Journal of Applied Information Science
11 (1) 2023, 01-15
http://www.publishingindia.com/jais

A Smart Approach Laundry Management System: A Tool to Integrate for Next Generation Life Style

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Abstract: This research work represents an online working website of laundry containing a management system and payment gateway. Many of the laundry firms don't have a proper management system to store the records, which include many problems such as, mixing up customer's clothes or sometimes losing up the record register. This system helps the users to have to keep track of their requests/orders, they can also set drop off time at their convenience. Two login portals will be there one for admin and one for users. User portal will be used by the customers to make orders whereas from the admin portal admin can see all the users' information and the status of the orders. Rates of laundry can be changed by the admin from the admin portal according to market price, occasionally the discounts/offers will also be provided. As the payment gateway is also included on the website customers can use that for making payments. Each customer is assigned with a unique ID on registration to avoid contrasting information and their rest information is kept safe. The technical skills include PHP/NodeJS, mongoDB/MySQL, Python, HTML, CSS & JavaScript. This solution solves many problems and brings ease to operating the business. All the customers' information is managed properly as well as their service requests/orders and record of the orders can never be lost. The design of the website is also unique and has a user friendly interface. Therefore, it will also be fun for the users to interact with the website and providers of the service have an opportunity to run the business smoothly.

Keywords: Customer satisfaction, Database, HTML, Interface, Management, MongoDB, Python, SQL.

I. Introduction

A. Laundry Management System: A Needed Software in Indian Colonies

A Laundry Management System is a set of laundry software solutions that keep operations flowing. This helps in automating and simplifying the day-to-day laundry related tasks like washing, cleaning, drying and air drying the clothes. This is developed to control or to manage the front-office capabilities like booking reservations, clothes check-in/check-out from the laundry centre, managing the washing rates and billing.

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https://raw.githubusercontent.com/abhishekbvs/laundry-management-system/master/ScreenShots/HomePage.png

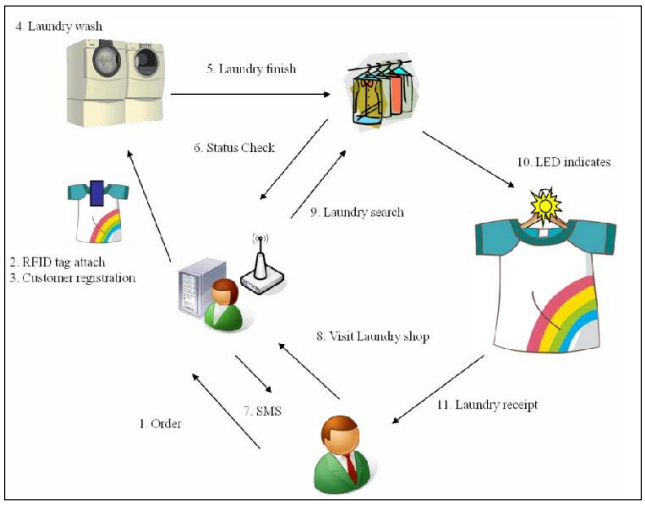
Fig. 1: Laundry Management System

As most Indian colonies still rely on old techniques like - colonies hire a single laundry organisation to manage their laundry system (it is extremely hard for a single organisation to complete tasks on time). And this is a time consuming and not very trusted process as mixing and losing of items are very common in this process. Thus arising the need of this advanced and more efficient technology in our society to make laundry a simple and effective task [6] [9].

This figure represents the starting page of this project. As observed in Fig. 1, multiple machines indicates that this project tends to implement automation of laundry service at a larger scale and minimise the complications involved in the laundry management system (as per Fig. 1).

B. Approach for Laundry Management System: Global Statistics

Our project represents an online laundry management system through which customers can place orders for their laundry. The interface of the website is created by using HTML, CSS and JavaScript. The user will register and then login to his account from where he can place the orders. From the admin portal prices of the laundry can be manipulated and all the users' information can be accessed. Users' information will be stored in the database created by using MySQL or mongoDB. After successfully adding the laundry items user will proceed to the payment page, this payment gateway is created by python by importing Django. After successful payments the laundry process will begin and status can be updated by admin via admin portal.



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https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.semanticscholar.org%2Fpaper%2FAn-implementation-of-Laundry-Management-System-onVanLee%2Fbe310bd1e2e5e37d23d73dece2a4caa4de0b46a9%2Ffigure%2F0&psig=AOvVaw1i-2-gfnkUucndUB4zhkyv&ust=1664113864486000&source=images&cd=vfe&ved=0CAwQjRx qFwoTCNCOj7bJrfoCFQAAAAAdAAAAABAT

Fig. 2: Functioning of Laundry Management System

Since almost everything is online in the current decade many laundry firms also made their websites and applications in order to provide the services through the internet. Taking laundry online improved the system drastically by increasing the number of users. Expenses which were included in the offline system are removed and laundry is now done at very cheap prices. Due to many advantages of the online laundry management system, online laundries are increasing day by day globally. And by 2026 the online on-demand laundry service market size is expected to grow by USD 98.6 billion [6] [10].

The image tells the full process of the project. First the customers will log in to their account and make the order of laundry by providing all the necessary details. Then the firm will do the given tasks in the given time and after the clothes have been washed and dried, customers can come and pick them up at their convenience (as per Fig. 2).

C. Societal Scenario of LMS: Needs and Advantages

These days' people are too busy in their personal as well as professional life due to which they don't get enough time for their daily chores. Our project provides them with the facility of doing it on time. It provides the collected information to users on a single platform. Each user can easily access the data and get the required update on time. The overall system is easy to use and secure.

Laundry Management System is used these days to manage day-to-day operations, delivery and billing of orders. It is used by the people in a way as they can place orders, receive the bill and get the clothes back after required time as soon as the payment is done successfully. The use and demand of Laundry Management System is increasing fast. It can be used from small to large scale [4] [11].

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https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.consumerreports.org%2Fcro%2Fnews%2F2012%2F09%2Flaundry-tips-for-college-students-help-them-take-a-load-off%2Findex.htm&psig=AOvVaw2XFbVRw9RqB45PpBCM8kdl&ust=1664128051086000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCKC315X-rfoCFQAAAAAdAAAAABAE

Fig. 3: Problems Faced by People

This figure shows the student facing a problem in managing his clothes.

Students and working professionals are the main ones who mainly faces such problems. Here, the student showing in the figure is tensed due to improper management of his clothes (as per Fig. 3).

D. Technologies Used for Designing LMS in 21st Century Smart Society

Skills sets required to develop this project (LAUNDRY MANAGEMENT SYSTEM) include knowledge of some coding languages like - HTML, PYTHON, CSS, JAVA and to develop the database some knowledge of MongoDB, SQL. The extra feature of payment gateway required skills like Django and Python.

To operate this project the skill set required is minimal. Users just need to login to this website and start exploring the features as per their use which are provided within this project.

To further enhance the functioning of this project, features like prediction can be added to it. For the implementation of prediction features Artificial Intelligence (AI) and Machine Learning (ML) is required. Prediction features will further extend the scope of this project as it is useful for laundry firms to analyse and predict the market conditions for their growth. The data of customers recorded in the management system can benefit laundry firms to compare their progress and work on their weak points to grow their business and make their services more affordable and enhance the user experience [4] [12].

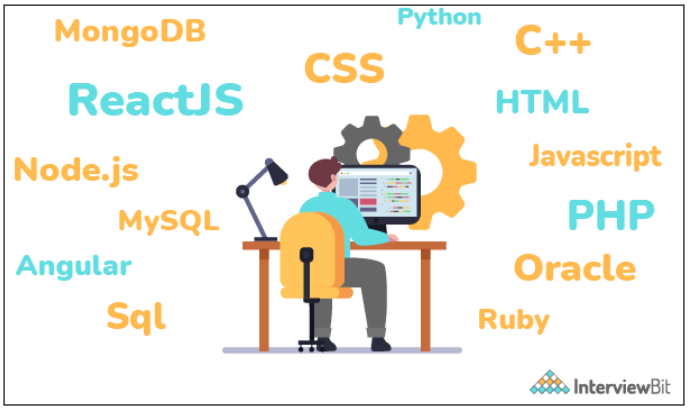

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Fig. 4: Skills Required to Manage and Develop the Laundry Management System Project

The technical skills implemented on this project. This project is made possible because of a combination of more than one technology and implementation of our knowledge in different languages and branches of computing (as per Fig. 4).

E. Automation and its Need of LMS in 21st Century Smart Society

Our Project (The Laundry Management System) can be used by everyone, from students to business professionals. This serves an important role in saving time and helping those who don't know how to wash and manage clothes. It can be used by hospitals, residential societies etc. Factories has the main usage of this project.

As most people are shifting to the smart usage and utilisation of the products available in the market. This project is a benefit for them, it saves time and money as it works fast and anyone can afford it. People are so involved in their lives that they need this kind of thing to make their task easier and faster. This complete project helps them to explore new technology and platforms [8] [13].

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https://www.google.com/url?sa=i&url=https%3A%2F%2Fshubhram.com%2Fhospital-linen-management%2F&psig=AOvVaw1lpr1Yx8zokSvuY4_M_h&ust=1664127554461000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCPD8p6X8rfoCFQAAAAAdAAAAABAP

Fig. 5: Laundry Management System Used in Different Fields

Figure showing the usage of Laundry Management System in hospitals how the clothes of doctors, nurses and patients are managed. This system is used widely just to enhance the quality of work done in less time. Hospitals using it on a large scale, it all makes it more demandable and work efficient (as per Fig. 5).

F. Problems Faced and Features of a Maintenance Software

Since this was our first project the major problem we faced was to have enough confidence to do the project. As we were in second year when we started working we faced many difficulties with skills and technologies. We had to learn required languages like HTML, CSS, JavaScript, NodeJS etc. that are used in the project.

Currently our project only involves a management system and payment gateway but in future we plan to involve a GPS system for navigation, which will help to provide door to door services to customers. Other services can also be added to the project in future such as updates of the order can be given through SMS or email. Verification via OTP, through SMS or email can be included which will increase the security of the user's data. Or the system can be transferred to an app from the website which will help in increasing the number of users and customers will find it more easy to use [**7**].

