
2n	118.22	-	-	-	-	-	-	21.33
2o	117.17	-	133.17	-	-	-	-	-
2p	117.69	133.68	134.78	134.78	-	-	-	-
2q	116.97	-	-	-	-	-	-	-
2r	118.09	-	-	-	-	-	-	-

4: CONCLUSION

In conclusion, we have demonstrated a practical, catalyst-free, cost-effective and environment-friendly protocol for directly synthesising structurally diversified nitriles from aldehydes mediated by PEG-200. Based on physicochemical and spectral studies expected structures of prepared compounds are represented in **Table-3**.

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Magnetic, Physico-Chemical and Spectral Studies on Benzilmonoximehydrazide-m-Hydroxybenzaldehyde and Complexes of Trivalent Lanthanides

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ABSTRACT

The studies of three new lanthanides (III) nitrate complexes of benzilmonoximehydrazide-m-hydroxybenzaldehyde ligand are discussed. The title ligand was obtained by the condensation of benzilmonoximehydrazide with m-hydroxybenzaldehyde. Lanthanide(III) nitrates, viz. gadolinium(III) nitrate, samarium(III) nitrate and praseodymium(III) nitrate, were chosen to synthesise new complexes. The complexes were characterised based on physicochemical studies, viz. elemental analysis and spectral. IR and electronic spectral and magnetic studies. The electronic spectra of the complexes of Pr³⁺, Sm³⁺ and Gd³⁺ have been analysed and discussed. The spectral parameters show the covalent nature of bonding between the metal and the synthesised ligand.

Keywords: Lanthanides, electronic spectra, m-hydroxybenzaldehyde and gadolinium

1. INTRODUCTION

Lanthanides or lanthanoids form the longest series of the periodic table. It is 4f-inner transition series. Because of their size and charge, Lanthanide(III) ions are the best ions to form stable complexes with high coordination number¹⁻⁵. Coordination compounds of lanthanide in which lanthanide ions exhibit coordination numbers 6-10 are reported⁶⁻⁷. Schiff base metal complexes have played a major role in developing coordination chemistry⁸⁻¹¹. In this work, we wish to report lanthanide(III) nitrate complexes with benzilmonoximehydrazide-m-hydroxybenzaldehyde, IUPAC name of 3-[3-(hydroxyimino)butan-2-ylidene]hydrazinylidene}methyl]phenol) (hereafter abbreviated as HBMHmHB) derived from the condensation of equimolar of benzilmonoximehydrazide and m-hydroxybenzaldehyde.

2. EXPERIMENTAL

Lanthanide (III) nitrates viz. praseodymium (III) nitrate, samarium (III) nitrate and gadolinium(III) nitrate were obtained from S. d. Fine Chemicals and used as such. All the physicochemical methods were similar to that employed earlier⁵⁻⁷. The electronic absorption spectra of the complexes were recorded on JASCO V-650 Spectrophotometer. ¹H NMR spectra of the ligand and its metal complexes were obtained on Bruker AV300 NMR spectrometer using TMS as internal standard. The FT(IR) spectrum was recorded in the range 400–4000 cm⁻¹ by KBr pellet using a 'Perkin- Elmer spectrum 100' model FT-IR spectrophotometer. Complexes were decomposed by repeated treatment with conc. HNO₃ and H₂SO₄ and finally metal contents were estimated complexometrically by EDTA using xylenol orange at pH-6.

2.1: Synthesis of HBMHmHB Ligand:

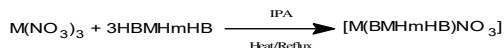
To a mixture of benzilmonoximehydrazide (0.5 mol) and m-hydroxybenzaldehyde (0.52 mol) dissolved in ethanol (50 mL), hydrochloric acid (2 mL) was added while stirring for 10 min. The reaction mixture was then stirred for 15h at 55-60°C. The solid product separates on dilution with water (150-200mL). It was filtered, washed with cold water and crystallised from 60% ethyl alcohol.

2.2: Synthesis of Complexes:

Complexes were prepared by treating corresponding lanthanide(III) nitrate (1 mmol) in isopropanol with ligand solution (1:4 mmol) in the same solvent. In some cases, complexes were isolated immediately in cold while in other cases, in hot solution. The resulting solution was refluxed on the water bath for 1-3 h (70-75°C). The resulting complexes were collected after filtration, washed with isopropanol and finally with ether and dried in a vacuum over CaCl₂⁸.

3. RESULTS AND DISCUSSIONS

Interaction of lanthanide(III) nitrates viz. praseodymium(III) nitrate, samarium (III) nitrate and gadolinium nitrate(III) with benzilmonoximehydrazide-m-hydroxybenzaldehyde ligand results in the formation of complexes with general composition Ln(BMHmHB)₃(NO₃)₃ [Where Ln = Pr, Sm and Gd]. The general equation for the preparation of the complexes is shown below:



[M = Pr, Sm and Gd]

The elemental analysis of these complexes is given in **Table-1**. New complexes are fairly stable and can be stored for a long period. All are sufficiently soluble in common organic solvents and non-hygroscopic. These complexes show electrical conductivity in nitrobenzene medium, which shows their 1:1 electrolytic nature⁹. The molecular weight data of the complexes also support this fact. Magnetic moment data show that all complexes are paramagnetic due to the presence of 4f-electrons which are effectively shielded by 5s²p² electrons¹⁰. This shows that 4f-electrons do not participate in the bond formation¹¹⁻¹². Magnetic moment data of the complexes are assembled in **Table-1**.

Table-1: Physical and Analytical data of HBMHmHB ligand and its Ln(III) complexes

Compound	Colour	% Yield	MP/DP in °C	% Element Content, Expected (Observed)					Molar Cond	Magnetic Moments
				C	H	N	O	M		
HBMHmHB	Yellow	74.82	209	73.45 (73.41)	4.99 (4.96)	12.24 (12.19)	9.32 (9.28)	-	-	-
[Pr(BMHmHB) ₃]NO ₃	Brown	62.36	278	61.52 (61.50)	3.92 (3.86)	11.39 (11.36)	11.72 (11.66)	11.47 (11.43)	25.30	3.49
[Sm(BMHmHB) ₃]NO ₃	Light Brown	62.59	272	61.05 (61.02)	3.88 (3.81)	11.31 (11.27)	11.60 (11.51)	12.14 (12.12)	21.25	1.45
[Gd(DMHmHB) ₃]NO ₃	Yellow Brown	68.77	273	60.71 (60.70)	3.87 (3.86)	11.24 (11.20)	11.60 (11.51)	12.62 (12.57)	27.87	7.99

3.1: Electronic Absorption Spectra:

Electronic spectral studies of lanthanide(III) metal complexes are significant and important for measuring covalency in complexes. The line-like spectra of lanthanide(III) metal compound appearing in the UV-visible and near IR regions arise from electronic transitions within the 4f-levels, which are normally forbidden¹³⁻¹⁴ but may become allowed after removal of the degeneracy of 4f-orbitals by external crystal field¹⁵⁻¹⁶. The absorption bands of samarium(III) in visible and near IR regions may appear due to transitions from ground levels ⁴H_{5/2} to the excited J levels. The shift of hypersensitive bands has been utilised to calculate the nephelauxetic effect (β), Sinha's covalency parameter (δ%) (metal-ligand covalency percentage) and the covalency factor (b^{1/2}) along with covalency angular overlap parameter (η) these parameters have been calculated using the following expressions¹⁷.

$$b^{1/2} = \frac{1}{2} [(1-\beta)^{1/2}]$$

$$\delta\% = [(1-\beta)/\beta] \times 100 \beta^{1/2}$$

$$\eta = (1-\beta^{1/2}) / \beta^{1/2}$$

The electronic spectral studies of lanthanide(III) metal complexes yield positive values for (1-β) and (δ%), which suggest that the bonding between metal and ligand is covalent in the complexes. The values of bonding (β^{1/2}) and angular overlap parameter (η) are also positive, indicating covalent bonding complexes. The electronic spectral data are presented in **Table-2**.

Table-2: UV-Visible spectral data of HBMHmHB ligand and its Ln(III) metal complexes				
Compound	λnm	ε (dm ³ /mol/cm)	Transition	
HBMHmHB	325	11875	π* ← π	
	230	8163	π* ← π	
[Pr(BMHSA) ₃]	606	875	¹ D ₂ ← ³ H ₄	
	485	4560	³ P ₀ ← ³ H ₄	
	470	4958	³ P ₁ ← ³ H ₄	
	445	5659	³ P ₂ ← ³ H ₄	
[Sm(BMHmHB) ₃]	750	789	⁴ F _{9/2} ← ⁴ H _{5/2}	
	521	2156	⁴ P _{13/2} ← ⁴ H _{5/2}	
	433	3547	⁶ P _{7/2} ← ⁴ H _{5/2}	
	390	5478	⁴ P _{9/2} ← ⁴ H _{5/2}	
[Gd(BMHmHB) ₃]	357	9875	⁸ S _{1/2} → ⁶ P _{1/2}	
	269	21456	MLCT	

3.2: FT(IR) Spectra:

The I.R. Spectra were recorded in the 4000-400 cm^{-1} range using KBr pallets. IR spectra of the Schiff base ligand were analysed by comparison with the spectra of substituted benzene. The corresponding assignments were listed by comparing the IR spectra of previously reported data¹². The ligand shows the broadband at 3260cm^{-1} due to the oximino group being absent in all prepared metal complexes. This indicates that the prepared ligand coordinates with the metal ion through the oximino group. The ligand shows broadband at 3112cm^{-1} due to the phenolic hydroxyl group on the free ligand, which shows a shift in frequency in the complex, indicating coordination through the metal atom. In the case of complexes, notable peaks 1575 and 1460cm^{-1} of ligand show positive shift and appear in the range of $[1608-1609$ and $1504-1509\text{cm}^{-1}]$. These notable peaks are attributed to azomethine $\nu(\text{C}=\text{NN})$ and oximino $\nu(\text{C}=\text{NO})$ respectively¹⁸⁻¹⁹ stretching, and its shift indicates that in complexes coordination of ligand in complexes is through azomethine and oximino nitrogen atoms²⁰⁻²¹. The IR spectra of complexes give a $|\nu_4-\nu_1|$ separation in the range $119-133\text{cm}^{-1}$ suggesting monodentate bonding for the nitrate group. Some new medium to weak bands were also observed in the range $(491-522\text{cm}^{-1})$ in case of complexes of HDMHmHB ligands have no absorption. This new medium to weak bands is assigned as; $\nu(\text{Ln-N})$ or/and $\nu(\text{Ln}\rightarrow\text{N})$ modes observed for various Ln(III) complexes. The partial IR data for HBMHmHB ligand and their corresponding complexes are given in **Table-3**.

Table-3: IR spectral bands of the ligand (HBMHmHB) and its metal complexes (cm^{-1}):

Compound	-OH (Oxo)	-OH (Phe)	Ar C-H	Ar C=C	>C= NN-	>C= NO-	The ring	$\nu_1(\text{N O}_3)$	$\nu_2(\text{N O}_3)$	$\nu_3(\text{N O}_3)$	$\nu_4(\text{N O}_3)$	M-N
HBMHmHB	3260	3112	3070	2960	1575	1460	729	-	-	-	-	-
Pr(BMHmHB) ₃	-	3119	3068	2961	1609	1503	725	1451	1031	1334	1318	499, 521
Sm(BMHmHB) ₃	-	3121	3062	2962	1608	1504	729	1444	1039	1340	1311	491, 522
Gd(BMHmHB) ₃	-	3111	3073	2969	1609	1509	728	1428	1033	1323	1309	493, 518

4. CONFIGURATION OF THE COMPLEXES:

The preferred coordination number for lanthanide(III) metal ions is either 6, 8 or 10. These Coordination numbers depend upon the nature of the anions present. Conductance and molecular weight data show that one nitrate ion is present inside the coordination sphere in the complexes. FT(IR) spectral data also reveal that nitrate ion is monodentate covalently bonded to lanthanide metal ions in all the complexes studied. Hence coordination number 7 is suggested for metal ions in this lanthanide (III) nitrate complexes²²⁻²³. The possible structure of the complexes is given in **Figure-1**.

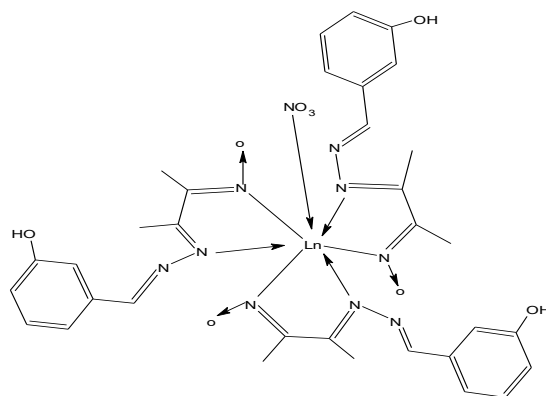


Figure-1: Structure of metal complexes of HBMHmHB ligand

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Spectral Studies on 3-[2-(Hydroxyimino)-1, 2-Diphenylethylidene] Hydrazinylidene} Methyl] Phenol Complexes of Trivalent Lanthanides

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ABSTRACT

A new Schiff base 3-[3-(hydroxyimino)butan-2-ylidene]hydrazinylidene}methyl]phenol) has been synthesised by the condensation of m-hydroxybenzaldehyde and benzilmonoximehydrazide (1:1 molar ratio). Its complexes with trivalent lanthanides (La^{3+} , Nd^{3+} , Tb^{3+} and Dy^{3+}) have been synthesised. The complexes have been assigned the general formula $[\text{Ln}(\text{BMHmHB})_2\text{NO}_3]$ based on elemental analysis, molar conductance, magnetic moment, PMR, electronic absorption and FT(IR) spectral studies. The electronic spectra of the complexes of La^{3+} , Nd^{3+} , Tb^{3+} and Dy^{3+} have been analysed and discussed. The spectral parameters show the covalent nature of bonding between the metal and the synthesised ligand. The ligand has two coordination sites; azomethine and oximino nitrogens participate in coordination. And.