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https://www.google.com/url?sa=i&url=https%3A%2F%2Fshriambikalogistics.in%2Fdoor-to-door-services%2F&psig=AOvVaw3XdWVCO6IK5ePnXVdjSazX&ust=1664115575124000&source=images&cd=vfe&ved=0CAwQjRxqFwoTCNCp_vnPrfoCFQAAAAAdAAAAABAD

Fig. 6: Door to Door Services

The image shows a delivery boy on a vehicle making home deliveries of the products. If home delivery services are included in the project then someone can be hired for delivering the laundry to the customers' home (as per Fig. 6).

II. Literature Review

Shoewu *et al.* (2016) [7] and his team exhibited a project on a laundry management system which has the goal to automate the management of the laundry firm making it more efficient and error free. Project included HTML at the front end and provided the graphical user interface, while the SQL database was at the backend to store the user's information.

The advantages their system had over the existing system were the less amount of paper work and more efficiency thereby improving productivity. It also reduced the cost of printing and purchasing registration materials annually. The system has been designed in such a way the users only need to input their customer data which is then entered into a computer database. Customers will be assigned a specific id on registration.

Tools used in the project are Graphical User Interface (GUI), Hyper-Text Markup Language (HTML), Cascading Style Sheets (CSS), Client-side Script (JavaScript), Structured Query Language.

User Requirements to gain the access to the laundry management system resources were a Personal Computer, a Username and a genuine Password.

User-Interfaces consists the Login page, Product page, View customers, View records, Search for customers, Register a new user, Print receipt. Conclusion that can be deduced from the project consists of below: Since the whole process is automated hence it provides great efficiency.

- The user interface in the project is very attractive and fun to use when compared to existing systems.
- Only the authorised users can get access to the system.
- Updating information in the previous records becomes much easier.
- System Security, data security and reliability are the striking features.

Limitations of the project are that it doesn't have any authentication system like OTP or verification code that can be sent to the user's mobile number or email id. Providing OTP verification security can be improved and data can be kept safe. Another limitation of the project is it should have an online payment gateway to make the payments more reflexive and convenient. If the payment gateway is included then customers can make cashless transactions and record of payments will also be kept safe. The major improvements that can be done in the project are instead of a website an app can be developed which will be more easy to use and the number of users will also increase. Another possible addition is providing door to door service so that customers don't have to go for drops and pick-ups. These services, if included can bring a major change to the project and will improve the project quality drastically [**7**].

Ibrahim *et al.* (2017) [5] exhibits a Laundry Management System which aims toward managing laundry services and providing recovery and backup for security management. It is a client-server system that can be accessed by staff, the database administrator, and the manager. For security purposes, only authorized users can log in to the system. It mainly focuses on database management services. Its interface is designed according to the current needs of the client. It is a two-sided architecture system that involves a client and an application server. It aims towards the problem arising these days. The methodology involves System Development Life Cycle. It is a prototyping model. They identified the problems:

Time Management: Manual System consumes a lot of time to manage and update the system manually.

Improper Communication: In manual LMS, employees and managers write down the services processed in the laundry. With LMS there are fewer chances of mistakes. Wok was done with aim and objective:

- It aims towards the development of a system that can handle the operations involved in the LMS.

- It focuses on the computerised system
- To increase the performance with time.
- The user gets many options to choose.

Hardware Requirements: The basic requirements involves: Processor 1.66 GHz processor speed, RAM 256 MB, Flash File for file transfer, Printer for printing receipt, backup storage hard disk.

Software Requirements: The Operating System, Windows 7/8/10, Microsoft Access 2013/2016.

Programming Language: VISUAL BASIC FOR APPLICATION (VBA). It enables the Rapid Application Development (RAD) of GUI, access to databases using Remote Data Objects etc.

Limitations and future scopes found were there were financial constraints as all the activities were self-done. Time factor was also the barrier in successful completion of the project.

- To increase the security setup that will be embedded into all login pages.
- A fast and good internet backup.
- To allow internet transactions [5].

Ashwini (2017) [3] and her team exhibited the project named Laundrokart which is laundry management software (LMS). LMS is created in order to make the management easier in the laundry firms. It improves business efficiency and reduces the expenses spent on inventory, printing laundry slips etc.

The existing system has many problems like repetition of the details of customers every time when they arrive to give clothes. Another issue is when searching for a particular customer, staff members have to go through all the customers' details in order to search for an individual. Other problems include mixing of clothes and data, due to which the productivity of the laundry shop decreases. Whereas Laundrokart applies the computerised system through which the business process will be more productive and efficient. The software also has backup and recovery procedures to make sure that all data is kept safe.

Tools used in the project are Graphical User Interface (GUI), Hyper Text Markup Language (HTML) Cascading Style Sheet (CSS), JavaScript (JS), Hyper Text Pre-processor (PHP), MySQL, XAMPP, Codeigniter.

Minimum Hardware Requirements Processor: Intel Pentium III, Hard disk drive: 500 GB, RAM: 4 GB.

Minimum Software Requirements are Operating System: WINDOWS 7, Front-end: HTML, CSS and JavaScript, Back-end: PHP, MySQL.

Dataset of Customer Table through the project it is concluded that it can overcome all the drawbacks that were there in previously existing systems. The application has a friendly user interface (GUI) which develops interest of the user and makes the application more attractive. Updating information in the system becomes easier and manageable. Security of the data and information is also increased in the project.

The project also has some limitations which include:

- The staff members must have some technical knowledge to interact with software.
- Both user and employee has to do the registration from the login page.
- Multiple information cannot be updated at the same time.
- This system cannot be applied in a client server setup or online.
- This project still can have many developments in future.
- Instead of generating paper bill receipts, SMS would be provided.
- Using SMS or email, status of the order can be sent to customer.
- Pick-up and delivering services can be provided [3].

Upadhyaya *et al.* (2022) [8] and her team demonstrated a study on Laundry Management and Environment in which they told the concept of laundry management, how it is needed in today's society with the concerns that arise due to laundry firms. In introduction the author tells the history of washing that is how in old times people were used to wash their clothes with their bare hands. And then how from 1900 wringers came into existence from 1900 to 1947 many machines came to the world where, in 1947 first automatic washing machine was built by Whirlpool. After the history of machines they tell us about soaps and detergents how they came into existence and how soaps are different from detergents. In the later 20^{th} century laundry services came where people would give their clothes to another person for doing the washing for him in exchange of money. But these laundry shops faced many problems in managing the data and records of the customer there for an automated management system has been introduced. Which consists of taking orders, managing records, transportation and payment mechanism.

Key features include, customers can place their orders using a mobile app. Payments can be also done by the app itself as payment gateway has been included. They even provide refund or rewash if required. Laundry management system provides many opportunities like easy management of business and flexibility to customers. The author and her team has collected the data through an extensive survey of literature and the opinions of people like students who reside in hostel away from homes or employees living far away from home. Other data is also collected via various articles. Conclusion of the project is these laundry shops will be much more beneficial with a proper management system and if the waste of laundry is disposed some better place than rivers then water pollution can also be avoided therefore saving lives of aquatic animals. Limitations that author state in their article are, initial capital requirement is high, cut throat competition in the market and investment on assets required is high [8].

Adekola *et al.* (2021) [1] and his team exhibited a project of Online Laundry Management System (OLMS) for organisations. The aim of their project is to overcome the major issues faced in Laundry domain such as similar and multiple data is stored in laundry firm database, which lead to problems such as mixing of customer data and their clothing data, mishandling of customer clothes, delivery not on time, not able to entertain certain customer items, inefficient methods to control system, insufficient collation of data for better dataset formation and company use, etc.

The advantages of this project include the leverage provided by digital automation to increase labour productivity and expand operations at marginal cost, this helps in minimising the need for manual workers. Also it is environment friendly as it reduces the use of paper work by storing the data over the laundry management infrastructure.

Tools used in the project were Hyper Text Markup Language (HTML), Cascading Style Sheet (CSS), JavaScript (JS), Hyper Text Pre-processor (PHP) and My Structured Query Language (MySQL).

User Requirements to gain the access to the laundry management system resources were a Personal Computer, a Username and a genuine Password.

User-Admin interaction consists the following Login page, Product page, View customers, View records, Search for customers, and Register a new user, Billing and Manage delivery.

Dataset of database there will be a customer table in database design which will consist of customer database design. It will include the field name, format type and width (that is the maximum size possible). And the table data will include Customer ID, full name, phone no., email, address, No clothes brought, Service duration and service charge.

There will be a Staff table in database design and its attributes will be field name, format type and width or size. And the included table data will be Surname, Other names, department, staff number, post and date.

There will be service data in database design with field name, type and width. The included table data are service type, price and ID.

Conclusions of the present work can be explained as the improvement in technology is always helpful and in constant demand to enhance the working life of business people and operatives. Every customer gets a platform to utilise the services with ease and at their own comfort without compromising the quality of the service. From the implementation of this project we can conclude that an online laundry management system would make life easier. This implementation is a web application with a view of providing services, technology and methods to users and providers of laundry services.

The project also consists of some limitations which are:

- Tracking of item can be provided to customer.
- Both user and provider has to register to utilise the features.
- Notification system to notify customers of process completion.
- Skilled labour is required to implement this project.

This project still can have many developments in future like:

- More improved receipt processing technique can be added.
- Using SMS or email, status of the order can be sent to customer.
- Live tracking of customer items can be added.
- Pick-up and delivering services can be provided [1].

Afzal *et al.* (2020) [2] exhibited a project of Laundry Digital Ordering System (LDOS). The aim of his project is to overcome the flaws or problems in existing laundry digital ordering systems. As laundry is one of the most common tasks in everyone's life, it needs to be more easy and convenient for the user to order the services. His project aims to order laundry services by using speech recognition which will be helpful to overcome the problems such as many users are not confident and are not able to express their desire through text communication, many users are not able to use keyboard and computers, and overcoming these problems makes this project more user friendly than ever before.

Tools used in development of the system are:

Xampp server for database, Laravel as the framework. Notepad++, Java, XML, PHP, MySQL for the database, Microsoft Word 2016 used for documentation of applications and Google Chrome a browser to run the local host and search for information.

Hardware used for the implementation of this project were:

Laptop - Lenovo Ideapad, Processor - Intel ® Core (TM) i5-7200u CPU 2.50Ghz 2.70Ghz, Memory - 4GB RAM, Operating System - Windows 10, System type - 64-bit operating system, Pen drive - Kingston 16 GB and Mobile phone - Iphone 7 Plus.

For the working of this project the literature review included study of iLaundry, Maurice Dry Cleaners, Google assistant, Google cloud speech-to-text and technique of speech recognition.

The project also had some limitations such as:

- Does not manage or store the audio files.
- Cannot locate the customer address.
- Different accent might be problem for the system.
- Only English language is entertained.
- Only supported on Google Chrome [2].

The Summary of Research work can be found in Table I.

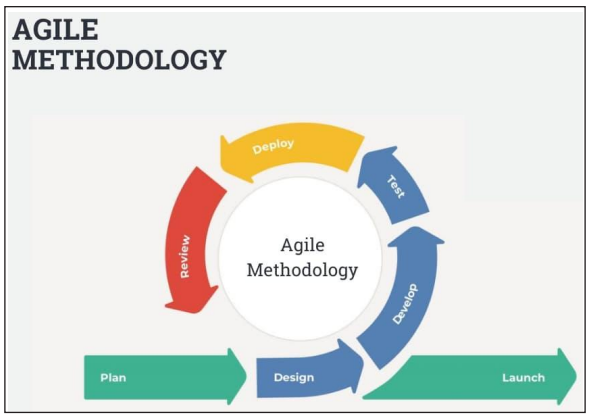
TABLE I: SUMMARY OF REVIEWED PAPERS

Paper Title and Author's Name	Introduction	Methodology	Dataset and Algorithm	Conclusion	Future Scope
Design and Implementation of a Laundry Management System [7]	Laundry firms currently use a manual system for the management and maintenance of critical information. The goal of the laundry management system is to automate the management of the laundry firm making it more efficient and error free.	HTML, CSS are used at the front end and provide the graphical user interface that relates with the user, while the SQL database is at the backend to handle the data storage process.	The dataset is created by using SQL which stores the user's information like unique registration id, name, phone number and other essential details. First the user registers himself and provides the required details after successful registration the user is ready to use the services of the project.	Conclusion of the project is that it provides a better and friendly graphical user interface compared to existing systems. Updating information becomes very easy, system security and data security also increases.	In future many other services can be included in the product such as online payments and home delivery by the laundry firms. Technology for OTP verification can also be included to increase data security.
Laundry Management System [5]	It is a Laundry Management System which aims toward managing laundry services and providing recovery and backup for security management. It is a client-server system that can be accessed by staff, the database administrator, and the manager.	The methodology involves System Development Life Cycle. It is a prototyping model.	The dataset is created by using SQL which stores the user's information like unique registration id, name, phone number and other essential details.	It provides a better and friendly graphical user interface compared to existing systems. Updating information becomes very easy, system security and data security also increases.	To increase the security setup that will be embedded into all login pages. A fast and good internet backup. To allow internet transactions.
LaundroKart, Laundry Management System [3]	LaundroKart is a laundry management software which is developed in order to facilitate management in laundry shops. It improves business efficiency and reduces the expenses spent on inventory, printing laundry slips etc.	The methodology of this system is System Development Life Cycle (SDLC) which is a prototype model.	Dataset is created using MySQL which stores the customers' information like id, name, gender mobile etc. Other datasets that are included in ItemTable, ServiceTable, ItemServiceTable, ItemServicePriceTable, InVoiceItemTable and CustomerInvoiceTable.	Conclusion of the project is that it provides a better and friendly graphical user interface compared to existing systems. Updating information becomes very easy, system security and data security also increases.	Many services can be improved and added in future like using SMS or email for status updates on laundry. Pick-up and delivery services can be provided.

Paper Title and Author's Name	Introduction	Methodology	Dataset and Algorithm	Conclusion	Future Scope
Laundry Management and Environment [8]	In laundry management and environment the authors told the requirements of laundry management system in societies and how the laundry firms impact our environment. Then he tells us about the evolution of washing machines time to time.	They simply used PHP and MySQL in their project for developing the system. And they took the surveys of many laundry firms so they can have a better analysis of how these laundry firms are causing damage to the environment.	Datasets have been created in their projects. All the basic datasets were already included like customer details etc. But in addition they also included the datasets for environmental health like amount of harmful chemicals and detergents released from the firms.	Conclusion from the project is harmful detergents need to be avoided and some other alternatives need to be introduced in order to avoid water pollution. As due to these harmful chemicals lives of many aquatic animals are in danger.	In future the harmful chemicals can be replaced by some eco friendly chemicals and the management system can be improved with some other changes also so that it can be sold to laundry firms.
Online Laundry Management System: OLMS [1]	This Online Laundry Management System (OLMS) aims to simplify management and working of laundry firms, automating most of the operations available and improving its efficiency. Its main target is to restore time efficiency, structured management, data security and to remove any inconsistency from the present laundry management system.	The agile model was adopted for their study and project. The proposed methods include user registration and log in, placing order, receiving and billing.	Dataset is created using MySQL and python which is sufficient to store the customers' details, staff members' details like Name, gender, address, age, mobile, etc. Some other dataset that are included are Service type details set.	Conclusion of the project was that it is helpful in providing a platform for laundry firms to operate and connect to customers easily and at their convenience. This project further provides customers with satisfaction of security and management of their items.	In near future many other features can be added to this project to make it more interesting and more useful in daily life of users and providers. Technology like tracking systems to reveal real time location of customers' items and more advanced payment methods can be introduced.
Laundry Digital Ordering System [2]	Laundry Digital Ordering System (LDOS) is developed in order to remove complications in daily life of users in ordering the laundry system by implementing a speech recognition system to order services online.	The methodology of this system is agile methodology. This method includes a set of procedures which are followed for implementation of the system.	Xampp server for database, Laravel as the framework. The languages used are Notepad++, Java, XML, PHP and MySQL for database purposes.	Conclusion of the project is that it provides more user friendly system to users to order online laundry services as per their requirements by speech recognition	Many limitations are still in this project which can be worked upon to further enhance the user experience like adding more languages other than English, add database to store audio files, etc.

III. Methodology and Setup of Experiment

Methodology is a method used to develop a system and define this system as a set of procedures. This project Laundry Management System with Payment Gateway is based on agile methodology.



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https://interqualitybg.com/en/resources/scrum- and-agile-resources/agile-methodology

Fig. 7: Agile Methodology

Methodology is important to achieve the success of the project. Agile methodology is a method that consists of different procedures to be followed to achieve the end product.

Plan: In this phase, the project title is selected. The selected title for the project was Laundry Management System with Payment Gateway. Abstract and introduction to the project was done and references to the project. Besides all this, the phase included collecting information and methods and techniques suitable for our project through research papers, articles.

Design: In this phase, all the gathering and collected data from the plan phase is transformed into the design. Diagrams to depict the flow of the system will be created in this phase such as Class Diagrams, Data Flow Diagram level 0 and 1, Entity diagram. These diagrams are designed to guide in future development of the system.

Develop: In this phase, all the designs created in the design phase are implemented through coding. In this project, a website will be created to provide an interface between the user and the service provider. This is the most critical phase because the end result and connection to the user is dependent on the coding executions.

Test: In this phase, when all other phases mentioned above are successfully completed testing is required to be done to check the implementation and running of the system as a whole together. All errors and bugs, if any, are omitted in this phase and testing is run continuously until all the functions run in a desired manner.

Deploy: This is the phase when all the implemented functions work accordingly as desired by the developer. The system is now ready to be deployed and finally the system can be published to the user for their use.

Review: In this phase, the developer gets the feedback and review from the user for any required maintenance. It is after this phase that users receive updated versions of the system.

Launch: This is the last phase, here the system is launched in masses and everyone who wishes to use the system can access all across the world (as per Fig. 7).

A. Execution Setup

- All the members started contributing by learning frontend development. At first everyone focused on HTML only which took around 3-4 days as it is the easiest among all the other skills.
- After learning HTML we practice some basic layouts that can be made by it. When we gained confidence we moved to CSS.
- CSS plays the most important role at any website's frontend as it is brings the beauty to the website and makes it more attractive. It tool around 1-1.5 weeks to learn CSS completely, then another 2-3 days in practicing few basic projects.
- When we all were confident in both HTML and CSS we divided the rest of the skills among us.
- Manvi Tyagi started learning Bootstrap which helped a lot in making our website more attracting.
- Pranav and Pranjal Vaidywan began working on backend development.
- Pranjal learnt MongoDB and SQL through which we were able to to make the required databases.
- Whereas side by side Pranav started working on NodeJS and JavaScript which is used to connect databases with the website.
- After successfully learning the skills all three team members began with the project. We contributed simultaneously each day and made the complete and working website.
- After successfully completing the website Manvi worked on including OTP verification while Pranjal and Pranav learnt Django in python so that payment gateway can be included.
- Working for almost two months we finally completed our project which is completely working and satisfactory.

B. Proposed Method

Different diagrams in this work have been represented below:

(i) Use Case Diagram

When a client registers himself the request goes to the admin and when the admin approves the client's registration then he will be able to log in to the website. After attempting the login process the client will be able to make an order and both

client and admin will be able to check the status of an order. The payment is done by the client and the order is successfully placed when the admin approves the billing (as per Fig. 8).