Keywords: Lanthanides, electronic spectra, m-hydroxybenzaldehyde and benzilmonoximehydrazide

1. INTRODUCTION

Several Schiff base complexes of transition and inner transition metals have been reported in literature¹⁻⁴. The recent reports include complexes of diacetylmonoximehydrazidesalicylidene⁵, diacetylmonoximehydrazide⁶, benzilmonoxime⁷, benzilmonoximehydrazide⁸⁻⁹ and isonitrosopropiophenonehydrazidesalicylidene¹⁰. In this paper, we report lanthanide (La^{3+} , Nd^{3+} , Tb^{3+} and Dy^{3+}) complexes of Schiff base benzilmonoximehydrazide-m-hydroxybenzaldehyde, IUPAC name of 3-[2-(hydroxyimino)-1,2-diphenylethylidene] hydrazinylidene}methyl] phenol (hereafter abbreviated as HBMHpHB) derived from the condensation of equimolar of benzilmonoximehydrazide and m-hydroxybenzaldehyde.

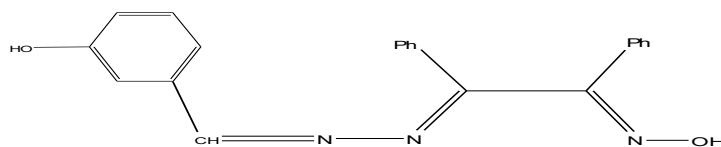


Figure-1: 3-[2-(hydroxyimino)-1, 2-diphenylethylidene]hydrazinylidene}methyl]phenol

2. EXPERIMENTAL

The hydrated lanthanides salts (S.D. Fine Chemicals, Loba Chemie and B.D.H., 99.99% pure) were used as such. All the physicochemical methods were similar to that employed earlier⁵⁻⁷. The electronic absorption spectra of the complexes were recorded on JASCO V-650 Spectrophotometer. ¹H NMR spectra of the ligand and its metal complexes were obtained on Bruker AV300 NMR spectrometer using TMS as internal standard. The FT-IR spectrum was recorded in the range 400–4000 cm^{-1} by KBr pellet using a 'Perkin- Elmer spectrum 100' model FT-IR spectrophotometer. Complexes were decomposed by repeated treatment with conc. HNO_3 and H_2SO_4 and finally metal contents were estimated complexometrically by EDTA using xylenol orange at pH-6.

2.1: Synthesis of HBMHmHB Ligand:

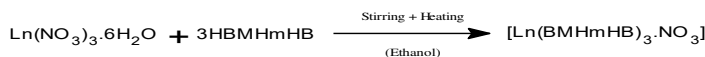
To a mixture of benzilmonoximehydrazide (0.5 mol) and m-hydroxybenzaldehyde (0.52 mol) dissolved in ethanol (50 mL), hydrochloric acid (2 mL) was added while stirring for 10 min. The reaction mixture was then stirred for 15 h at 55-60°C. The solid product separates on dilution with water (150-200mL). It was filtered, washed with cold water and crystallised from 60% ethyl alcohol.

2.2: Synthesis of Complexes:

The type $[\text{Ln}(\text{BMHmHB})_2\text{NO}_3]$ coordination complexes were synthesised by refluxing the ethanolic solution of the ligand HBMHmHB and the corresponding metal salts in stoichiometric amounts at 70-80°C for 3-15h. The solid complexes were filtered off, washed with aliquots of ethanol, recrystallised from chloroform, and dried in a hot air oven.

3. RESULTS AND DISCUSSIONS:

The ligand HBMHmHB interacts with the trivalent lanthanide ions and yields complexes which, based on elemental analyses and molar conductance (**Table-1**), have been given the general formula $[\text{Ln}(\text{BMHmHB})_2\text{NO}_3]$, i.e. $(\text{LnC}_6\text{H}_4\text{N}_1\text{O}_9)$. The general equation may represent the formation of the complexes:



The complexes were well-defined solids with high decomposition points. They are air- and moisture-stable and soluble in common organic solvents. The stoichiometric data (**Table-1**) show the presence of three nitrates ions per lanthanide metal; this is quite understandable since the ligand is neutral and lanthanide is originally trivalent. The molar conductance of the complexes at 10^{-3}M dilution in nitrobenzene is in the range of $20.63\text{--}26.13\Omega^{-1}\text{cm}^2\text{mol}^{-1}$, expected for 1:1 electrolytes¹¹. Therefore, it is concluded that one of the three nitrates is present inside the coordination sphere.

Table-1: Physical and Analytical data of HBMHmHB ligand and its Ln(III) complexes

Compound	Colour	% Yield	MP/DP in °C	% Element Content, Expected (Observed)					Molar Cond	Magnetic Moments
				C	H	N	O	M		
HBMHmHB	Yellow	74.82	209	73.45 (73.41)	4.99 (4.96)	12.24 (12.19)	9.32 (9.28)	-	-	-
[Nd(BMHmHB) ₃]NO ₃	Red	65.22	289	61.35 (61.30)	3.90 (3.83)	11.36 (11.31)	11.70 (11.69)	11.70 (11.68)	20.3	3.59
[Tb(BMHmHB) ₃]NO ₃	Brown	63.91	283	60.67 (60.64)	3.85 (3.80)	11.24 (11.22)	11.60 (10.56)	12.76 (12.71)	23.6	9.62
[La(BMHmHB) ₃]NO ₃	Yellow	69.39	288	61.62 (61.58)	3.91 (3.86)	11.41 (11.35)	11.70 (11.65)	11.32 (11.30)	19.5	-
[Dy(BMHmHB) ₃]NO ₃	Brown	73.33	287	60.48 (60.49)	3.84 (3.80)	11.20 (11.19)	11.50 (11.44)	13.00 (12.94)	22.9	10.58

3.1: Electronic Absorption spectra:

The electronic spectra of all complexes were recorded in chloroform and presented in **Table-2**. The spectrum of the complexes shows a red shift of the bands compared to those of respective aqua-ions, known as the nephelauxetic effect¹². The shift is a measure of covalency in a given complex. The nephelauxetic (β), bonding ($b^{1/2}$) and covalency (δ) parameters have been calculated by the same method as reported elsewhere¹³. The parameter β is less than one, and $b^{1/2}$ are positive for these complexes showing covalent bonding between the metal and the ligand. It is evident from **Table-2** that the present complexes can be arranged in the following decreasing order of covalency: La>Nd>Sm>Gd>Tb>Dy.

Table-2: UV-Visible spectral data of HBMHmHB ligand and its Ln(III) metal complexes

Compound	λ_{nm}	ϵ (dm ³ /mol/cm)	Transition
HBMHmHB	325	11875	$\pi^* \leftarrow \pi$
	230	8163	$\pi^* \leftarrow \pi$
	215	8500	$\pi^* \leftarrow \pi$
[Nd(BMHmHB) ₃]	827	568	${}^4\text{F}_{9/2} \leftarrow {}^4\text{H}_{5/2}$
	770	3068	${}^4\text{P}_{13/2} \leftarrow {}^4\text{H}_{5/2}$
	600	4098	${}^4\text{P}_{9/2} \leftarrow {}^4\text{H}_{5/2}$
	526	9480	${}^4\text{P}_{7/2} \leftarrow {}^4\text{H}_{5/2}$
[Tb(BMHmHB) ₃]	595	1700	${}^7\text{F}_4 \leftarrow {}^5\text{D}_4$
	531	1600	${}^7\text{F}_5 \leftarrow {}^5\text{D}_4$
	400	4500	${}^7\text{F}_6 \leftarrow {}^5\text{D}_4$
[La(BMHmHB) ₃]	370	5969	MLCT
	263	15468	MLCT
[Dy(BMHmHB) ₃]	429	6530	${}^4\text{H}_{15/2} \rightarrow {}^4\text{F}_{9/2}$
	348	7458	${}^4\text{H}_{15/2} \rightarrow {}^4\text{I}_{15/2}$
	302	12670	MLCT

3.2: FT (IR) Spectra:

The FT(IR) Spectra provide valuable information regarding the nature of a functional group attached to the metal atom. The important I.R frequencies exhibited by the Schiff base ligand and their corresponding ligand complex are tabulated in **Table-2**. The ligand shows broadband at 3260cm^{-1} due to the oximino group being absent in all its prepared metal complexes, indicating prepared ligand coordinates with the metal ion through the oximino group. The ligand shows broadband at 3112cm^{-1} due to the phenolic hydroxyl group on the free ligand, which shows a shift in frequency in the complex, indicating coordination through the metal atom. The Bands are observed at 1575 and 1460cm^{-1} in the prepared ligand because the azomethine and oximino group, respectively, is shifted to higher frequencies in its metal complexes, indicating the participation of azomethine and oximino group in complex formation. The Schiff base ligand coordinated with the metal via "N" atoms. The IR spectra of complexes give a $|v_4-v_1|$ separation in the range $74-148\text{cm}^{-1}$ suggesting monodentate bonding for the nitrate group. Moreover, the appearance of additional weak bands in the region $490-570\text{cm}^{-1}$ attributed to $\nu(\text{M-N})$ further confirmed complexation¹³.

Table-3: IR spectral bands of the ligand (HBMHmHB) and its metal complexes (cm^{-1}):

Compound	-OH (Oxo)	-OH (Phe)	Ar C-H	Ar C=C	>C= NN-	>C= NO-	$\nu_1(\text{N O}_3)$	$\nu_2(\text{N O}_3)$	$\nu_3(\text{N O}_3)$	$\nu_4(\text{N O}_3)$	The ring	M-N
HBMHmHB	3260	3112	3070	2960	1575	1460	-	-	-	-	729	-
Nd(BMHmHB) ₃	-	3180	3070	2960	1611	1525	1451	1033	1334	1377	729	495, 533
Tb(BMHmHB) ₃	-	3182	3072	2960	1612	1521	1453	1034	1340	1369	741	490, 525
La(BMHmHB) ₃	-	3178	3076	2960	1607	1529	1452	1032	1340	1345	730	489, 519
Dy(BMHmHB) ₃	-	3179	3073	2960	1600	1533	1477	1034	1323	1329	733	499, 517

3.3: The PMR Spectra:

PMR Spectra of Schiff bases and their complexes were recorded in d_6 DMSO solution, and TMS was used as an internal standard. Comparing the spectrum with that of the ligand, it noted that the oxime proton of the ligand (12.20δ) is missing in the PMR spectra of its metal complexes, confirming the proposed replacement of the oximino proton by the metal ion during complex formation¹⁴. The aromatic proton in the Schiff base appears at 6.90 ppm to 7.30 ppm and in their metal complex range of 6.90 ppm to 7.9 ppm¹⁵.

Table-4: PMR spectrum of HBMHmHB and its metal complexes in d_6 DMSO

Compounds	-OH	Phenolic -OH	-CH=	Phenyl rings
HBMHmHB	12.20	11.70	8.20	6.90-7.80
La(BMHmHB) ₃	-	11.65	8.20	7.30-7.8

4. CONCLUSION

The preferred coordination number of Ln(III) metal ion is 7. This coordination number depends upon the nature of the ligand. Conductance and molecular weight data show the presence of nitrate anion inside the coordination sphere in the complexes. FT(IR) spectral data reveal that ligand is coordinated to metal ions nitrogen atoms of oximino and azomethine linkages in all the complexes studied. Hence, coordination number 7 is suggested for metal ions in this lanthanoid complexes¹⁶⁻¹⁹. The possible structure of the complexes is given in **Figure-2**.

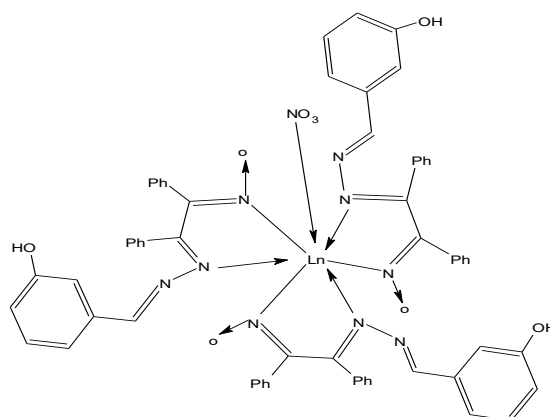


Figure-2: Structure of metal complexes of HBMHmHB ligand

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Reaction of P-Chlorobenzaldehyde Derived Ligand Complexes Possessing an Azomethine and Oximino Functions with Lanthanide (III) Ions and its Biological Activity

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ABSTRACT

The synthesis of benzilmonoximethiocarbohydrazide-p-chlorobenzaldehyde (HBMTpCB) ligand possessing one of oxime functions that is associated to a second functions such as azomethine or thiocarbohydrazide function in the first described. This prepared ligand, which possesses an inner N₂S coordination site, allows formation of neutral lanthanide (III) metal-ligand complexes under their mono deprotonated form. The ligand was characterized by elemental analysis, FT (IR), ¹H NMR and electronic spectra. The La (III), Nd (III), Gd (III), Tb (III) and Dy (III) complexes of the HBMTpCB were prepared and characterized by the analytical and spectroscopic methods. In addition, the magnetic susceptibility and molar conductance measurements have been made. Seven coordinated geometrical structure were proposed for La (III), Nd (III), Gd (III), Tb (III) and Dy (III) complexes. These prepared novel complexes complete our work dealing with the oxime function complexing ability towards lanthanides (III) ions.

Keywords: Oxime functions, benzilmonoximethiocarbohydrazide, p-chlorobenzaldehyde

INTRODUCTION

Hugo Schiff first identified Schiff base compounds as those containing an azomethine group that come from a reversible acid-catalyzed condensation reaction between primary amine and carbonyl compounds in 1864¹⁻². Because of the wide range of biological applications, simplicity of synthesis, chelating properties, and stability of Schiff base compounds, this class is significant and has been widely studied³⁻⁵. Depending on the type of bacteria and lanthanide, there are numerous different types of lanthanides (Ln-L) that respond differently to bacteria⁶. Additionally, (Ln-L) has numerous advantageous uses in physics, such as luminescence and solar cells^{7, 8}. There are various ways to make the chemical 3-(2-fluoro) acrolein, including Witting⁹, Heck¹⁰, and Stille reactions¹¹. The chelating ligand benzilmonoxime is well recognized and frequently used as a Schiff base derivative in organic and inorganic chemistry¹²⁻¹³. The researchers have for the first time shown that benzilmonoxime is a well-known analytical extracting agent for molybdenum, tungsten, and vanadium¹⁴. Cobalt was extracted and its microgram amount was determined using benzilmonoxime¹⁵. Utilizing sodium dodecylsulfate micellar medium and benzilmonoxime, cobalt has been detected spectrophotometrically¹⁶. Analytical and biological considerations make benzilmonoxime important. In view of these, our aim is directed towards the preparation of lanthanide (III) metal complexes of HBMTpCB ligand.