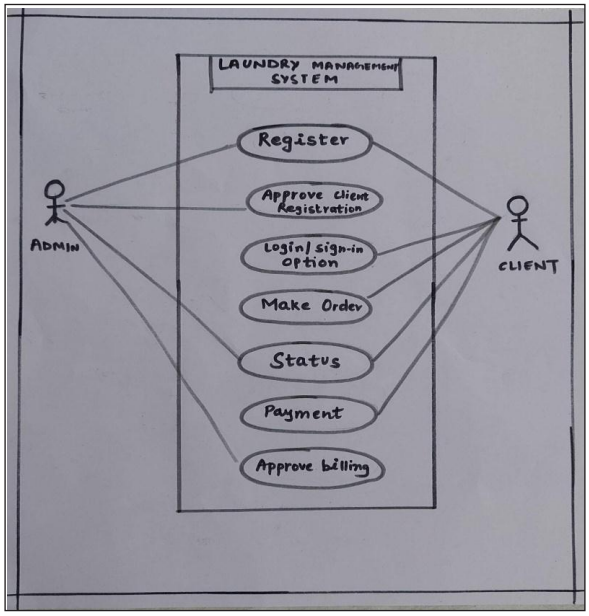

Fig. 8: Use Case Diagram

(ii) Entity Relationship Diagram

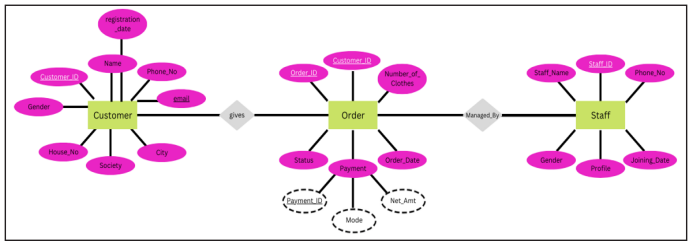

Fig. 9: Entity Relationship Diagram

As per Fig. 9 above we can see all the datasets that are included in the LMS. The first data set is of the customer which stores all the basic information of a customer like customer_ID which is the unique key of the dataset. Rest of the details are like name, address, phone_no etc. After this comes the second dataset named order consisting of all the details of orders such as order_id an unique key and customer_id which is also the unique key. Rest are just attributes which can be common for various orders like number of clothes, payment and many more. Last dataset is for staff of the corporation including the details like name, Mobile_no, address etc., where staff_id is the unique key (as per Fig. 9).

(iii) Class Diagram

This diagram represents the relation and the workflow of the Laundry Management System. As shown in Fig. 10 Laundry staff is connected directly to customers and also responsible for reservation and maintaining reservation record. Also staff members can manage the delivery. Whereas customers can operate search operations and search information (as per Fig. 10).

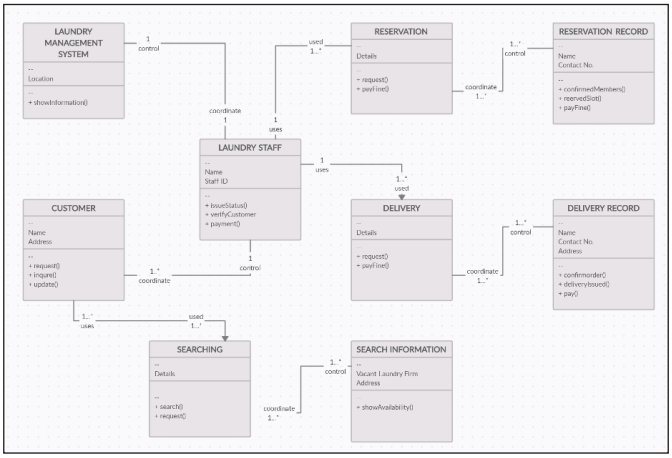

Fig. 10: Class Diagram

(iv) Data Flow Diagram

a) Level 0 DFD

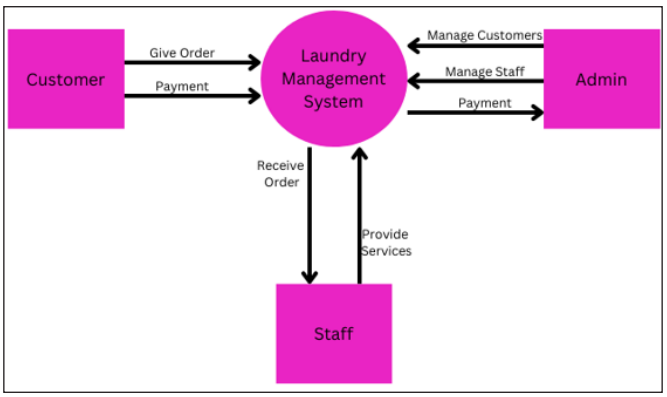

Fig. 11: Level 0 Data Flow Diagram

Fig. 11 represents the 0 level data flow diagram which shows the basic structure of LMS. Where customer, staff and admin is the strong entity. Customer places the order in LMS where it is received by the staff and then the staff provides the services. Payment is done by the customers which is received by the admin. Admin also managed customer details and staff details. This is how our LMS works (as per Fig. 11).

b) Level 1 DFD

Fig. 12 represents the Level 1 data flow diagram of LMS. Which shows a more deep structure of the system than 0 level DFD. It shows that an admin has many abilities like he/she can add, edit or delete any customer. He can even manage item details and services too in the same way as customer details. Whereas the staff manages the services, prices and payments of the orders and items (as per Fig. 12).

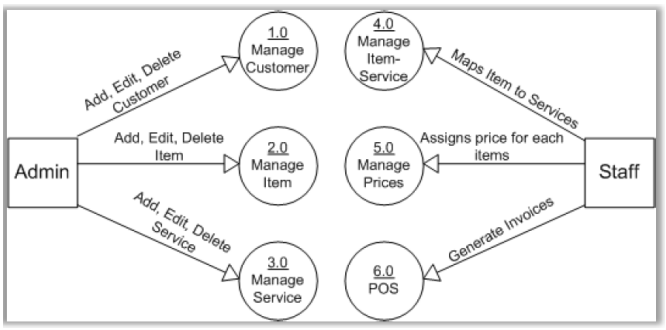

Fig. 12: Level 1 Data Flow Diagram

C. Flowchart

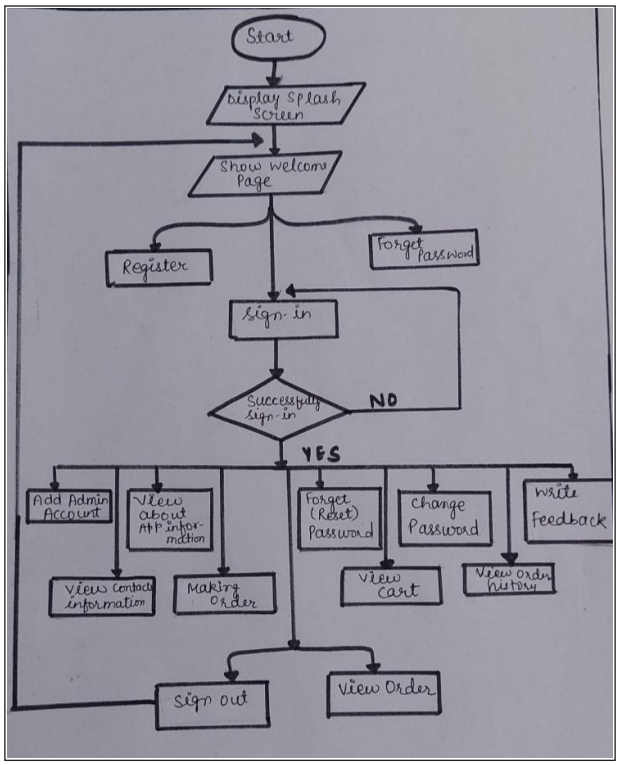

Fig. 13: Flowchart of LMS Software

When a user clicks on the website the welcome page will be there. Then there will be two options available for him/her to sign in and to register. If he/she is already registered he/she can choose the sign-in option to proceed and if not, he/she can go with the registration process. After successfully signing in a person can go with various options like viewing contact information, regarding making an order, app information, and admin account.

Other than these features there are various other services like changing passwords, resetting passwords in case one forgets, viewing order history and cart and you can write the feedback too. At last, you can sign out when you're done with the whole process (as per Fig. 13).

IV. Results and Discussions

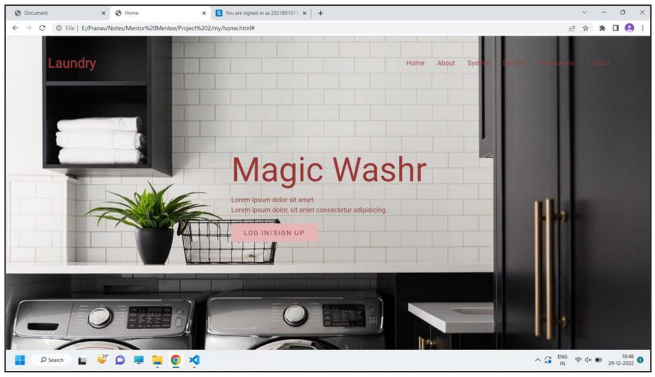

Fig. 14: Welcome Page

This is the first view of our website which shows how the user will be interacting with us. There users can choose any of the options to login/sign-up accordingly.

The sign in/up form will appear as soon as the user selects any of the provided option (as per Fig. 14).

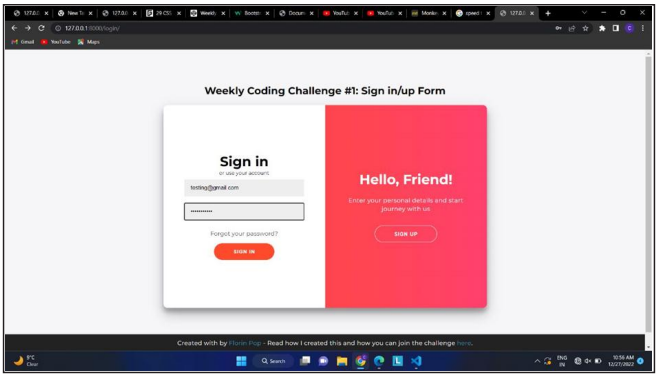

Fig. 15: Login Page

This is a page which shows the sign in form where the user is asked to fill the details like username and password to continue. If the details entered are correct, the user is ready to proceed with us. If the user is not registered to the website then he/she can go to the sign up page and can get themselves registered by providing the required details (as per Fig. 15).