RESULTS

The free HBMTpCB ligand can be synthesized by equimolar amount of benzilmonoximethiocarbohydrazide and p-chlorobenzaldehyde in ethanol. The La (III), Nd (III), Gd (III), Tb (III) and Dy (III) metal complexes are prepared by 1:3 (ML₃) molar ratio in ethanol solvent, under refluxed condition¹⁷. This prepared HBMTpCB ligand and its lanthanide (III) complexes are easily characterized by NMR, FT (IR), electronic absorption spectra, magnetic moment and molar conductivity measurements. The molar conductivity data of the all prepared complexes, suggested that they are 1:1 electrolyte in nature¹⁸. The physical and analytical data for the HBMTpCB ligand and its metal complexes are listed in **Table-1**.

Table-1: Analytical and physical data of the ligand and its lanthanide (III) metal complexes

Compound	Color	Yield %	M.P. / Dec. point °C	Elemental Analysis						Magnetic Moment (B.M.)	Electrical Conductance 10 ⁻³ M(in nitrobenzene) mhos
				% M Found (Calcd)	% C Found (Calcd)	% H Found (Calcd)	% N Found (Calcd)	% O Found (Calcd)	% Cl Found (Calcd)		
HBMTpCB	Yellow	81.61	209	-	60.61 (59.92)	4.16 (4.98)	16.07 (16.02)	3.67 (3.65)	8.13 (8.00)	-	-

[Tb(BMTpCB) ₃] NO ₃	Brown	80.69	239	10.42 (10.29)	51.91 (51.00)	3.34 (3.21)	14.68 (14.50)	6.29 (6.20)	6.29 (6.20)	9.52	26.15
[La(BMTpCB) ₃] NO ₃	Green	81.26	244	10.70 (10.21)	50.86 (50.80)	3.66 (3.61)	15.08 (15.07)	6.89 (6.83)	7.65 (7.63)	Dia	22.33
[Dy(BMTpCB) ₃] NO ₃	Orange	73.06	238	10.81 (10.33)	52.70 (52.33)	3.39 (3.20)	13.97 (13.50)	6.38 (6.58)	9.40 (6.58)	10.48	26.24
[Gd(BMTpCB) ₃] NO ₃	Brown	78.62	243	10.50 (10.05)	52.89 (52.52)	3.41 (3.21)	14.02 (13.92)	6.41 (6.36)	9.48 (9.66)	7.79	21.69
[Nd(BMTpCB) ₃] NO ₃	Green	79.96	241	9.54 (9.48)	52.41 (52.29)	3.38 (3.30)	14.82 (14.78)	6.35 (6.23)	7.00 (6.88)	3.60	30.45

FT (IR) Spectroscopy:

The FT(IR) spectrum of the HBMTpCB ligand showed a sharp band at 1613 cm⁻¹ and 1588 cm⁻¹, which due to azomethine and oximino linkages which was shifted to higher frequencies in the lanthanide (III) metal complexes, indicating coordination of the lanthanide (III) metal ions through the azomethine and oximino linkages¹⁹⁻²⁰. For broadband shown in the HBMTpCB ligand at 3641 cm⁻¹ due to -OH of the oximino group, this band disappeared in the lanthanide (III) metal complexes spectra, indicating involvement of this group in the complex formation and deprotonation²¹.

The appearances of new bands at the region 525-535 and 428-440 cm⁻¹ due to ν(M-N) and ν(M-S) groups, respectively²². The FT (IR) spectral data and their tentative assessment are listed in **Table-2**.

Table-2: IR spectral bands of the ligand (HBMTpCB) and its metal complexes (cm⁻¹)

Assignments	HBMHpCB	Nd(III)	Tb(III)	La(III)	Dy(III)	Gd(III)
ν(OH)	3641	-	-	-	-	-
ν(N-H)	3297	3187	3301	3295	3297	3287
νC=C Ar.	3046	2915	3047	3023	3080	3191
νC=NN	1613	1633	1629	1614	1645	1599
νC=NO	1588	1570	1593	1577	1588	1590
νN-N	974	1054	1021	1049	1056	1014
νN→O	-	985	957	965	922	966
νM-N	-	541	593	559	557	606
νM→N	-	503	507	540	508	523

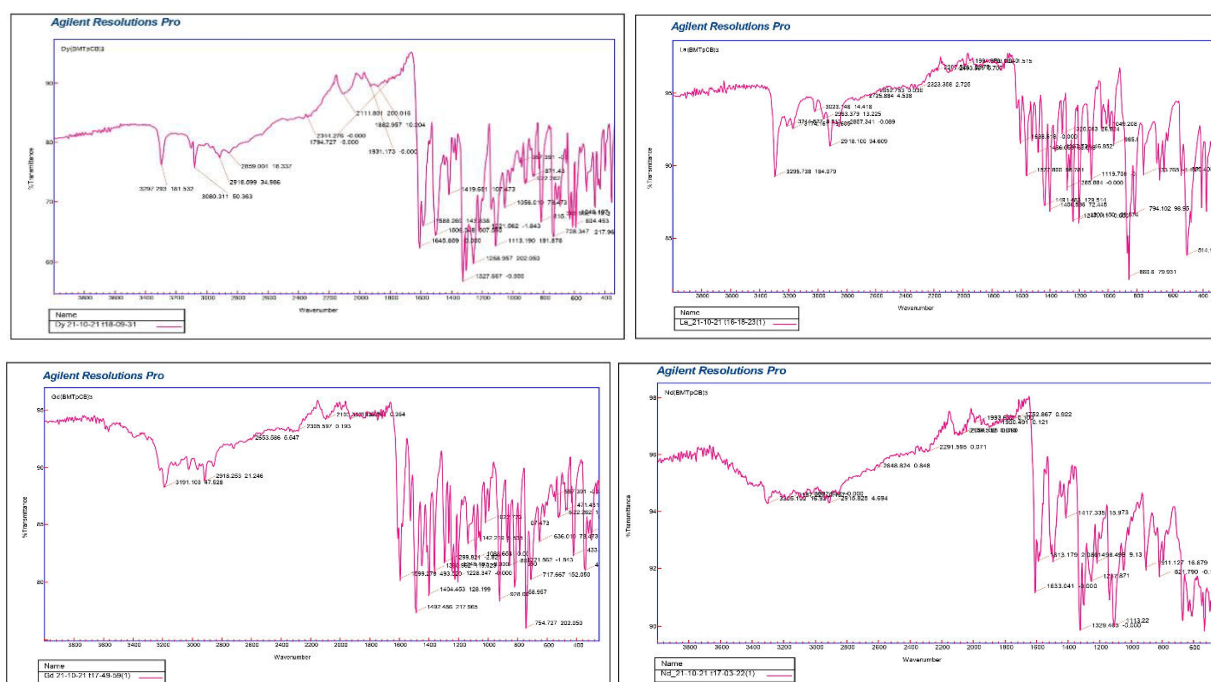


Figure-1: FT (IR) spectra of HBMTpCB ligand-metal complexes

Electronic Spectra

Electronic absorption spectra of the HBMTpCB ligand and its lanthanide (III) complexes were carried out in methanol and chloroform solvents respectively. The HBMTpCB ligand electronic spectra had a strong band at 353 and 274 nm assigned as $\pi \rightarrow \pi^*$ transition of azomethine and oximino linkages.

The $[\text{La}(\text{BMTpCB})_3]\text{NO}_3$ complex exhibited only a broad band around 323 nm it was assigned to the metal to ligand charge transfer transition. The absorption bands are of a gadolinium(III), lanthanum(III), neodymium(III), terbium(III) and dysprosium(III) in the near infrared and visible region appear due to transitions from $^4\text{I}_{9/2}$, $^8\text{S}_{7/2}$, $^6\text{H}_{5/2}$, $^3\text{H}_4$ and $^6\text{H}_{15/2}$ ground levels to the J-level excited of the 4f-configuration respectively. Some nephelauxetic effect or red shift is observed in the chloroform solutions of these complexes. This nephelauxetic effect is usually accepted²³ as a higher degree of covalency evidence than the aqua compounds presence. In all prepared lanthanide (III) complexes, marked intensity enhancement of the observed band and this nephelauxetic effect (β) utilizes hypersensitive bands to calculate this effect. From the β values, the Sinha parameters ($\delta\%$), covalence factor ($b^{1/2}$) and the covalency angular overlap parameter (η) have been calculated using the expression below;

$$\eta = [(1-\beta)^{1/2}/\beta^{1/2}] \quad \text{-----eq-1}$$

$$b^{1/2} = 1/2[(1-\beta)^{1/2}] \quad \text{-----eq-2}$$

$$\delta\% = [(1-\beta)/\beta] \times 100 \quad \text{-----eq-3}$$

The $\delta\%$ and values (1- β) are positive in these coordination compounds (**Table-3**), suggesting that the bonding between the ligand and metal ion is covalent compared to the bonding between the aqua ion and metal ion. The angular overlap (η) and bonding parameter ($b^{1/2}$) values are found to be positive, indicating that the covalent bonding.

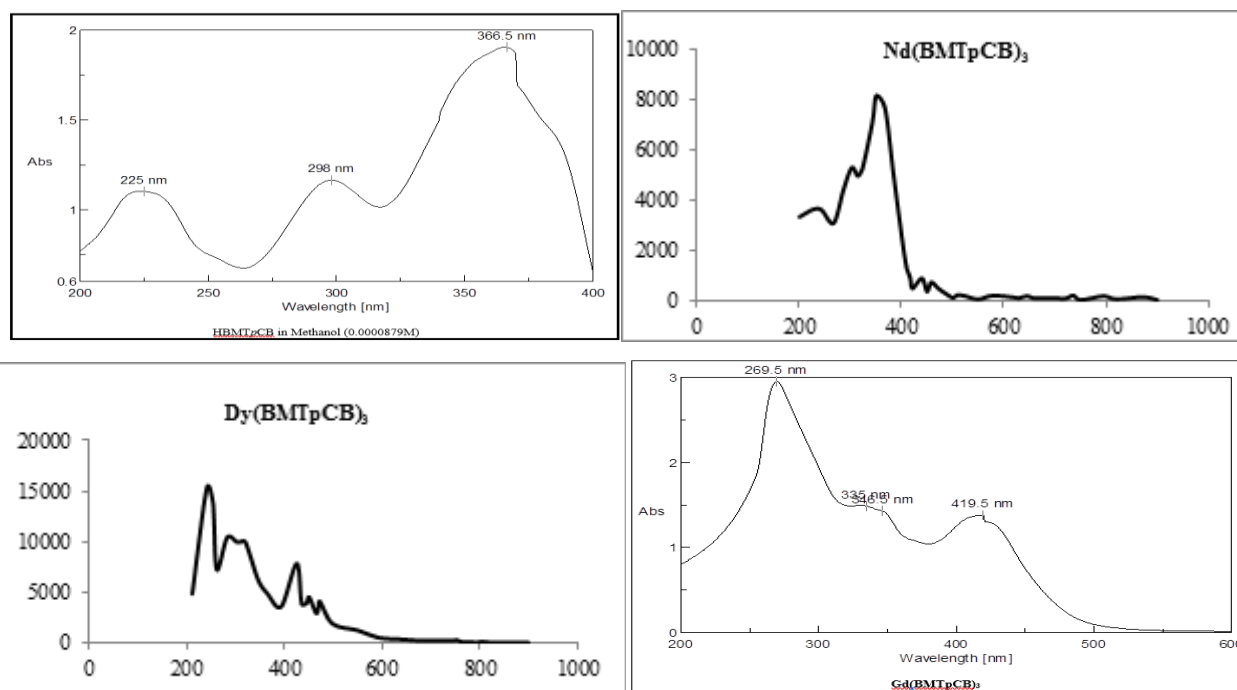


Figure-2: Electronic absorption spectra of the HBMTpCB ligand and its lanthanide (III) complexes

Table-3: Electronic absorption spectral data of HBMTpCB ligand and its Ln (III) metal complexes

Compound	λ (nm)	ϵ ($\text{dm}^3/\text{mol}/\text{cm}$)	Transition	
HBMTpCB	353	7740	$\pi \rightarrow \pi^*$	
	274	10730	$\pi \rightarrow \pi^*$	
	225	12756	$\pi \rightarrow \pi^*$	
$[\text{Nd}(\text{BMTpCB})_3]\text{NO}_3$	874	103	$^4\text{I}_{9/2} \rightarrow ^4\text{F}_{3/2}$	$\beta_{\text{ave}} = 0.9925$ $b^{1/2} = 0.0591$ $\delta\% = 0.7587$ $\eta = 0.00387$
	800	127	$^4\text{I}_{9/2} \rightarrow ^4\text{F}_{5/2}$	
	745	56	$^4\text{I}_{9/2} \rightarrow ^4\text{F}_{7/2}$	
	584	3879	$^4\text{I}_{9/2} \rightarrow ^4\text{G}_{5/2}$	

			${}^2G_{7/2}$	
	524	4568	${}^4I_{9/2} \rightarrow {}^4G_{7/2}$	
	518	5789	${}^4I_{9/2} \rightarrow {}^4G_{9/2}$	
[Tb(BMTpCB) ₃]NO ₃	623	1170	${}^5D_4 \rightarrow {}^4F_3$	$\beta_{ave} = 0.9933,$ $\eta = 0.00336,$ $b^{1/2} = 0.0527,$ $\delta\% = 0.6737$
	587	3257	${}^5D_4 \rightarrow {}^7F_4$	
	546	7568	${}^5D_4 \rightarrow {}^7F_5$	
	490	9291	${}^5D_4 \rightarrow {}^7F_6$	
[La(BMTpCB) ₃]NO ₃	392	110		MLCT
	243	13541		MLCT
[Dy(BMTpCB) ₃]NO ₃	740	89	${}^4H_{15/2} \rightarrow {}^4I_{15/2}$	$\beta_{ave} = 0.9971, \eta =$ $0.00272, b^{1/2} = 0.0505,$ $\delta\% = 0.545$
	450	4952	${}^4H_{15/2} \rightarrow {}^4I_{15/2}$	
[Gd(BMTpCB) ₃]NO ₃	564	9365	${}^8S_{7/2} \rightarrow {}^6P_{5/2}$	$\beta_{ave} = 0.9978, \eta =$ $0.0049, b^{1/2} = 0.0629,$ $\delta\% = 0.975$
	410	11590	${}^8S_{7/2} \rightarrow {}^6P_{5/2}$	

BIOLOGICAL ACTIVITY

All the synthesized ligands and their lanthanide complexes have been studied for antibacterial activities against two gram positive species, *S. aureus*, and *C. diptheriae* and two gram negative species, *P. aeruginosa* and *E. coli*, as well as in vitro antifungal activities against *Aspergillus Niger*, *Candida albicans*, and *Aspergillus clavatus*. Broth dilution methods have been employed for the evaluation of the antibacterial activity. It is one of the manual in vitro assays for bacterial susceptibility. The amount of antimicrobial agents required to stop the growth of particular microbes can be quantified using this traditional method. It is conducted in tubes.