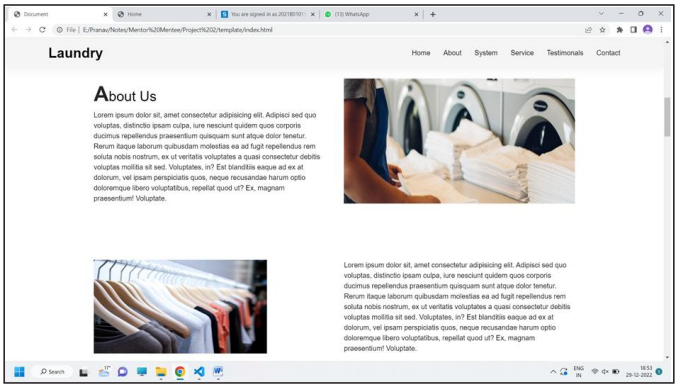

Fig. 16: Image Showing Details about Our Website

There is an option in the Navigation bar named 'About Us' which redirects the user to this page which shows the details about Magic Washr like what are the main features that are provided here. Or what are the benefits of this system? Each and every information about the website required to know by the user is available on this page (as per Fig. 16).

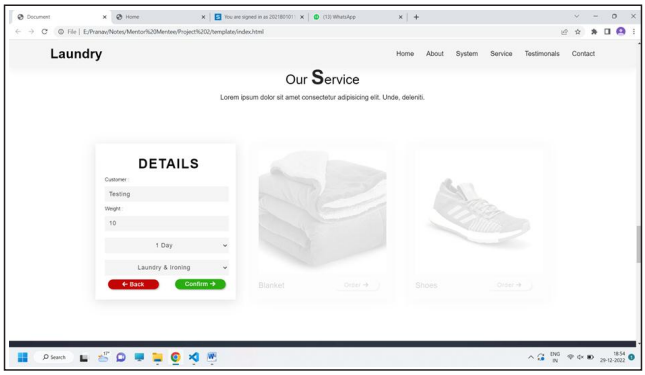

Fig. 17: Image for Customers to Enter Their Details Regarding Their Clothes

After successful login the customers are ready to use the services provided by Magic Washr. Hence, customers will provide their names, the weight of their laundry and other mentioned details which will directly be registered to the admin once it is confirmed. There is an option for going to the back page too. All these options makes the use of website easy for the customer (as per Fig. 17).

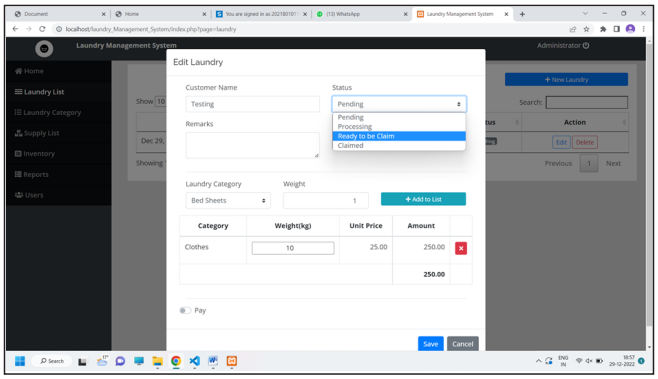

Fig. 18: Edit Page for Staff Member

Edit page allows staff members to update the status of the customer's laundry and also create the bill which is required to be paid for the delivered services. This also helps in confirming the number of clothes received and delivered to prevent any misplacing of laundry items of the customer (as per Fig. 18).

Through this page the customers can pay their bills for the respective laundry services they consumed. The page offers multiple options to choose from to pay the bill. Different company Credit and Debit cards are accepted to pay the bill. The user needs to provide a few details of the card and the transaction is done simply online (as per Fig. 19).

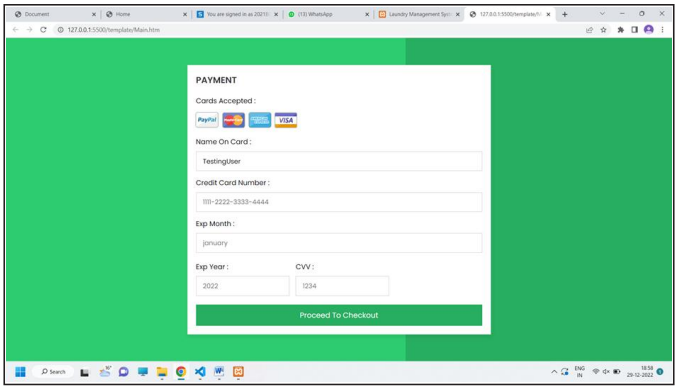

Fig. 19: The Payment Gateway Page

This is the section in which all the transactions and services provided are recorded for future reference and security purposes. The report consists of the Customer name and the date on which they delivered their laundry items for service and the date on which the laundry items were delivered back to them along with the total amount paid by them (as per Fig. 20).

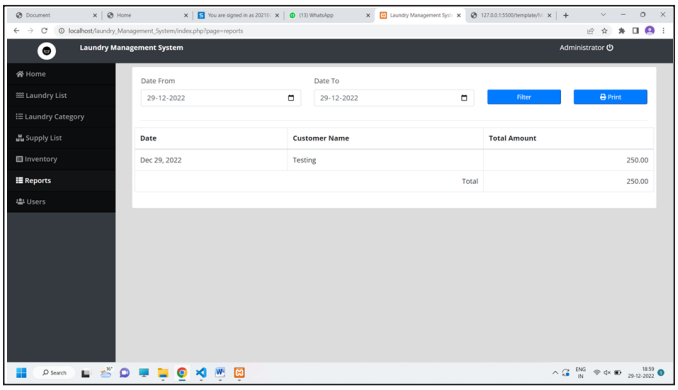

Fig. 20: The Reports Section

This is the snapshot which shows how the data is recorded and stored in the form of tabular data in the report section (as per Fig. 21).

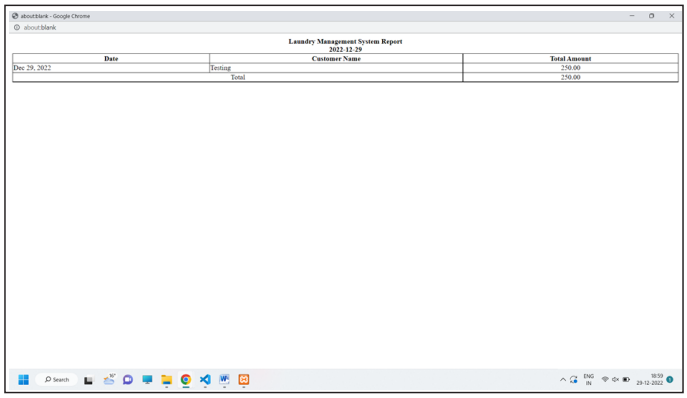

Fig. 21: The Recorded Data in Report

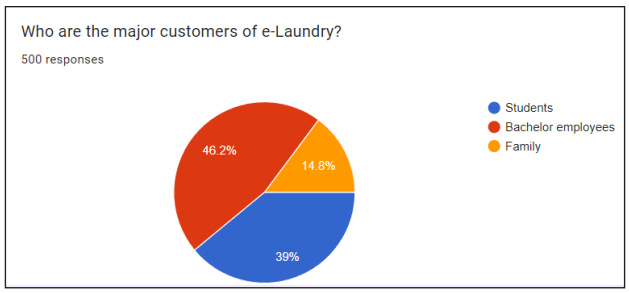

Fig. 22: Stakeholders of E-Laundry

We took a total 500 responses from different users of our laundry services asking them one simple question i.e., Who are the major customers of e-laundry? After getting responses, the majority of them voted for Bachelor employees (46.2%). Students got a total of 39% votes and families got the least number of votes. Hence we can clearly see that this service will be highly beneficial for the unmarried employees or the employees living far away from home (as per Fig. 22).

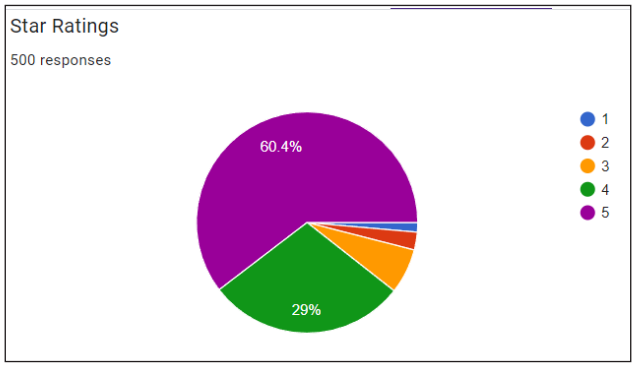

Fig. 23: User Ratings

As one can see in the above chart, the total percentage of the 5 star ratings is 60.4% which shows that many users liked using this management system. Very few opted for 1, 2 or 3 star ratings which clearly indicates many users are satisfied with the project. The average when calculated is 4.4 rating which is overall a good rating. The detailed information of all the ratings is given below (as per Fig. 23):

5 stars : 302 users, 4 stars : 145 users, 3 stars : 33 users, 2 stars: 13 users, 1 star : 7 users

V. Novelties

- This system helps the user to keep track of their orders and set drop-off time as per their convenience.
- Using payment gateway customers can directly make payments.
- Simplifies the task of the laundry manager, as everything is stored in a database.
- Using the admin portal admin can easily check all users' details and status of orders. Even the rates of laundry can be modified by admin.
- In future positioning systems can be added to this system so that users can have real time location of their clothes delivery. This can also be used to navigate nearby laundry services.
- Chatbots can be included to further enhance the system and navigate the new users.
- A Recommendation system can be introduced for suggestions.

VI. Recommendations

Laundry Management System is a website and database based project. Which includes the management system which is used to store the records of customers' laundries. It saves a lot of time for the staff and all the records are stored safely and securely. The details of customers, orders and staff will never be lost and can be accessed at any time from wherever the admin wants. Since we have included an OTP verification in the project therefore the security has been increased and no faulty customer can login to someone else's account. The total amount of order and by the time your laundry will be done, all such necessary details are shown to the customer through the website itself which is a great feature of this project. As we have included the payment gateway in the website itself hence customers can easily pay the laundry amount through the internet easily and due to that e-receipt will also be generated automatically. Record of transaction can also be accessed from anywhere at any time which gives too much flexibility in bills. Hence we suggest every laundry firm to use such a type of management system as ours as it will be very much beneficial for their business.

VII. Future Research Directions and Limitations

A. Limitations

- There could be an app for this Laundry Management System Gateway.
- Door-to-Door services could have been added to the website as a feature to make it more reliable.
- A feature in the website to analyze the cleanliness percentage of the clothes.
- Customer needs to access the website every time whenever he/she wants to see the status of their laundry.

B. Future Directions

- A better payment system with more security and facilities can be included.
- A feature for the authentication of user by clothes can be the next step ahead.

- A GPS system can also be introduced in the future for time saving purpose.
- Door-to-Door services can be included to put customer at ease.
- Notification via emails will be a great feature if introduced in future.

VIII. Conclusion

The project Laundry Management System with Payment Gateway is an online working website that was designed to resolve the major problems experienced by the laundry sector workers and users. Many problems such as mixing of data, mixing up customer's clothes and even sometimes losing the record were causing trouble in laundry services. As now in the 21st century mostly everyone is so busy in their day to day life they don't get time to waste on managing their laundry and this creates the need of technology for convenience in the way business is operated. This project helps in ordering laundry service with the help of the internet and users can directly pay for their services online using the payment gateway feature. As the demand for laundry services is increasing exponentially in recent times the need for a laundry management system is also increasing. At the end the main task of this system is to provide an easier and convenient way to manage their laundry.

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Additional Readings

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Annexures

Key Terms and Definitions

HTML: HTML is Hypertext Markup Language. It includes basic tags to design webpages, to make tables, to create forms etc.

CSS: CSS refers to Cascading Style Sheets. It defines how HTML elements are to be displayed on paper, screen or any other media.

JS: JS stands for JavaScript. It is used to create dynamic and interactive web content like web browsers and applications.

BOOTSTRAP: It is an open source framework used for creation of websites and web apps. It provides a collection of syntax for template designs.

PHP: It is a server scripting language. It is used for making dynamic and interactive web pages. It is fast, flexible and pragmatic.

NodeJS: It is single-threaded in nature. It is used for non-blocking, event-driven servers.

PYTHON: It is a high level programming language. It can be used to create web applications.

MYSQL/MongoDB: MongoDB is a document based non-relational database management system. It was designed to replace the MYSQL structure to work with data in an easier way.

Database: Database is a collection of information in permanent storage for faster retrieval and updation of data.

Journal of Applied Information Science
11 (1) 2023, 16-20
http://www.publishingindia.com/jais

TubeRate: YouTube Rating System

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Abstract: YouTube is one of the comprehensive video information sources on the web where video is uploaded continuously in real time. It is one of the most popular sites, where users interact with sharing, commenting and rating (like/views) videos. Generally the quality, relevancy and popularity of the video is maintained based on this rating. Sometimes irrelevant and low quality videos ranked higher in the search result due to the number of views or likes, which seems untenable. To minimize this issue, we present a Natural Language Processing (NLP) based sentiment analysis approach on user comments. A sentiment classifier model is built which identifies tweets positive, negative or neutral. In this technique, the collected corpus was divided into 3 sets namely positive emotions- happiness, amusement or joy; Negative emotions- sadness, anger or disappointment and Neutral-text doesn't contain emotions. YouTube data is also automatically classified into positive, negative and neutral according to query terms used in user review comments. In the paper the author uses Parts Of Speech (POS) polarity technique and tree kernel technique. Research work uses two types of resources such as a hand dictionary of emotions and a dictionary collected from the web. Different types of classification and feature extraction algorithms are used [1]. This analysis helps to find out the most relevant and popular video of YouTube according to the sentimental analysis of the comments posted by users on YouTube videos. Using sentiment analysis, these users' opinions and emotions can be extracted and quantified. TubeRate examines the current papers on sentiment analysis on YouTube comments as well as present the work done on proposed idea of user comment based YouTube video rating that is analyzed through polarity and segregation as positive, negative or neutral. This can be useful in predicting the like proportion of a YouTube video. These ratings will be on a scale from 1 to 5, where 1 means extremely dissatisfied and 5 means extremely pleased with the content of the video.

Keywords: Machine learning, Sentimental analysis, Support vector machine, YouTube.

I. Introduction

In recent years YouTube has made space for millions of users to share their information and opinion with each other. It is a popular online video site that has uploaded a huge amount of videos on different areas that may be description about a product, their services, or tutorials about software, likewise YouTube received a huge amount of comments from the viewers. YouTube is recognized as the second most popular website in the world by Alexa Internet [2].

The current YouTube algorithm only utilizes the statistics of user engagement while suggesting content. Through the use of the TubeRate app, the user will be able to view ratings of the videos which will be based on sentiment analysis performed on the comments of those videos [3]. Perform sentiment analysis on 2053 movie reviews collected from the web Movie Database (IMDb). They examined the hypothesis that sentiment analysis is often treated as a special case of topic-based text classification. Their work depicted that standard machine learning techniques such as Naive Bayes or Support Vector Machines (SVMs) outperform manual classification techniques that involve human intervention. However, the accuracy of sentiment classification falls in need of the accuracy of ordinary topic-based text categorization that uses such machine learning techniques. They reported the simultaneous presence of positive and negative expressions. Sentiment analysis is useful for quickly gaining the whole idea by using large amounts of text data and it will be helpful to understand the user's opinion. The sentiment is decided by the frequency of the positive-oriented and negative-oriented words. So, in these lexicon-based methods [4], domain dependency makes them less suitable for the domains without specialized lexicons.

However, these techniques often have a low precision rate due to the lack of powerful linguistic resources. Sentimental analysis is additionally referred to as opinion mining that means to find out or identify the positive, negative, neutral opinions, views, attitudes, impressions, emotions and feelings indicated in the text. Comments serve the purpose of helping the community to filter relevant opinions more efficiently [5, 6, 7]. For the proposed work, we collected the data from the YouTube comments of the public and measured the attitude of the users towards the aspects of a video which they describe in text to rate the video in our search engine.

II. Related Work

Many research papers are published in the field of sentimental analysis. We have reviewed the following papers to get a better understanding of this field. The review papers and their description is given below:

Salha al Osaimi and Khan Muhammad Badruddin [8] proposed an automatic approach to predict sentiments for informal Arabic language. They made use of Natural Language processing along with artificial intelligence. They further came to a conclusion that emotion icons play a vital role in development of an accurate classifier.

Pragya Tripathi, Santosh Kr Vishwakarma and Ajay Lala [9] proposed a system to perform sentiment analysis of English tweets using a rapid miner platform. They built two classifiers and also tested the dataset using Rapid Miner. Further they compared both the classifiers in order to find the better results.

Abbi Nizar Muhammad, Saiful Bukhori and Priza Pandunata [10] have used Naive Bayes and Support Vector Machine to classify comments of YouTube as positive and negative.

The dataset is divided into a 7:3 ratio .i.e. 70% training and 30% testing dataset. The two algorithms are combined and acquired precision of 91%, recall 83% and fl score of 87%.

Weilong Yang and Zhensong Qian [11] have shown some deep understanding of characteristics of videos from YouTube of different categories. Study included video duration, user engagement, view source, view counts and growth trends. Analysis of growth trend, view counts were done. Those patterns were very different but intuitive.

III. Literature Review

Title of Project	Name of Author	Year of Publication	Description	Limitations	Improvement
YouTube Comments Sentiment Analysis	Ritika Singh [12]	2021	Presented a Sentiment analysis system for YouTube comments, by using different machine learning classifiers to process the data and optimize the classification results.	Considered the emojis too, for the classification of the dataset.	In our proposed model we used different features to classify the comments which removes the emojis, the abusing words and the repetition of words.
Sentimental Analysis of YouTube Videos	Aditya Baravkar [13]	2020	The proposed system considers the sentiment of top comments of every video and displays the results. The system is web application which takes input as search keyword and displays top nine videos related to educational content only. Only positive comments are taken into consideration.	The project is only based on educational content on YouTube. Only positive comments are taken into dataset, all the negative and neutral comments are ignored.	In our proposed model we considered all the videos present on YouTube. The polarity is generated by considering positive, negative and neutral comments.
Analysis and Classification of User Comments on YouTube Videos	Hanif Bhuiyan [14]	2020	This paper illustrates an automatic process for finding useful video by sentiment analysis of user's comments based on Natural Language Processing. Their approach was to evaluate the quality, relevancy and popularity of YouTube videos considering the relationship of user's sentiments expressed in comments.	They included the repetition of words, which leads to inaccuracy of results sometimes. They only considered 10 topics from YouTube randomly for the data testing.	In our proposed model, we have taken random YouTube videos for testing and worked on the important features that would lead to inaccuracy of results sometimes, such as reputation of words, ignoring abusive language.

Title of Project	Name of Author	Year of Publication	Description	Limitations	Improvement
Retrieving YouTube Video by Sentiment Analysis on User Comment	K. M. Kavitha [15]	2018	They extracted the comments using the video URL and manually categorized them into four classes. They considered a few random comments and the description of the video.	YouTube video should have an associated description.	It is not necessary for a YouTube video to have a description, and there the project fails. In our proposed model, we have taken the top comments for the optimization of results.

IV. Motivation

Thousands of hours worth of content is being created and shared on YouTube throughout the day by content creators of YouTube. It has become really difficult to spend time watching such videos which may have a longer duration than expected and sometimes our efforts may become futile if we couldn't find relevant information out of it. There are times when we are searching for something on YouTube and there are a lot of videos about it and we can't just rely on the number of likes/dislikes a particular video has. More often than not, people like/dislike certain videos randomly or without even watching them at all. The current YouTube algorithm only utilizes the statistics of user engagement while suggesting content. Through the use of the TubeRate app, the user will be able to view ratings of the videos which will be based on sentiment analysis performed on the comments of those videos.