Table 4. Antibacterial activity of the ligand (HBMTpCB) and its metal complexes

Minimal Inhibition Concentration [Microgram/ml]					
Sr No.	Comp Name	E. coli	P. aeruginosa	S. aureus	C. diptheria
		MTCC 443	MTCC 1688	MTCC 96	MTCC 116
1	HBMTpCB	100	50	62.5	50
2	[La(BMTpCB) ₃]NO ₃	100	25	62.5	50
3	[Nd(BMTpCB) ₃]NO ₃	125	100	250	125
4	[Gd(BMTpCB) ₃]NO ₃	125	100	125	25
5	[Tb(BMTpCB) ₃]NO ₃	125	50	125	62.5
6	[Dy(BMTpCB) ₃]NO ₃	100	250	250	250

The Standard Drugs

DRUGS	E. coli	P. aeruginosa	S. aureus	C. diptheria
-	MTCC 443	MTCC 1688	MTCC 96	MTCC 116
Minimal Inhibition Concentration [microgram/ml]				
Gentamycin	0.05	1	0.25	0.5
Ampicillin	32	-	40	25
Chloramphenicol	50	50	50	50
Ciprofloxacin	25	25	50	50
Norfloxacin	10	10	10	10

Table 5: Antifungal activity of the HBMTpCB ligand and its complexes.

Minimal Fungicidal Concentration [microgram/ml]				
Sr No.	Comp Name	C. albicans	A. niger	A. clavatus
		MTCC 227	MTCC 282	MTCC 1323
1	HBMTpCB	500	1000	>1000
2	[La(BMTpCB) ₃]NO ₃	500	1000	>1000
3	[Nd(BMTpCB) ₃]NO ₃	500	500	1000
4	[Gd(BMTpCB) ₃]NO ₃	250	500	500
5	[Tb(BMTpCB) ₃]NO ₃	500	1000	>1000
6	[Dy(BMTpCB) ₃]NO ₃	500	500	500

The Standard Drugs

Drugs	C.albicans	A.niger	A.clavatus
-	MTCC 227	MTCC 282	MTCC 1323
Minimal Fungicidal Concentration [microgram/ml]			
Nystatin	100	100	100
Greseofulvin	500	100	100

From the obtained data, the following inferences can be concluded:

Ligand shows medium antibacterial activity against *S. aureus* but quietly strong activity against *C. diphtheria*. The La (III) and Gd (III) complexes show promising antibacterial activity against *P. aeruginosa* and *C. diphtheria*. Tb (III) complex are also moderately active against *C. diphtheria*. While Tb (III) and Dy (III) complexes do not show any antibacterial activity against any of the bacteria. The enhancement of the activity against the bacteria after the formation of the complexes may be due to the chelation of the ligands with the central metal ion, which may produce partial polarization of the complexes²⁵⁻²⁷. The prepared complexes were subjected to antifungal activity against the mentioned fungi. From the obtained data, the following result can be evaluated:

- Gd(III) complex show antifungal activity to some extent against the bacteria *C. albicans*²⁸,
- For the fungal species *A. niger* and *A. clavatus*, no any complexes show antibacterial activities, i.e., these complexes are inactive against *A. niger* and *A. clavatus*.

In Vitro Cytotoxicity:

It is evident from the data recorded in **Table-6** that all prepared transition complexes displayed cytotoxic activity with $LD_{50} = 2.178-8.439 \times 10^{-4}$ M/mL, against *Artemia salina*, while the HBMTpCB ligand were almost inactive for this assay⁴⁶.

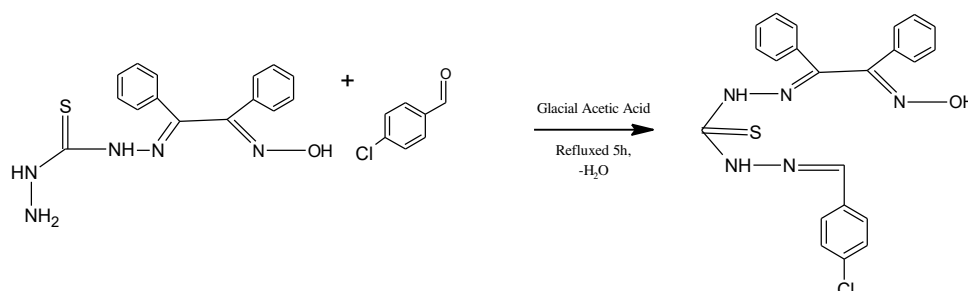
Table-6: Brine shrimp bioassay of HBMTpCB and their metal (III) complexes

Compound	LD ₅₀ (M)
HBMTpCB	$>2.05 \times 10^{-4}$
[La(BMTpCB) ₃]NO ₃	$>2.178 \times 10^{-4}$
[Nd(BMTpCB) ₃]NO ₃	$>3.45 \times 10^{-4}$
[Gd(BMTpCB) ₃]NO ₃	$>6.11 \times 10^{-4}$
[Tb(BMTpCB) ₃]NO ₃	$>3.78 \times 10^{-4}$
[Dy(BMTpCB) ₃]NO ₃	$>4.57 \times 10^{-4}$

EXPERIMENTAL:

Chemicals:

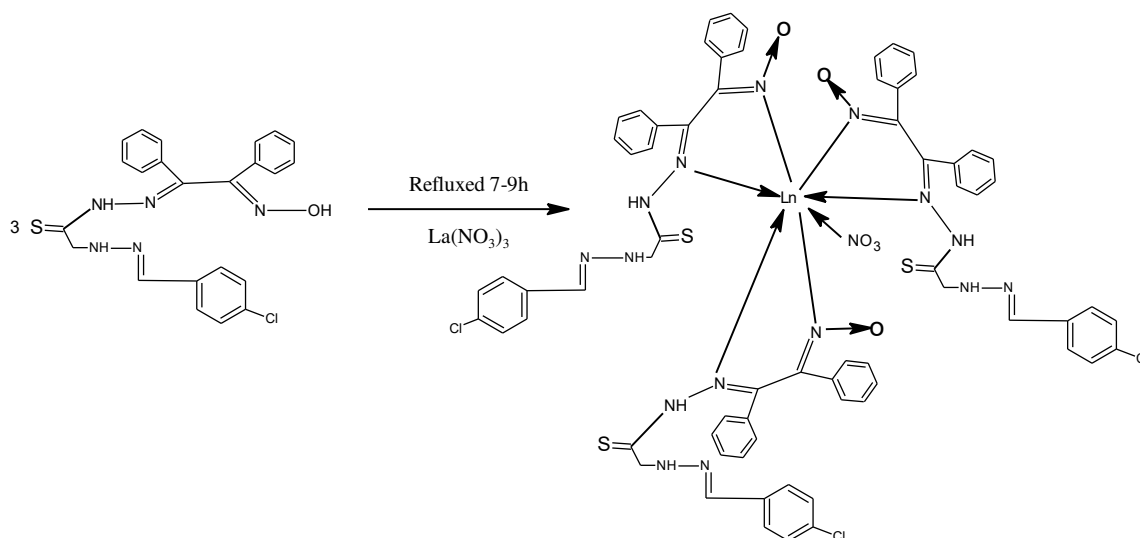
All required solvents and reagents were purchased from Sigma-Aldrich chemical and used as a received. The HBMTpCB ligand was prepared by a reported method²⁹ (**Scheme-I**). HMOTCH was synthesised by combining a hot aqueous solution of thiocarbohydrazide (20.000 g, 0.188 mol) with an ethanolic solution of benzilmonoxime (10.000 g, 0.044 mol) in the presence of sodium acetate (20.000 g), then refluxing the mixture for seven hours on a water bath and storing it overnight at room temperature. The solid was filtered, washed with hot water, and dried at 100°C.



Scheme-I: Preparation of HBMTpCB ligand

Preparation of Lanthanide Complexes:

All Ln (III) complexes are prepared by refluxing a mixture of lanthanide (III) nitrate (1mmol) in distilled water and HBMTpCB ligand (2 mmol) in ethanol, at 70 °C for 5-9 h to form a clear color solution. Cool these reaction mixtures to 25-30 °C, filtered and hot distilled water (**Scheme-II**).



Scheme-II: Preparation of metal complexes of HBMTpCB ligand

In Vitro Cytotoxicity:

The cytotoxicity (brine shrimp bioassay) of the synthesized HBMTpCB ligand and its La (III), Nd (III), Gd (III), Tb (III), and Dy (III) complexes was tested. Ten shrimp were transferred to each sample vial using a 9 in disposable pipette and artificial sea water was added to make 5 ml. The nauplii can be counted macroscopically in the stem of the pipette against a lighted background. A drop of dry yeast suspension (Red Star) (3 mg in 5 ml artificial sea water) was added as food to each vial. The vials were maintained under illumination. Survivors were counted, with the aid of a 3 >> magnifying glass, after 6 and 24 hours, and the percent deaths at each dose and control were determined. The 24 hours counts were more useful. In cases where control deaths occurred, the data were corrected using Abbott's formula: % deaths = [(test—control)/control] x 100.

CONCLUSION

In summary five new lanthanide (III) complexes of HBMTpCB ligand with structures $[La(BMTpCB)_3]NO_3$ where Ln=La, Nd, Tb, Gd and Dy, have been successfully prepared and all the prepared Ln (III) complexes are magnetically and structurally characterized. All the complexes exhibited a 3:1 molar ratio based on their stoichiometry (ligand: lanthanide ion) in a neutral state. It was discovered that the recently synthesized Schiff base molecule and its complexes had strong antifungal and antibacterial activities. The antibacterial result proves that metal complexes are more effective against microbes than free ligands.

DECLARATIONS

I. Ethical Approval: Not applicable

II. Competing Interests: The authors declare that they have no conflict of interest.

III. Authors' Contributions: The authors confirm contribution to the paper as follows:

- 1) Author 1: Study conception and design.
- 2) Author 2: Data collection
- 3) Author 2: Analysis and interpretation of results.
- 4) Author 1 and Author 2: Draft manuscript preparation.

All authors reviewed the results and approved the final version of the manuscript.

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V. Availability of Data and Materials: The data that support this study are available from the corresponding author upon reasonable request.

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Comparative Study on Soil Pollution of Waste and Agriculture Land with Coal Mine in Area of Godda District in Santal Pargana, Jharkhand, India

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ABSTRACT

Samples of agricultural soil and wasteland from a coal mine in the Godda district of Santal Pargana, Jharkhand, India, were gathered, and their total heavy metal levels were examined. In the Godda district of Santal Pargana, Jharkhand, India, hazardous levels of Cr and Ni have been discovered. If nothing changes soon, the other metals will likely reach this level. Some metals' subsurface soil content is higher than their surface soil content in wastelands, which is a sign that they are being transported to groundwater quickly. In wastelands, damage to growing crops, livestock, and fish casualties are also visible. Vegetables and other commodities cultivated on polluted farms are also sold in open markets in urban areas, endangering human health.

Keywords: Godda district, Lalmatia coalfield, Santal Pargana,

INTRODUCTION

With almost 75% of all fuel coming from coal, it is the most common fossil fuel on the planet¹⁻². More than 39% (1/3) of the world's power is produced using coal, which is also used to produce heat through combustion, gas through liquefaction, and diesel fuel³. Even while it significantly aids in the economic development of any nation, the impacts of coal mining on the ecosystem cannot be ignored^{4,5}. It results in soil, air, and water pollution, the loss of forests, and damage to the landscape, worsening the state of biological communities⁶⁻⁹. There are 352 coal mines in India, of which 174 are open-cut, 158 are underground, and 20 are mixed mines. India's Jharkhand region is home to nine significant coal mines. In the Godda district of Jharkhand, Lalmatia is one of the principal open-cut coal mining regions. The Indian Geological Survey team¹⁰ discovered this coalfield in 1973. The Indian government took control of this coal mine and transferred control to Eastern Coalfield Ltd. (ECL), a division of Coal India Ltd. Every day, this coal mine generates about 100 tonnes of coal. Thirty-four kilometres are spent north of Godda district at the Lalmatia coalfield. The coal's low sulphur and ash levels meet international environmental standards^{11, 12}. The Lalmatia coalfield, however, is experiencing various environmental issues due to soil, water, and air pollution, as well as poisoning from heavy metals in the soil¹³. Lalmatia Coalfield's mining operations, according to Eastern Coalfield Ltd., are the world's most hazardous, posing a serious threat to the local ecology. The practice of collapsing coal mining techniques causes land subsidence, the depletion of local water supplies, soil erosion, air pollution, and a decline in biodiversity¹⁴¹⁵. The local agricultural industry is threatened by heavy metal contamination of the soil, drainages, and streams from coal mining and other mining processes¹⁶⁻¹⁷. In light of this, the goal of the current study was to determine the environmental impact. This study aims to assess the degree of heavy metal contamination caused by coal mining in the communities close to the Lalmatia coal field in the Godda district of Jharkhand, India. The study's findings will contribute to our understanding of how harmful metals enter the food chain and our ability to forecast the rate at which heavy metal accumulation will occur over a specific period. In the end, everyone involved, including farmers, decision-makers, environmentalists, etc., will be made aware of the issue so that the severity of the issue can be understood and other waste disposal methods can be considered.

MATERIALS AND METHODS

This study aims to assess the degree of heavy metal contamination caused by coal mining in the communities close to the Lalmatia coal field in the Godda district of Jharkhand, India. The study's findings will contribute to our understanding of how harmful metals enter the food chain and our ability to forecast the rate at which heavy metal accumulation will occur over a specific period. In the end, everyone involved, including farmers, decision-makers, environmentalists, etc., will be made aware of the issue so that the severity of the issue can be understood and other waste disposal methods can be considered. The soil sample's physical characteristics, including odour, temperature, and colour, were assessed at the time of sample collection. A pH meter (EQ-650) was used to determine the pH of each sample, and an ELICO-CM-180 conductivity metre was used to assess electrical conductivity. Walkley and Black use titrimetry to assess the percentage of organic carbon. The potassium content was measured using a flame photometer and the ammonium acetate technique. The wavelength of the radiation that was released was between 76 and 70 nm. The soil extraction method was used to measure the presence of zinc, copper, lead, cadmium, manganese, magnesium, calcium, chromium, nickel, mercury, and vanadium using a Shimadzu atomic absorption spectrometer.

RESULTS

Soil samples from wasteland areas scored significantly lower in the current pH assessment. Neema village (5.84) and Bagjori village had pH measurements done (6.72). The optimal availability of secondary nutrients like magnesium, calcium, and sulphur, as well as primary nutrients like potassium, nitrogen, and phosphorus, are found in the pH range of 6.50 to 6.75. Low pH soil samples were found in the wasteland villages of Neema (5.84), Janakpur (6.18), Hijukita (6.16), and Jatakothi (6.00). The pH levels of the wastelands in the settlements above prevent plants from utilising K, P, N, and other necessary nutrients. Plants are more susceptible to absorbing harmful metals in acidic soil, and some plants finally succumb to poisoning. The electrical conductivity of soil salinity and the electrical conductivity of aqueous solutions are quantified. In six communities around the Lalmatia coalfield, they found wastelands with electrical conductivity ranging from 0.36 to 0.40 m/cm during the investigation. This soil is necessary for plant growth if the conductivity is between 0.2 and 0.8 m/cm. As a result, all wasteland soil samples can be used to grow plants. Weight determines the bulk density of the soil per unit volume, often on a dry basis in an oven. The bulk density of a soil sample varies from site to site and is influenced by the soil's structure, texture, and level of organic matter. The bulk density of soil samples from wastelands was between 0.78 and 0.99 g/mL. The Hijukita wasteland soil sample had a maximum bulk density of 0.99 g/ml, whereas the wasteland in Janakpur village had a minimum bulk density of 0.788 g/ml. As Cd, Cu, Ni, Pb, Zn, Mg, Co, and V are not detectable in the soil samples from the Lalmatia Coalfield Wasteland according to the analytical data of the heavy metal analysis. Cr and Fe concentrations varied from 0.1185-0.1568 ppm and 0.02-0.43 ppm, respectively. The wastelands of Neema village had the greatest levels of Fe and Cr, with Cr concentrations at around half of the sampling locations exceeding the Bureau of Indian Standards (BIS) soil standards.

CONCLUSIONS:

Results of the investigation indicate that unless direct waste disposal into farmlands is stopped, the toxic metal build-up will progress to threshold levels annually. These levels could be achieved even more quickly depending on the amount of coal mining waste, the rate of entry, the soil conditions, the protective measures, etc., as seen with the Lalmatia coal field in the Godda district of Jharkhand, India, which contains some heavy metals. It is simple to conclude from the sample analysis taken at the Lalmatia coal field's summit position in the Godda district of Jharkhand, India, that nearby areas may also be contaminated by emissions or groundwater seepage addition to places directly receiving waste disposals. As a result, proper planning of coal mining sites and selecting appropriate disposal sites are critical considerations. Farmers should be reminded regularly not to use coal mining liquid wastes as irrigation water sources. Consumers should also be informed that crops grown on such farms are hazardous to human health. Through field days and demonstrations, extension agents can play a significant role in this. At this point, the focus is on determining the extent of heavy metal build-up and increasing public awareness. In subsequent works, the heavy metals will be fractionated to determine which form is more responsible for pollution. It will also be interesting to see how crop and soil management techniques can assist. Examining how crop and soil management strategies can help will also be interesting.

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Creating Technology Savvy Educators: The Need of Technology Training for Teachers in the Digital Era

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ABSTRACT

It has been observed in the past few days that online education and ICT mediums have gained momentum due to the prevailing situation of the Covid-19 pandemic. It is a global crisis and the world is facing a disruptive phase. All sectors and walks of life have been put on halt and are suffering a decline, especially the educational sector. Attempts are being made to conduct classes, tests and examinations online. However, even though innumerable ICT mediums are at the disposal of the teachers for the purpose of real time education, not many teachers are comfortable with the idea of conducting educational activities online. This is a hindrance in the smooth conduction of educational activities which are for now entirely relied on technology. This research paper attempts to lay down the importance of technology in education, its surged need in the current times and tries to emphasize on teachers perspective and attitude towards educational technologies, the kind of training they have received, if any, and what could be done to elevate the standard of teachers training programs in technology further. It also explores the possibility of increasing teachers affinity with technology through the concepts of tech-mentors or tech-support and VLE training programs.

Keywords: Technology, Teacher training, Virtual Learning Environment, Digital Age, ICT

INTRODUCTION

Information and communication technologies (ICT) play an undeniably important role in education, and hence we have witnessed a surge in initiatives towards their adoption and use in educational institutions. ICT in education uses information and communications technology to support, enhance, and optimize the delivery of information to students. Research from all over the world has proven that the adoption of ICT can lead to an improved learning experience through better teaching methods. Without doubt, the “Digital Natives”- a term ascribed to the students of the 21st century digital age and popularized by education consultant Marc Prensky in *Digital Natives, Digital Immigrants* (1)- have moved on from yesteryear’s teaching methods. The chalk and board method, or simple reading-from-the-book method to them, does not seem exciting and fun anymore in classroom, which in turn results in their diminished interest in the topic at hand. Prensky in his study associates the contemporary decline in education to educators’ failure to understand the needs of modern students. He elucidates that “the arrival and rapid dissemination of digital technology in the last decade of the 20th century” (1) had changed the way students think and process information, making it difficult for them to excel academically using the outdated teaching methods. The “digital natives” as he calls them, have been raised in a digital, media-saturated world and require a media-rich learning environment. Traditionally, individuals were being prepared for the industrial society that preceded the Digital Age, with the focus on 'making things'. However, in the Digital Age, the challenge is to prepare individuals for the information society in which one of the most important aims is to handle information and technology. (2) Educational technology has the extreme potential to change everyday classroom practice dramatically.

According to the UNESCO, “Information and communication technology (ICT) can complement, enrich and transform education for the better.” As educators of the 21st Century, it is important to realize that there is the upcoming need to change the pre-existing teaching methodologies and that ICT, in addition to the traditional teaching methods, can be used to augment the quality of lectures in higher education.

ADVANTAGES OF ICT IN HIGHER EDUCATION:

Some believe that technology is a very effective way of engaging young minds and improving student engagement. (3) To think creatively, work in teams, and have deep understanding of project-based learning, students must understand that technology is a useful tool but not a replacement for human interaction. Potential advantages of ICT in education are that it can help students learn at their own pace, provide them with ample sources of information, offer access to other learners and mentors, collaborate on projects with others, and present knowledge to audiences. According to a report published in Netherlands in 1996 by the Committee on Multimedia in Teacher Training (COMMITT) (2), these skills are necessary for students who are a part of the information society in which the primary task is to handle and optimize information. Life skills such as collaborating with others, solving complex problems, critical thinking, developing different forms of

communication, leadership skills, and improving motivation and productivity can be imbibed through technology. Learning through gamification and virtual field trips pique the interest of students which leads to better retention of knowledge. An active participation is observed which can be difficult to achieve through a traditional lecture environment alone. The teacher's role here, along with facilitating the students with the correct technologies and being a partner in the learning process, is of an adviser.

Shaw points out a number of differences in his study on the comparison of traditional v/s technological classrooms.(4) According to him, we see a clear transition from teacher oriented to student oriented approach in this age. The student is no more a passive receptor but an active contributor. That combined with the fact that we live in the Information and Digital Age, it is required that teachers in higher education try to integrate technology for better lessons and versatile classes.

The New Education Policy, 2019, drafted by the Ministry of Human Resource and Development in India also aims at appropriately integrating technology into all levels of education to improve classroom processes, support teacher professional development and enhance educational access for disadvantaged groups. Hence, it has become necessary to conduct stupendous technology teacher training programs with a different approach so that teachers develop an accord with educational technology.

REVIEW OF LITERATURE:

Bryant and Zhao in their paper *Can Teacher Technology Integration Training Alone Lead to High Levels of Technology Integration? A Qualitative Look at Teachers' Technology Integration after State Mandated Technology Training* focus on how teachers need to participate in extensive technology training programs and know beyond basic computer skills. They opine that the courses are mostly short term and futile as there is no follow up. Georgia Technology Integration Centre conducts tech-mentoring with teachers after the sessions and it was observed that it helped them develop liking for technology.

Carol Granston in her research titled *Models for Integrating Technology into Teacher Training Programs* talks about the need of technology in classrooms in the Information Age and the inadequacy of teachers in using it due to lack of proper training. She elaborates on the New England University 5 step model (Familiarize, Partner with mentors, Develop personal projects, Become mentors, Keeping abreast with current technologies), RIPPLES model (Resources, Infrastructure, People, Policies, Learning, evaluation, Support) and the IT3P model (Integrating Technology Into Teacher Training Programs). She pulls out a common thread in all these models of teacher tech training: teachers need prolonged exposure to tech training and continued tech support.

Ageel & Woollard in their study *Enhancing University Teachers' Information And Communication Technology Usage By Using A Virtual Learning Environment Training Course* have elaborated on the concept of VLEs which has been stressed upon in this study as well as a potential method for training teachers in technology. They discuss MOODLE and WebCT as potential VLEs and observe how teachers who got trained with VLE experienced much efficacy with technology integration.

Sibusisiwe Dube in her research titled *The 21st Century Students' Educational ICT Preferences* discusses the role of ICT in education and the increase in initiatives towards their adoption and use. The findings show that students prefer emerging technologies such as Google classroom.

Marc Prensky in his study entitled *Digital Natives, Digital Immigrants* points out how students are different than teachers in terms of how they learn and the ways in which they are able to take in information. He gave the two different groups of people different titles; digital immigrants, and digital natives. Immigrants being those people who were born in a time when technology was not readily available have had to learn over time how to use it, while natives have been exposed to the use of technology from early on in life and need this to thrive in our the classroom setting.

Maduakolam and Bell in their study *A Product-Based Faculty Professional Development Model for Infusing Technology into Teacher Education* talk about a model for teacher training which grew out of Technology Infusion Project, a US Department of Education funded initiative for improving teacher education. The course pre-assessed teachers' individual needs and motivated them through incentives and certificates. The study also establishes how technology must be taught real time to teachers.

RESEARCH METHODOLOGY

This study is a combination of qualitative as well as quantitative research, and primary and secondary data. A structured questionnaire was circulated through Google Forms and garnered responses from 60 teachers.

Secondary data was extracted from online articles, research papers, reference books etc. The period of the study is 2020 while the respondents belong to Mumbai city.

LIMITATIONS OF THE STUDY:

The research focuses only on suburbs in Mumbai region. The sample size comprises of 60 teachers which might not be sufficient to infer for the entire population of teaching faculties in higher education.

OBJECTIVES OF THE STUDY:

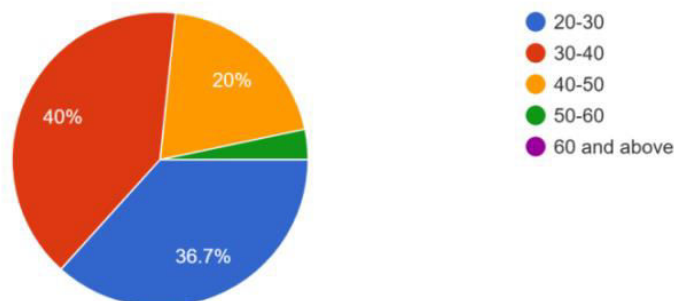
1. To measure the level of comfort of higher education teachers in incorporating technology in their classrooms
2. To learn about the existing methods of technology training for teachers in higher education & examine their adequacy
3. To determine if VLE(Virtual Learning environment) as a system can adopted for technology training for higher education teaching faculties
4. To suggest measures for improvement in technology training for teaching faculties of higher education sector

HYPOTHESIS:

1. Providing in depth training courses on technology and tech-support will make teachers more willing and comfortable to integrate technology in the classroom.
2. Virtual Learning Environments have the potential to be adopted as an effective method of teacher training in technology .

DATA ANALYSIS

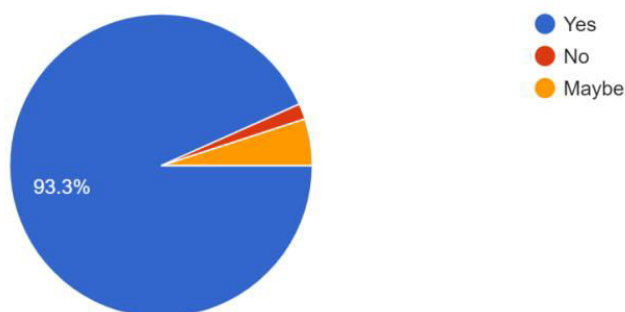
Age
60 responses



Out of the 60 respondents , a majority belonged to the age group of 20-40, approximately 77%. The rest belonged to the age group 40-60.

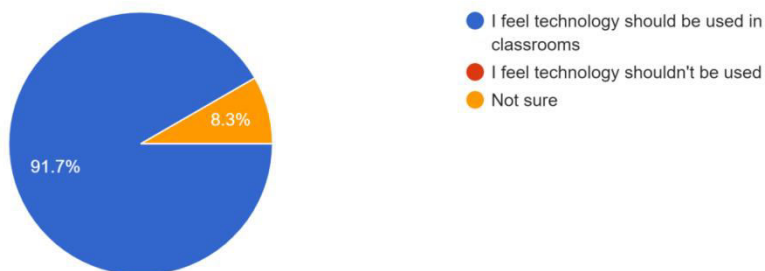
Are you of the opinion that ICT(Information and Communications Technology) enhances the quality of the teaching-learning process?