V. Methodology

Our project is mainly divided into six modules:

a) Extracting comments and preprocessing
b) Data gathering
c) Feature extraction
d) Creating ML model and training
e) Sorting based on ratings
f) Integrating in a web application

A. Extracting Comments and Preprocessing

The comments for each of the videos are extracted using YouTube Data API in JSON format, which is then converted into a Pandas DataFrame. This comments dataset is then cleaned and preprocessed to get rid of symbols, emojis and stopwords.

B. Data Gathering

Labeled data (positive/negative/neutral) was needed to train our classifiers using supervised learning. Two labeled datasets of YouTube comments were found and used. The first dataset consists of about 2900 comments from the video "The Boring Company | Tunnels" by the channel The Boring Company [16]. The comments were manually labeled positive, neutral, or negative [17].

The second YouTube dataset was found on Github [18] and features about 1100 YouTube comments. The comments appear to belong to one or several videos from the channel Dude Perfect and some videos featuring news footage. Automatic labeling, the lowest accuracy scenario, was assumed as no information was given about manual or automatic labeling.

Testing data was taken from the Kaggle dataset Trending YouTube Video Statistics and Comments [19], consisting of YouTube videos that were trending in the United States of America and the United Kingdom during a period in 2020. Data includes among other information video likes, video dislikes and comment texts. The data is separated per country. All videos from the UK dataset and only the videos in the US dataset that were not also featured in the UK dataset were used. For videos that were trending several times and thus featuring several times in the dataset, all comments were added along with the last appearing like count and dislike count.

C. Feature Extraction

Feature extraction is an important stage in text mining or SA, and the methods used for extracting the features significantly impact the results. Deep learning models have recently been adopted in the field of SA for learning word embeddings. Word embeddings aim to capture similarities between words and their linguistic connections [20].

D. Creating ML Model and Training

Support Vector Machine was used to train the model with five classes- each representing a rating from 1 to 5. The classifier uses five SVMs since it is a One-to-Rest approach. Each SVM would predict membership in one of these classes. The data used consisted of comments taken from several YouTube videos across different categories, along with their ratings.

E. Sorting Based on Ratings

The most relevant videos against a search term are sorted based on the comments of those videos. Unlike the default order

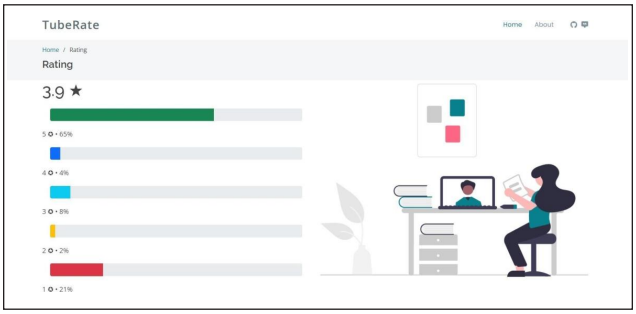
which has videos sorted based on likes, views, hashtags, titles, etc. this sorting is solely based on the ratings predicted by the ML model.

F. Integrating in a Web Application

The web application is built using Flask. It provides the user with the functionality to view ratings of individual videos by entering their URLs as well as have videos sorted based on their ratings by entering relevant search keywords.

VI. Result

The essential data for ordering videos is successfully fetched using API. Top video comments are passed through the ML model to detect sentiments and generate ratings. The final ratings are calculated based on the percentages of these ratings for each video. The sorting employs the final ratings to display relevant videos.



VII. Conclusion

This paper illustrates an automatic process for finding useful video by sentiment analysis of user's comments based on Natural Language Processing (NLP). Our approach evaluated the quality, relevancy and popularity of YouTube videos considering the relationship of user's sentiments expressed in comments. We analyzed a sample of almost 1,000 YouTube comments. Large-scale studies of YouTube video metadata (comment) using the NLP and SentiStrength revealed the importance of user sentiments.

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Journal of Applied Information Science
11 (1) 2023, 21-30
http://www.publishingindia.com/jais

A Study on the Impact of Cyberchondria on the Indian Population

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Abstract: In this digital era, the Internet has become one of the primary health information sources. As a result, information is straightforward to obtain for little or no cost via the Internet. Another aspect is that much online information about health is available where results are obtained quickly, making people search about their health online very often. The Internet has become their first stop for learning more about health problems and symptoms for most people. Such repetitive or excessive searches for information related to health on the Internet empower some individuals to make medical choices to control and manage diseases. In contrast, others might get more anxious, which might affect there day to day life activities. To rely on online medical information, the quality of the content must be controlled and well-managed. People should be competent in discerning between credible and noncredible data sources on the Internet.

Keywords: Cyberchondria, Health information, Health searches, Internet, Public health.

I. Introduction

The Internet's ability to serve as a ubiquitous delivery method for medical searches and a recognized tendency for online health has shown an escalation in anxiety [1]. Exposed to such information obtained through web searches, particularly distressing, erroneous, and misleading health information regarding life-threatening illnesses might worsen existing concerns about these disorders sicknesses, which in turn cause new fears, resulting in a repetitive loop of anxiety discomfort and frequent visits on the Internet for health-related information which is referred as cyberchondria pattern [2].

The terminology 'Cyberchondria,' which combines the words 'cyber' and 'hypochondriasis,' is now commonly used to describe a habit of frequent, excessive, and maladaptive Internet use to get medical information [3]. Cyberchondria has a behavioural component that is unreasonable and frequent online health searches. This may be identical to attaining confirmation, in which the individual wants confidence online rather than in person [2]. On the contrary, According to Lemire *et al.,* Users feel empowered (i.e., competent and in charge) when they engage in health-related web use [4]. It offers new possibilities for maintenance and preventive treatment that could be utilized as a warning system, for example, cancer [5].

II. Literature Review

A. Impact of the Digital Revolution

In the realm of the 5th technological uprising with digitalization and global networking [6]. How people communicate and network using digitalization is evolving daily, and the use of influential, powerful and dynamic technologies can impact the world [7]. Health care workers (HCW simultaneously, technological advances are going uphill at a remarkable pace, while hardware and software rising are making room in health care, with this healthcare digitalization, the abundance of medical information and data available on the Internet has evolved quickly, and patients become empowered the info readily obtainable by the use of mobile phones with easy, affordable, abundant information available on the Internet these days, an enormous fraction of medical knowledge [8].

As the usage and addiction to smartphones are soaring, internet usage has gone up, and hence along with it, the cyberchondria-related anxiety level has also increased [9]. Internet is affordable at low cost, and jio is coming up with long-term voice-over evolution (VoLTE) technology with higher speed internet than 2G and 3G [10].

Another reason could be. However, Innovations in computer science and information technology are encouraging us to deal with and interpret the enormous amount of health knowledge on the Internet; also, free access to clinical studies and protocols is becoming accessible. In addition to a significant amount of information, mobile health provides an option for self-care with certain limitations, such as the possibility of misinterpreted

data and the existence of questionable online resources that can lead to incorrect medical conclusions that are not based on the opinion of a medical expert and can even endanger a person's life. As a result, medical professionals and policymakers have an enormous responsibility to ensure that mobile health is used responsibly. Therefore, the well-operating of the patient-physician relationship is yet another crucial part of healing (Patients may turn to ineffective therapies and self-diagnosis because of decreased faith in the healthcare system) [8].

B. Benefits of Health Insurance

In the 2020 financial period, almost 500 million people across India were covered by health insurance [11]. The ageing of the population is a global sensation that nearly every country in the world is experiencing and reflects social and economic achievements. By 2050, people over 60 will be dwelling in developing regions. The ageing population significantly contributes to the nation's health and socio-economic development. In addition, reinforcing geriatric citizens is critical to achieving Sustainable Development Goal 3**,** which includes health and well-being**.** Therefore**,** promoting senior fitness is a significant concern**,** especially in developing countries**,** including India. Increased insurance awareness and facilities for good quality and subsidized health facilities will only strengthen the care for older adults and help them against the tax disaster [12].

Time gaps in insurance content are related to delayed care behaviour and more precarious health problems [13]. Combining health insurance in the country was essential to lower healthcare costs. Such things can be seen in countries like South Korea and Thailand, the benefit of linking health insurance to achieve universal health content has already been advocated [14] if the German statutory health insurance system is recognized as one of the prototypes of the ultramodern health system configurations. Germany's practical policy-making style, with its confined nation, manager of the fitness system, an approach that the solon is charging the equal actors with operating the issues that they created with inside the first vicinity that is, with calling the Federal Joint Committee, the principle self-governance organization of payers and providers, to outline regions for excellent enhancement via way of means of unique constricting and pay-for-performance [15].

Adding the information together, prolixity is a part of medical insurance, possibly specifically salient withinside the growing global in which the use of tertiary care is low and those who aresceptical approximately the blessings of treatment. Suppose that in these contexts' rational agents, in this case economically poor, calculate on an anecdotal basis or learn from the family's experience, musketeers, and neighbours - choosing the health service. Therefore, insurance convinced the increase in healthcare applications could significantly slip over goods of improved healthcare utilization. These slippage over-effects could also be relevant to similar scope conditioning, such as the educational giants and health camps [16], as endogeneity of health insurance prevents unproductive conclusions about health insurance assets in the health care system from experimental studies [17].

C. E-Health Literacy: Information Transfer Makes it Easier and Simple

E-health is a rising field in the convergence of medical information, people's health, and business, implying healthcare utility and facts provided or improved with the help of the Internet and likewise technologies. In the broader sense, the term identifies a technical improvement, a frame of mind, a style of thinking, a mindset, and a dedication to utilizing information and communication technologies to improve health care locally, regionally, and globally [18].

The capability to search, identify, absorb, and evaluate health information from electronic sources and employ the information learned to resolve or treat a health problem is introduced and characterized as eHealth literacy [19].

In a countrywide poll of Internet users, 40% claimed to use the Internet for health-related searches; in the last year, 80% of youth Internet users have browsed for health advice, out of which 63% browsed about a particular disease, and 47% inquired for medical therapy [20]. It was also found in the European health literacy survey (HLS-EU) that each second individual had an insufficient amount of health literacy [21].