60 responses



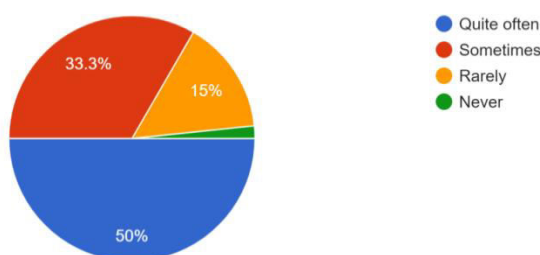
93.3 % of the total teacher respondents believe that ICT is an education enhancer and an essential tool of making the teaching learning process better.

Do you have affinity for or aversion towards the use of ICT in a classroom setting?
60 responses



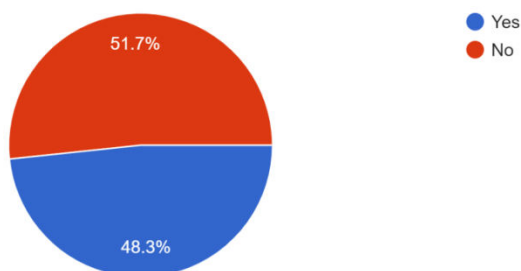
91.7% of the respondent teachers feel technology must be incorporated in classroom.

Do you make use of computer based technology in your classroom?
60 responses



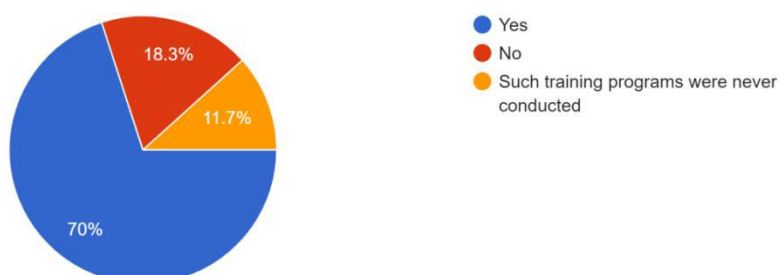
Even though more than 90% teachers feel technology is a must-include in teaching, only 50% of them use it often in classroom while around 48% use it sometimes or rarely and 2% do not use it at all. Here, it is clear that the resources or the training is not adequate and hence, teachers who would like to use technology are not able to use it to the desired effect.

Has your institution had a major training program in technology for teachers in the last five years?
60 responses



51.7% of the respondents say that their institution hasn't conducted even a single training program in the last 5 years, which explains the lack of training. 48.3% say programs have been conducted.

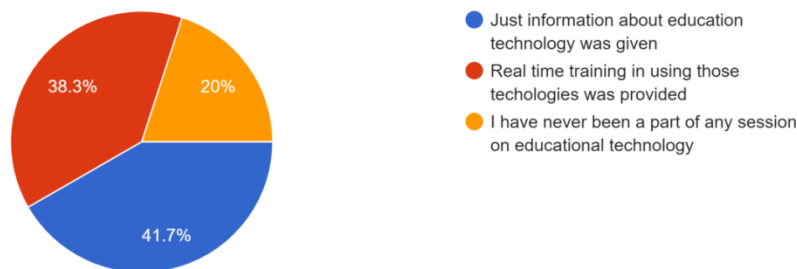
Have you ever been a part of teacher training programs/seminars/courses/workshops for technology training?
60 responses



70% respondents have been a part of technology training in some or the other way. 18.3% have never attended a single training session while others (11.7%) never got the opportunity to attend.

Were the sessions about technology or "with technology" (there's a difference)?

60 responses



41.7% of total respondents opine that the sessions regarding technology did not provide any real time training to them while 38.3% have received training. 20% say they never got the opportunity to be apart of such programs.

What best describes your level of technology expertise in your classroom?

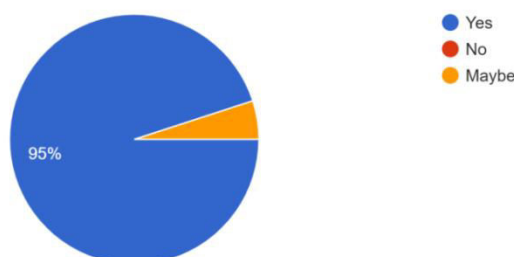
60 responses



50% respondents are very comfortable using technology, 45% are fairly comfortable while around 5% of them are not at all comfortable.

If tech-support/tech-mentors are assigned, will you be more willing and comfortable to incorporate technology in teaching?

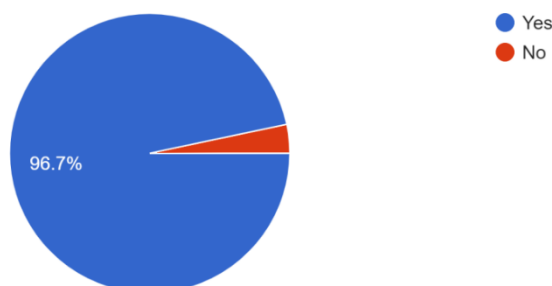
60 responses



Clearly, 95% teacher respondents opine that they are more willing to learn and integrate technology if tech-support or mentors are assigned to the for assistance.

Do you feel intrinsically motivated to learn and incorporate technology in your classroom?

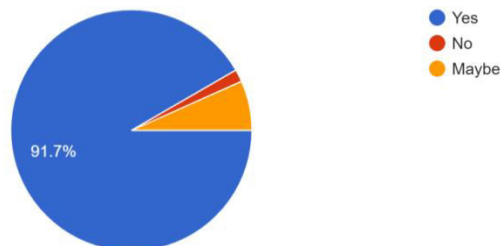
60 responses



96.7% teachers feel motivated to learn about and incorporate technology into their classrooms.

Will you be willing for training in new education technologies each year if monetary incentives and certificates are awarded for the same?

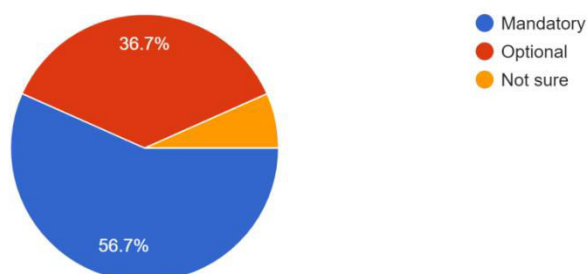
60 responses



91.7% teachers believe that monetary incentives and certificates might motivate them more to enroll into tech-training programs.

Should these training programs/seminars/courses/workshops be mandatory or optional?

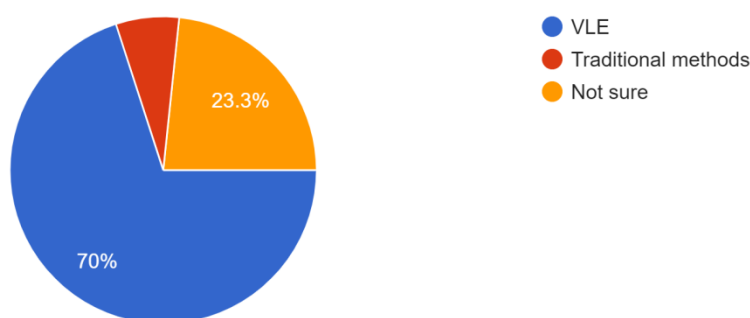
60 responses



56.7 % of teacher respondents feel the tech-training programs must be mandatory, while 36.7% feel they must be optional.

Do you feel that Virtual Learning Environments (VLEs) would be an effective method for training in technology or do you prefer traditional, physical m...rm of e-mails and discussions, even in real-time.)

60 responses



70% of teacher respondents feel that VLEs are a great method of conducting real time, readily available training sessions for faculties. 6.7 % faculties prefer the traditional methods for training while 23.3 % are not sure.

A teacher from one of the colleges of Mumbai commented that- "All Educational institutions including regular colleges should now start for technology based teaching. Workshops with hands on training need to be conducted regularly to make teachers comfortable to use it with confidence."

Another teacher says that "We are teaching the millennials, hence should be equipped with technology."

A faculty from Cosmopolitans Valia College in Mumbai feels that "it is high time all faculties from all streams learn and use technology in classrooms. We are in the digital age, if we do not use technology now we are not doing justice to our students."

Another faculty stresses on the need of "live sessions of workshops, seminars for the faculties" in technology.

CONCLUSION AND RECOMMENDATIONS:

According to the findings, it is observed that majority of the higher education teachers believe in integration of technology as an important factor to enhance educational practices today. However, many of them have not been a part of an exhaustive training in educational technology which makes it difficult for them to implement them in class. Universities and institutions must arrange technology training workshops where teachers are taught how to use technology not just verbally, but with practical application. These programs must be made mandatory and can be certified or with monetary incentives. According to the data collected, respondents feel that if technology support or mentors are provided to them after training, they would better be able to incorporate educational technologies as real time support would render them confident about it. Also, they feel Virtual Learning Environments are an excellent method for training as it is real time, available at the click of a button and interactive environment. In the time of the pandemic, VLEs might be an excellent option to train teachers as all are confined to their houses.

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A Study of Transaction Banking Products Mapped on Macro Indicators

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ABSTRACT

Transaction Banking is a set of services and products that banks provide their trading partners to aid them with the transaction of reciprocal of goods (Trade Finance) and monetary flows (Cash Management).

Important function of Transaction banking is to add a third party to the transaction to reduce the risk related to different covenants of an agreement of business. The Primary function of transaction banking is to transfer payments efficiently and with utmost security for corporate clients across the Globe.

Companies use this facility to meet either their short-term requirement of funds / working capital requirement for trade related transactions. Corporates use the products to facilitate international trade and commerce.

Keywords: Trade Finance, Cash Management, Interest rates, Trade volumes, Commodity prices and Factoring volumes.

INTRODUCTION

Transaction banking broadly comprises the products or services provided by a bank to its trading corporate partners with short term solutions to financially support their reciprocal interest in goods and to assist in trade and monetary flows to assist with cash management.

Transaction Banking is divided into two verticals

Trade finance represents the financial instruments and products that are used by companies to facilitate international trade and commerce. Trade finance makes it possible and easier for buyers and sellers to transact business through trade. The function of trade finance is to introduce a third-party to transactions to remove the payment risk and the supply risk. Trade finance helps sellers by converting receivables into payments as per the agreement while the buyer might be extended longer credit at reasonable cost to fulfil the trade order.

Finance is blood for any business. Every business has a multiple cash inflows and outflows which make it necessary to prudently manage to meet payment obligations timely and impart stability and ensure sufficient liquidity to sustain business on on-going basis. The products of cash management assist cash strapped corporates to overcome short term financial liquidity problems.

LITERATURE REVIEW

Many empirical studies have been conducted on the subject of Transaction Banking and Commercial Banking. The major emphasis of these studies is on the factors that govern the macro indicators' effect on Transaction banking.

The need for banking has grown faster in last few decades and with Globalization it is further accentuated. Banking products have become as helpful and complex as they can get. Each banking product solves a definite problem of the consumer and hence the constant need or requirement of banks is emerging. With different facilities, from corporate banking to online banking at the touch of screen, banking has come a long way. (Rohit Bansal, 2013). Banks have come a long way in the history of corporate banking and retail banking. Commercial banking is responsible for economic renaissance and transformation of the society and nation. For an underdeveloped nation to progress, it has to have sound system of commercial banking as per (Dr K.S.Thakur, 2012).

Banks are financial intermediaries which attract information asymmetry. Banks in an economy play a vital role for not only financial transactions and providing debt services, but also to information creation, communication and application. Banks take a cumulative decision based on various factors to lend money to borrowers. (Gan, 2020). Banks take varied amount of risk when they enter cross border payments and cross border lending. The risk in a banking sector is mitigated by inclusion of foreign commercial banks. There is a dire need for capital regulation and stringency to reduce the risk factor. Use of macro indicators to understand the necessary lending market and current economic situation is extremely important. (Sichong Chen, 2019)

The essence of trade finance is to perform two vital tasks; catering to working capital needs of the clients and support in international trade transaction being a third party to mitigate payment risk. The research suggests that one-third of the global trades are financed by letter of credit; product of trade finance. It is necessary to analyse the economic condition through different drivers, trade volumes and traded commodity prices as they directly affect the trade finance in a region. Trade finance is considered one of the most liquid and well-functioning products in lending. Trade finance product typically has short-term maturity and it is based only and only on underlying trade transactions (Clark, 2014)

The significance of supply-chain financing (SCF) for transaction banking is increasing. The use of financial tools, procedures, and technology to optimise the management of working capital and liquidity connected to supply-chain operations is referred to as SCF in this study. The physical supply chain's events are a major influence on SCF. The biggest growth for SCF is occurring in internal, local commerce. (de Meijer & de Bruijn, 2013-14)

Supply-chain finance is the latest development in payments (SCF). This novel concept's central idea is to understand different macro-economic factors like import-export volumes and factoring volumes. SCF has experienced double-digit growth over the past five years for a variety of causes. By using SCF, banks shift the financing risk to the stronger link in the chain, the buyer. Notwithstanding the broader credit shortage, SCF very simply mobilises financial resources for small merchants. (Cavenaghi, 2013-14)

Although numerous research has emerged in developed economies, this study found that the with respect to macroeconomic factors, GDP growth has a positive and considerable influence on the profitability of banks. The empirical findings of the study revealed that banks may increase their profitability by boosting capital and liquidity, lowering operational costs, and making a conscious effort to keep their business practises transparent. A favourable economic climate for financial institutions also encourages a rise in bank profitability. (Ebenezer, Omar, & Kamil, 2017)

For a variety of reasons, the number of people applying for loans has recently increased in India. The representatives of the bank cannot determine whether the client—whether they are a great client or a terrible client—will be able to repay the loan fee. The purpose of this paper is to learn about the customer's application for an individual advance. (Khadse D. K., Applications of Machine Learning in Loan Prediction Systems, 2021)

Coronavirus is the serious episode that prompts lockdown as a preventive measure. There are explores investigated in importance to Coronavirus in the field of clinical, scholastics, financial aspects however there is deficiency of exploration that investigate strength, shortcoming, opportunity and danger of covid19 lockdown in regard of representatives and climate. (Dr. Makarand Upadhyaya, 2022)

This study examined the macroeconomic and bank-specific factors that affect bank profitability in Azerbaijan, a transitioning economy that is dependent on oil. The profitability was favourably correlated with bank size, capital, and loans as well as the economic cycle, inflation expectations, and oil prices, but deposits, liquidity risk, and exchange rate depreciation were adversely correlated with it. Additional investigation revealed that the bank profitability exhibited modest persistence and that failing to take into account country-specific characteristics might result in estimation bias and subpar performance. The findings of this study are helpful in formulating banking policies aimed at boosting profitability. The study's innovative aspects include making use of current economic trends, taking into account regional differences, and for the first time, studying how the economic cycle affects bank profitability in Azerbaijan. The study also included robustness tests for consistency of results and adequate handling of the time series features of the panel data. (Fakhri J. Hasanov, 2018)

The nation's economic growth is hindered by inflation, a pressing issue. Economists, politicians, and even ordinary people are finding themselves caught up in the chaos. Because it directly affects people's standard of living, it is extremely risky. The obligation regarding government and government officials, financial specialists is to secure/safe watchman everyday person from expansion.

As per measurable information the expansion in India is higher explicitly in food things. The demand-supply side may be to blame, as this affects people's savings and reduces their purchasing power. Inflation is a pressing issue that impedes the country's economic expansion. It is becoming more chaotic to financial specialists, lawmakers and even individuals too. It is extremely risky in light of the fact that it is straightforwardly influencing on way of life of individuals. The obligation regarding government and legislators, business analysts is to secure/safe watchman everyday person from expansion. India's inflation, particularly in food

items, is higher, according to statistics. Causes might be request/supply side, which lessens the buying force of individuals, which affecting on investment funds of individual. (Dr. Kavita Khadse & C., 2023)

The overall performance and efficacy of various smart city development sectors can be enhanced by block chain technology. The smart city has emerged as a new model for providing citizens with high-quality facilities by dynamically optimizing the city's resources. Smart urban areas can provide the best administrations for assisting residents with their day-to-day lives in terms of medical care, transportation, energy use, and education. In any case, in spite of its expected vision, the idea of a shrewd city is still in its outset, and there are expanding security issues. The decentralization, auditability, transparency, and immutability of block chain have the potential to encourage the creation of smart cities. (Dr. Kavita Khadse & H., 2023)

OBJECTIVES

- 1) To identify effect of trade Volumes on Trade Finance products.
- 2) To study characteristics of different transaction banking products.
- 3) To study trade finance practices and usage in different continents.
- 4) To study cash management in different continents.
- 5) To identify the effect of interest rates on cash management.

RESEARCH METHODOLOGY

Trade Finance between countries and Cash Management tools used by them is very vast subject and to gather Primary data would have been herculean task given paucity of time and other resources. So Secondary Research Method was used to collect information which was then collated to convert it into meaningful data.

Enormous amount of information was collected from articles on different platforms, written by experienced scholars. Research Journals were perused to capture different trade finance tools, their usage, reasons for increase or decrease in usage over long enough periods to derive conclusions. In many cases Government released information and / or World Bank collected information of trade and factoring volumes year on year basis are included. Changes in interest rates and their effects on volumes was another aspect researched here.

Many macro and micro indicators are used to deep dive into quantitative and qualitative factors impacting the Trade finance and Cash Management tools which helped in evolving good understanding of their correlation as well as inter-dependence.

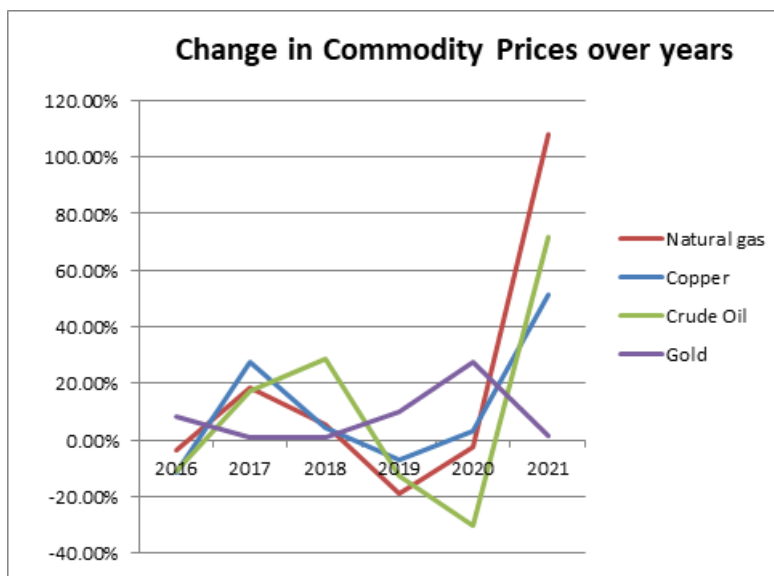
Major Global events impact political and economic texture of related country resulting in increase or decrease of trade of various commodities. This intern compels banks and other financial institutions to model suitable tools and products which intern impacts trade finance breadth and depth. We observed sudden change in Trade volumes and need for Cash management as confirmed by Government published reports.

Trade Volumes

Volumes of trades for trade finance as an indicator are the total trades for a country, total of import and exports. This helps understand how a particular country is doing with trades internationally. The international trade volumes are one of the most important indicators, it helps to understand the important economic dynamics of a country, as the factor is also an important factor for GDP. This indicator also helps to gauge how a country's Balance of Payments (excess of imports or exports) is doing, deficit or surplus. The trend of trade volumes is directly related to different products of trade finance.

Commodity trade prices

Commodity prices are one of the most important indicators. Exchange of commodity is seen from a long period of time as an expansion of business. Commodity prices play a vital role and it is identified from demand and supply for the commodity throughout the world. Countries are major importers or exporters of some commodities and it plays a vital role to affect its Balance of Payments. Major commodities are Natural gas, Crude oil, Copper, Zinc, Aluminium and Gold. For the study of effects off macro indicators on trade finance only commodities natural gas, copper, crude oil and gold are considered.



Factoring Volumes

Factoring in finance means to sell its account receivables to a third party to meet its short term liquidity needs. Factoring relieves the first party of accounts receivables to boost its working capital to continue his business, while the buyer chases up to the maturity of factoring to earn the full amount as well as earn spread on factoring as fees. Bank generally factor the invoice of trade to boost corporates short term needs and earns revenue through fees in return for factoring as well as spread between the discount rate and the full amount. Factoring is the key essence of trade finance as each product of trade finance has factoring in it, say it letter of credit or export credit agency. There is also a concept of Islamic Factoring, which believes that wealth must not be used to generate more wealth, and hence they don't charge interest on factoring of accounts receivables.

Innovation and creative ideas have helped evolve both Trade finance and Cash Management over the years. Developed countries have been in forefront in structuring new products that address niche requirements of customers. Commodities Trade felt need for such products owing to the huge volumes involved and very high value being at stake. Geo-political issues, Trade Agreements between countries have furthered their cause.

ANALYSIS AND FINDINGS

The research observes a close relationship between macro indicators and transaction banking products. With data about not only the mentioned macro indicators but also for other indicators like cross border payment volumes of countries, balance of payments, trade balances are all useful while mapping out the transaction banking products and understanding them. Quite high correlation is seen between these indicators and actual trade and factoring volumes.

With advent of COVID 19 pandemic, economies came to stand still, unemployment increased and this affected demand. To help industries interest rates were reduced drastically in most of the countries. Besides central banks took steps to improve liquidity in market leading to further lowering of effective interest rates to borrowers. By end of 2021, when the pandemic was brought under control, the central banks started interest rates making borrowing costlier. Also, they started removing the excess liquidity from market. Following the opening up the trade volumes improved drastically quarter on quarter basis. The year 2021 saw substantial increase in earnings and revenues with the help of quantum jump in exports. This was due to pent up demand getting free, showing strengthening consumption pattern. All these things help us understand that due to increase in trade volumes for the countries the trade finance sector performed well as people believed in export for the purpose of revenues.

Interest going down from end of 2020 till the start of 2H of 2021 gave opportunity to the people to easily raise capital at lower interest rates. This affected the spreads of the banks while lending and hence the revenues for cash management didn't grow as much as those from trade finance. Due to excess liquidity in the economy, the cost to raise capital reduced drastically. This situation had led to easy availability of loans and advances, at a lower interest rate.

In order to successfully operate a payments factory, the treasury needs to have full visibility of cash throughout the business units of the organization. This starts with accurate and timely cash forecasting, which then informs the treasury of the optimal time to implement cash management strategies such as netting and pooling. To gain

this visibility, treasury technology offers many options, but it also relies on the treasury department educating the business units that they deal with as to the benefits of providing accurate information in good time.

While corporates are hard at work trying to gain greater visibility over their cash, banks are facing equally complicated challenges. Regulatory changes from even before the credit crisis are removing access to banks from some areas that were previously profitable. Banks are now finding that they have to re-invest in their payment infrastructure in order to stand out in an increasingly competitive market for corporate business.

According to study of the report by The Global Treasurer (CGI transaction banking survey, 2019), few challenges for the banks are the increasing entry cost as well as regularity complexity for new countries. The adoption of new regulation in existing countries, implementation of GDPR (Global Data Protection Regulation) has caused increased troubles to the transaction banking vertical of the banks. There are a lot of structural changes when it comes to infrastructure, scalability of current systemic infrastructure. The major reason is the threat of new entrants in the market, the growing market share of fin-tech companies in the banking business and development of web 3.0 based financing.

CONCLUSION

Transaction banking has been an essential part of corporate banking. With other services like lending and security services being provided to the corporate clients, transaction banking has been in adolescent stage. Historically businesses were aware of plain vanilla type loans. With increasing competition, Corporates are trying to shorten working capital cycles and that's where transaction banking is helping them. Increase in cross border trades (both imports and exports) are exposing Corporates to higher and different types of risks which if not managed well can be fatal to their very existence. Importance of trade finance products and cash management tools need to be understood in this context. Short term loans usually have a higher rate on interests. But now with the help of transaction banking, clients can easily discount their invoices to make the cash conversion cycle shorter and use services like Payables to effectively manage the amount due to creditors.

There has been a good amount of correlation between the macro indicators and the transaction banking products. It is observed that even though most trades might not even get factored or trade aided, mere increase in volumes of trades at macro level suggest that the due to increasing number, the volumes for trade finance are also increasing. Increase in Commodity prices directly increase exposures thereby demanding appropriate trade finance products to address / mitigate risks involved.

The use of micro indicators shows us real picture as to how the transaction banking products are performing. Micro indicators generally refer to the reported numbers in the annual reports. Even though micro indicators are accurate numbers but for the purpose of forecasting they are quite useless. The annual report after all the audits and corrections comes in the 1Q of the next year. This becomes a lagging indicator for the purpose of forecasting the revenues of trade finance and cash management.

There is also an observed pattern with the macro indicators, all over the globe, countries seem to be having a similar situation. It never feels as some countries are in expansion of economy when some are in contraction. For a situation like pandemic, this had huge repercussion on almost all the economies of the world. But this is an outlier economic activity. The project though was a comparative study of transaction banking products with the help of macro indicators the base year was seen maximum contraction while, 2021 saw massive expansion.

SCOPE AND LIMITATIONS

The scope of the project has been limited for the study of transaction banking products with the help of macro indicators for the year 2021. The comparative study has been for understanding different trends in macro indicators, reasons behind the trends, and the effect on the different transaction banking products. This study has been for 2021 compared with 2020.

The accuracy of revenue estimation to figure out different trends can be done through various other macro indicators as well. The list of indicators is not hard bound and if indicators correlate to the revenues earned for a particular product by a bank, then it can be definitely be used. There are a few assumptions when it comes to macro indicators, like the reason commodity trade prices are considered, because it assumes the supply for the trade of a particular commodity doesn't change, it mainly is the effect of increasing demand, as the supply is reducing but only at a stable rate. The factoring volumes of certain region have been higher but the trade volumes have not been as high, reason is the existence of larger corporates in the region, which actively benefit from the usage of transaction banking. Considering all these assumptions the products of transaction banking were studied keeping in mind the effect of macro indicators on it.

The accuracy of the correlation can be increased by the usage of more leading indicators. The use of lagging indicators suggest that the acquired data and the situation derived for the products relates to past, the study of trend is necessary, but forecasting should be done at either coincidental indicators or leading indicators.

The study of products for this project was done with the help of different macro indicators. The indicators like interest rates, trade volumes and factoring volumes. These tend to be lagging indicators. Even though lagging indicators can be used to gauge trends in the economy in general, it cannot be used as a business operations or statistical tool to forecast future revenues or volumes of a particular product with certainty.

The comparative study was done to analyze different macro indicators where the base year was considered 2020. The results of this data might look abnormal as year 2020 showed major contraction in the economies while the effective opening up of and increasing liquidity in the markets by the central banks, reduction in interest rates and other relief packages led to exponential growth of all products in 2021.

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Goodness of Fit Measures for SURE Models Using Feasible GLS Estimators

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ABSTRACT

The present paper develops the goodness of fit statistic for the linear regression models fitted by the shrinkage type estimators. The family of double k-class estimators is considered as a shrinkage estimator which encompasses several estimators as its particular case. The covariance matrix of error term is assumed to be a non-identity matrix under two situations known and unknown. The goodness of fit statistics based on the idea of coefficient of determination. We provide a feasible generalized least squares estimator for (unrestricted) multivariate models. We show that the estimator is consistent and asymptotically normally distributed under mild assumptions. Unlike the maximum likelihood method, the feasible GLS is considerably fast to implement and does not require any complex optimization routine.

Keywords: SURE models, Feasible GLS Estimator, McElroy's measure, Bewley measure

INTRODUCTION

In the estimation of SURE models, as with single equation models, one may wish to report summary statistics reflecting some of the features or quality of the results obtained. In addition, one might wish to indicate the extent to which the fitted SURE model "explains" the variability in the data for the dependent variables. That is, some measure of goodness-of-fit in the form of a coefficient of determination might be applied. Here, we consider how such a measure might be constructed if the model is estimated consistently, say, by means of a Feasible GLS (FGLS) estimator.

To derive McElroy's measure R_{Mc}^2 , write the SURE model as:

$$Y = X\beta + U$$

$$Y = \bar{X}\bar{\beta} + X^*\beta^* + U \quad (1)$$

$$E(U) = 0, \quad E(UU^1) = (\sum \otimes I_T)$$

Where

$$\bar{X} = \begin{bmatrix} \bar{X}_1 & 0 & \dots & 0 \\ 0 & \bar{X}_1 & \dots & 0 \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ 0 & 0 & \dots & \bar{X}_1 \end{bmatrix}$$

$$X^* = \begin{bmatrix} e_T & 0 & \dots & 0 \\ 0 & e_T & \dots & 0 \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ \cdot & \cdot & \dots & \cdot \\ 0 & 0 & \dots & e_T \end{bmatrix}$$

where e_T is a $(T \times 1)$ column vector with all elements unity and the i^{th} diagonal block of X is

$$X_i = (\bar{X}_i, e_T)$$

Formulating the model as in distinguishes the intercept term in each equation from the other regressors. Note that the following discussion requires the presence of an intercept in every equation of the model. Now, let S be any consistent estimator of \sum , with $S^{-1} = A^{-1}A$, where A is nonsingular. Pre-multiplying by $(A \otimes I_T)$ and applying OLS yields an FGLS estimator of β , determined by the choice of S . That is,

$$\hat{\beta}_F = \begin{bmatrix} \hat{\beta}_F \\ \hat{\beta}_F^* \end{bmatrix}$$

With the associated residual vector

$$U_F = (Y - X\hat{\beta}_F) = (Y - \bar{X}\hat{\beta}_F - X^*\hat{\beta}_F^*)$$

Now, given that an intercept appears in each equation, the usual orthogonality between OLS residuals and regressors ensures here that

$$X^{*'}(S^{-1} \otimes I_T)U_F = 0$$

which can be shown to implies that

$$X^{*'}U_F = 0 \quad (2)$$

So, taking deviations about sample means for the data eliminates the intercepts from each equation, as in the single-equation case. Let

$$\bar{P}_{e_T} = (I_T - \frac{1}{T} e_T e_T')$$

so that after a little manipulation the FGLS estimated model may be written in deviation form as

$$(I_M \otimes \bar{P}_{e_T})Y = (I_M \otimes \bar{P}_{e_T})\bar{X}\hat{\beta}_F + U_F \quad (3)$$

Pre-multiplying (3) by $(A \otimes I_T)$ and decomposing the total variation into its "explained" and "unexplained" components, we get

$$Y'(S^{-1} \otimes \bar{P}_{e_T})Y = \hat{\beta}_F' \bar{X}'(S^{-1} \otimes \bar{P}_{e_T})\bar{X}\hat{\beta}_F + U_F'(S^{-1} \otimes I_T)U_F \quad (4)$$

Where use has been made of the relationship

$$\hat{\beta}_F' \bar{X}'(S^{-1} \otimes \bar{P}_{e_T})U_F = 0$$

A Coefficient of Determination for the full SURE system follows directly from (4):

$$R_{M_C}^2 = \frac{\hat{\beta}_F' \bar{X}'(S^{-1} \otimes \bar{P}_{e_T})\bar{X}\hat{\beta}_F}{Y'(S^{-1} \otimes \bar{P}_{e_T})Y}$$

$$\Rightarrow R_{M_C}^2 = 1 - \frac{U_F'(S^{-1} \otimes I_T)U_F}{Y'(S^{-1} \otimes \bar{P}_{e_T})Y} \quad (5)$$

As McElroy notes, this $R_{M_C}^2$ has several desirable properties. Clearly, from (4) and (5), $0 \leq R_{M_C}^2 \leq 1$. For a particular choice of estimator for \sum its value is maximized by constructing R^2 from b_F . It is related monotonically to an appropriate test of

$$H_0 : \bar{\beta} = 0 \text{ against } H_1 : \bar{\beta} \neq 0$$

$$Z^* = \begin{bmatrix} V \\ G^* \end{bmatrix} \begin{bmatrix} R_{M_C}^2 \\ 1 - R_{M_C}^2 \end{bmatrix} \quad (6)$$

Where $V = (MT - \sum K_i)$

$$G^* = (\sum K_i - M)$$

All of these results follow the properties of the usual OLS coefficient of determination for a single-equation model. Finally, it can be shown that $R_{M_C}^2$ may be interpreted as the squared correlation coefficient between $(A \otimes I_T)Y$ and $(A \otimes I_T)X\hat{\beta}_F$. This last result exposes the principal weakness of McElroy's measure. It measures the correlation between the actual and fitted values of the dependent variables in a transformed space, not in terms of the original measurements for the data. This deficiency is equally apparent if we interpret $R_{M_C}^2$, from (4) and (5), as that proportion of the sample variation in $(A \otimes I_T)Y$ explained by $(A \otimes I_T)X$. Note that these last two interpretations have only asymptotic justification, a point not noted by McElroy, as $S = (A'A)^{-1}$ is an asymptotically justified estimator of \sum . It is not clear that we should be interested in a measure based on such a

transformation of the original problem. Presumably, a more interesting measure of goodness-of-fit would be one which can be given interpretations such as those above when viewed in terms of the original sample space.

McElroy compared her R_{MC}^2 with other goodness-of-fit measures which have been proposed for Sets of Linear regression equations, and Buse (1979) extended McElroy's analysis to allow for the possibility that the SURE model's disturbances might be autocorrelated or heteroscedastic. Recently, Bewley (1985) considered McElroy's and other measures of goodness-of-fit when the SURE model incorporates the constraints of an allocation model, as typified by a system of demand equations. As noted earlier, McElroy's R_{MC}^2 is derived on the assumption that each equation in the system includes an intercept. If this is not the case, then the decomposition in (4) which ensures the equivalence of the two formulae for R_{MC}^2 in (5) no longer applies. In this case the definition of R_{MC}^2 is ambiguous and in particular it may take on values in excess of unity if defined by the first relationship in (5), or negative values if defined by the second relationship in that equation.

Finally, note that McElroy's measure is one for the goodness-of-fit of the entire SURE model. If the usual single-equation coefficients of determination are calculated on the basis of FGLS estimates and residuals, the usual decomposition of the OLS sums of squares will not hold in general, and ambiguous measures will be obtained (irrespective of the inclusion of an intercept in the equations). It is not clear what meaning can be attached to single equation goodness-of-fit measures in the context of SURE models. The construction of appropriate such measures remains open for investigation, although an obvious suggestion is to compute the correlation between the actual sample values for the dependent variable and those values predicted using the FGLS parameter estimates, equation by equation. The effect on R_{MC}^2 of the choice of S, in finite samples also could be considered. This last issue may be important if R_{MC}^2 is used to rank competing models which explain the same dependent variables. The usefulness of R_{MC}^2 in this regard has not been explored, although one would conjecture that choosing between competing SURE models by maximizing R_{MC}^2 would (under certain conditions) lead to the selection of the correct specification, asymptotically.

A simple model-selection rule which may be helpful in some cases for choosing between alternative SURE model specifications which explain the same vector of dependent variables may also be mentioned here. It is well known (e.g., Theil, 1970; pp. 212-214) that under certain conditions, choosing between two OLS regressions with the same dependent variable by minimizing the estimated error variance leads to the selection of the correct specification, on average. If we recall the discussion of the FGLS estimator of β in this estimator is just OLS applied to the transformed model,

$$Y^* = X^*\beta + U^*$$

Where S is a consistent estimator of Σ . That is

$$\hat{\beta}_F = (X^{*t} X^*)^{-1} X^{*t} Y^*$$

SUMMARY AND CONCLUSIONS:

In this research paper identified the best model for linear regression models. Further, goodness of fit measures for SURE models based on Feasible GLS estimators have been developed in the present research paper.

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Functional Specification of Nonlinear SURE Models

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ABSTRACT

A Non-linear model is one in which at Least one of the parameters appears non-linearly. More formally, in a nonlinear model, at Least one derivative with respect to a parameter should involve that parameter. is the partial derivative of the functional form of the model. SURE models where the disturbances are additive and the variables and parameters are linear. Such a model definition could be overly restrictive in real life. Non-linearities might be a property of the model, for instance, if the system of equations we want to estimate is generated from an underlying microeconomic optimisation issue. For many widely used utility functions, a case in point is the derivation of a system of demand equations from the constrained maximisation of the consumer's utility function. Renaming the variables or appropriately transforming the model will typically reduce non-linearities in the data.

Keywords: Non linear SURE Models, Gallant's, Wald, Lagrange multiplier, likelihood ratio principles.

INTRODUCTION

In the present study, we have considered SURE models which are linear in both the variables and parameters, and in which the disturbances are additive. In practice, such a model specification may be unduly restrictive. For example, if the system of equations which we wish to estimate is derived from some underlying microeconomic optimization problem, then non-linearities may be a feature of the model. The derivation of a system of demand equations from the constrained maximization of the consumer's utility function is a case in point, for many commonly used utility functions. Non-linearities in the variables often may be eliminated by an appropriate transformation of the model or renaming of the variables.

Specification of Non Linear SURE Models:

We retain the assumption that the disturbances are additive and discuss Gallant's (1975) analysis of the model

$$Y_{ti} = f_i(X_{ti}; \beta_i) + U_{ti}, (i = 1, 2, \dots, M; t = 1, 2, \dots, T)$$

where X_{ti} is a $(K_i \times 1)$ vector containing the t^{th} observation on each of the explanatory variables in the i^{th} equation; β_i is a $(P_i \times 1)$ vector of unknown parameters in the i^{th} equation; and $f_i(-; \cdot)$ denotes the i^{th} response function. Thus, the nature of the non-linearities may differ from equation to equation.

Writing the model more compactly, we have

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ Y_M \end{bmatrix} = \begin{bmatrix} f_1(\beta_1) \\ f_2(\beta_2) \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ f_M(\beta_M) \end{bmatrix} + \begin{bmatrix} U_1 \\ U_2 \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ \cdot \\ U_M \end{bmatrix}$$

Or,

$$Y = f(\beta) + U$$

We have condensed the notation so that $f_i(\beta_i)$ is a $(T \times 1)$ vector with typical element $f_i(X_{ti}; \beta_i)$, and β is the $[(\sum_i P_i) \times 1]$ vector formed by stacking the elements of the β_i . In the following analysis it should be recalled that f is a function of the data as well as of β . Now, treating each equation of the system separately, choosing β_i to minimize the quantity

$$\frac{1}{T} [Y_i - f_i(\beta_i)]' [Y_i - f_i(\beta_i)]$$

The non-linear OLS estimators, $\hat{\beta}_i$ ($i = 1, 2, \dots, M$), the U_i 's are assumed to be normally distributed then it is easily seen that $\hat{\beta}_i$ is also the maximum likelihood estimator of β_i . The corresponding estimator of β say $\hat{\beta}$, is obtained directly by stacking the $\hat{\beta}_i$, and the elements of Σ may be estimated by constructing

$$S_{ij} = \frac{1}{T} [Y_i - f_i(\hat{\beta}_i)]' [Y_j - f_j(\hat{\beta}_j)]$$

and $S = (S_{ij})$

Taking account of the jointness of the equations in the FGLS estimator, $\hat{\beta}_F$, is obtained by minimizing

$$\frac{1}{T} [Y_i - f_i(\beta_i)]' (S^{-1} \otimes I_T) [Y_i - f_i(\beta_i)]$$

It should be kept in mind that the minimization will generally require the use of numerical approximation methods, and that $\hat{\beta}$ and $\hat{\beta}_F$ cannot be written in closed-form. Of course, this considerably limits the extent to which the finite-sample properties of these estimators can be described, but some general asymptotic results were discussed by Gallant (1975). His results require a number of assumptions, including compactness of the parameter and sample spaces; the existence of continuous first and second derivatives of f_i with respect to the elements of β_i ; and the non-singularity of the matrix

$$\Omega = \begin{bmatrix} \sigma^{11}V_{11} & \dots & \sigma^{1M}V_{1M} \\ \vdots & \ddots & \vdots \\ \sigma^{M1}V_{M1} & \dots & \sigma^{MM}V_{MM} \end{bmatrix}^{-1}$$

Where $V_{ij} = (P_i \times P_j)$ matrix

Under these conditions Gallant established the strong consistency of $\hat{\beta}$ and $\hat{\beta}_F$ for β , and showed that $\sqrt{T}(\hat{\beta} - \beta)$ and $\sqrt{T}(\hat{\beta}_F - \beta)$ converge in distribution to multivariate Normal with null mean vectors and (asymptotic) variance covariance matrices Δ and Ω respectively, where Ω is given by

$$\Delta = \begin{bmatrix} \Delta_{11} & \dots & \Delta_{1M} \\ \vdots & \ddots & \vdots \\ \Delta_{M1} & \dots & \Delta_{MM} \end{bmatrix}$$

With $\Delta_{ij} = \sigma_{ij}V_{ii}^{-1}V_{ij}V_{jj}^{-1}$ ($i, j = 1, 2, \dots, M$).

Finally, to assist in the construction of asymptotic confidence intervals or tests, Ω can be estimated consistently by

$$\hat{\Omega} = \left[\frac{1}{T} \hat{F}' (S^{-1} \otimes I_T) \hat{F} \right]^{-1}$$

Where

$$\hat{F} = \begin{bmatrix} \hat{F}_1 & 0 & \dots & 0 \\ 0 & \hat{F}_2 & & 0 \\ \vdots & \vdots & \dots & \vdots \\ 0 & 0 & \dots & \hat{F}_M \end{bmatrix}$$

It should be noted that under the assumption of normally distributed disturbances, so that $\hat{\beta}_F$ is the (non-linear) ML estimator of β , tests of general (non-linear, within or across equations) restrictions on the parameters could

be constructed by appealing to the Wald or Lagrange multiplier or likelihood ratio principles in a manner analogous. Although the asymptotic distributions of the test statistics are the same under each of these approaches, the finite-sample properties of these tests are unexplored in the present context.

SUMMARY AND CONCLUSIONS

Specified various criteria for the selection of non linear regression models besides some advanced general criteria for Regression analysis.

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