The way of utilizing the understanding and expanding information with the use of communication technology to enhance healthcare can significantly impact their health and their environment. It efficiently associates health consumers with the findings of the Internet. Still, there are some challenges in considering online health information which as the generalizability of results another aspect is ethical considerations in practice, as a wide range of information available should be appropriate. It should also have some standards set by the policymakers for improving an individual's health literacy on the positive side. As people become empowered by the knowledge, it reduces the system complexity on the Internet [22, 23].

D. Cyberchondria

Cyberchondria is a kind of anxiety described by an inordinate online medical search. It gives rise to unnecessary mental stress and medical expenditures. Different validated scales are used to measure analogous forms of anxiety, similar to health anxiety and general anxiety; CSS is one of them, which is a multidimensional construct evaluating anxiety, its compulsive nature, and the patient-physician relationship.

The CSS scale can also measure the psychometric aspects of anxiety caused by online health searches [23]. The German scale of CSS also possesses good psychometric characteristics,

and the factorial structure duplicated the association between stress and depression for the above scale, emphasizing their validity and applicability [24].

E. Impact of Cyberchondria on Health

The terms "health anxiety" or "Illness anxiety" are used interchangeably and might appear somewhat similar to hypochondriasis. However, we can consider health anxiety as a stressful form of hypochondria. Opinion of health anxiety has come to a beneficial generality and has attracted a decreased hobby within the ultimate five times. The centre capabilities of health anxiety are devilish solicitude over health and worry of growing criticism. Anxiety symptoms, including bodily symptoms, are misinterpreted as a validation of natural contamination.

Health anxiety is expected due to the tendency for people to be told to hide their health status and the destructive results of evil internet browsing on fitness-related topics. Still, it persists numerous times, leading to great suffering and disability. If it is untreated, assessment of Cyberchondria had been virtually severed, and most of the remedy validation became based on physical tension. Health anxiety and Cyberchondria seem to be phenomenologically related but distinct truths, and it may be helpful to interpret the two conceptions separately. Four demonstrated tone-evaluation measures for Cyberchondria are to be had in the literature [25].

Cognitive behaviour remedy (CBT) added both bodily or through the Internet (iCBT) were manufacturing unit to be robust for each fitness tension and Cyberchondria. Pharmacologic techniques for fitness tension have especially worried the use of Picky Serotonin Reuptake Impediments, suggesting powerful pills are superior for depression/anxiety [3].

People suffer from an intolerance of uncertainty (I.U.), a dispositional fear of the unknown, locate questions in large part distressing and interact in protection conduct to lessen analogous torture. Still, searching clinical statistics on the Internet has the implicit in resulting in decreased conditions of question and complicating fitness tension for individuals with excessive I.U. The dogmatism of the question must be mild, the connection between the frequency of Internet searches for clinical statistics and health [26].

Cyberchondria represents a not unusual place transdiagnostic sample in instances with OCD, Advertisements, and MDD with a diapason of inflexibility and shows a variable burden of illness, assisting the want for specific scientific concerns and interventions [27]. Cyberchondria and its affiliation with first-class lifestyles for this particular epidemic. This contagion has altered the lives of individuals worldwide, and its results will close for a protracted time. With all the manners completed to forestall the improvement of COVID-19 and meliorate bodily issues, inner fitness calls for instant care [28].

The cyberchondria theory has been generated to explain the anxiety aggravating online health-related quests. In other words, Cyberchondria is not only related to seeking information on health-related issues but also the mental effect we face after that. Now, it has become part of ultra-modern life. Line fitness-associated quests in Cyberchondria bring about ideal conditions of fitness tension in comparison to the needs of health. Particular interest paid to fitness-associated facts determined online might also contribute to growth in fitness tension and inspire a few human beings to keep coming again to the Internet to lessen stress through persevering with the quests. Not most effectively can the Internet supply disagree, nebulous, or incorrect facts regarding the hunt? However, it may be abstracting and cause different, probably tension-amplifying facts (e.g., facts approximately here to fore unknown situations or fitness pitfalls) [6].

Therefore, an interpretation of the superior rating of a few malice as a reason for the symptom that initiated a web hunt is usually in all likelihood to growth fitness tension. Also, the outcomes of hunt machines (e.g., Google) are possibly prejudiced in the direction of rare life-striking ails, which beget gratuitous solicitude or tension amongst information seekers. When human beings have enough functionality to gather, estimate and reuse colourful fitness facts online, they may be much less in all likelihood to increase Cyberchondria. This is because they may be frightened that the Internet is only a device to list feasible troubles approximately their hunt question and cannot diagnose their signs and symptoms scientifically and objectively [29].

Health information has been described because of the functionality to seek, find, understand, and estimate fitness facts from virtual sources, using the obtained data to pick out or smash a fitness-associated problem. In the flip sense, the exquisite affiliation between terrible emotions and passions of loneliness causes the excessive use of the Internet and its operation. Unemployed girls sense to expose superior emotional and fashionable loneliness, depression, tension, stress, and cyberchondriac signs and symptoms. In addition to acute responses of fear, women's prominent bodily and personal signs and symptoms of tension cause special excessive, obsessive, or repeated fitness-associated quests on the Internet, no matter the ensuing torture and impairment of regular existence conditioning [30].

Health anxiety, compulsive-obsessive symptoms, and dogmatism are all associated with cyberchondria rigidity, with health anxiety constituting the most significant exact contribution. Depression and bodily signs and symptoms additionally prognosticated cyberchondria inflexibility. These findings have critical counteraccusations for exploration and medical practice [26].

F. Patient-Physician Relationship

As Internet operation increases encyclopedically, the Internet's use for health is likely to increase as well. As the Internet has

progressed, individuals have expanded their use of it to learn about a disease or affliction, determine if special medical care is necessary, learn about available treatment choices, and seek peer support from others with similar illnesses [31].

It is very well understood that people glance at the symptoms on the Internet before visiting a doctor [32]. A survey conducted in Swiss said that 30% of patients who had full internet availability used to get online health-related information (HRI) before and after consulting the physicians. Consulting physicians is essential as it helps to decide the therapy's length and other related factors [33].

The information gained through the Internet also helps to understand the medical treatment better and explain the feelings better; hence, the treatment can again be patient-centric. The Internet has created a sense of insecurity and anxiety among physicians as the patient gets the information from the web and devalues the physician's advice, which might impact the relationship between the doctor and the patients [35, 36].

G. COVID-19 and Cyberchondria

The WHO has also emphasized the rapid spread of misleading information through different platforms, which poses a significant risk to public health [35]. As known, Cyberchondria is the redundant seeking of information available on the Internet, which is linked with raised degrees of stress and discomfort, all instances of PUI represent public health concerns and should be considered from a mental health perspective; Cyberchondria should be dealt with as exacerbated perception of threat can cause unwanted problems, control, and supervision of health information available on the Internet. In COVID-19 pandemic, the model of Cyberchondria clarifies the hypothesized increase in online health searches [36]. Cyberchondria was evaluated utilizing Cyberchondria Severity Scale (CSS), and positive associations were found between distress, anxiety, and Cyberchondria, although no correlation was observed between the hyperthymic temperament and Cyberchondria [37].

The relation between irresponsible internet usage and Cyberchondria, along with the fear of COVID-19, was significantly channelled by anxiety sensitivity and metacognitive beliefs. As the fear of COVID-19 has been associated with Cyberchondria, sensitivity, and anxiety, the healthcare provider will need to provide add-on assistance to patients who suffer from cyberchondria and anxiety sensitivity [38]. To empower individuals and motivate them to adopt preventive care such as self-isolation and inform them about the severity of the situation [39].

During the pandemic COVID-19 has increased focus on the significance of mental health and behavioural sciences, which assist the medical and pharmaceutical sciences. They compensate for the lack of distribution in "effective prevention or treatment" by providing a safe guideline for collective and behavioural adjustment, which ultimately protects our health; in such a scenario, this should be the safe use of online health searches to improve public health and facilitate the well-being of an individual during and after COVID-19 [21].

III. Methodology

Survey Design of Research

a) Participants Selection - An online survey was conducted in November 2021 to study Cyberchondria and its effect on daily life activities. For this, an exhaustive literature survey was done. On the lines of the standard Cyberchondria severity scale (CSS) the questionnaire was generated as the survey was mostly conducted in foreign nations; the questionnaire was revised according to the Indian diaspora, and for this, personal interviews were conducted and by knowing their point of view certain questions were added in the questionnaire. A pilot run was done (Table I). At the end, the questionnaire was circulated to reach respondents through various social media platforms like WhatsApp and LinkedIn, etc. The survey questionnaire has the screening questions like "Have you ever googled (web search) any illness symptoms that you are facing (e.g. checking about signs of (COVID-19)" so the people who have experienced the cyberchondriac behaviour were only considered for further results and rest were eliminated from the study.

Table I: The Demographic Information and Characteristics of Study Participants

Characteristics		Number of Respondents (N)	Percentage (%)
Age			
	18 - 25	396	94.28
	26 - 35	14	3.33
	36 - 50	7	1.66
	More than 50	3	.714
Gender			
	Female	237	56.42
	Male	183	43.57

Characteristics		Number of Respondents (N)	Percentage (%)
Online health-information seekers			
	Yes	340	80.95
	No	50	11.90
	Maybe	30	7.14
People worried after online health search			
	Yes	203	54.86
	No	62	16.75
	Maybe	105	28.37
Source of health information			
	Top related searches	232	75.32
	Specific websites	76	24.67

The Table shows the Demographic data of the participants: 94.28% of respondents were aged between 18-25 years, 3.33% lay between the 26-35 age group, 1.66% were between the 36-50 age group, 0.714% of respondents were more than 50 years of age, 237 representing (56.42%) of the respondents were Female and 183 representing were Male (43.57%), 80.95% of participants seek for online health information, 54.86% people get worried after online health search, 75.32% participants look for top related searches as a source of health information.

b) Measures for Analysis - The Likert scale and multiple-choice grid were adopted for recording responses. Above mentioned type of question was generated to carry forward the research. Of the 420 respondents, 308 were considered in our study, as the rest were screened from the screening question. The sample size is considerable for the application of CFA and SEM [40].

Table II

The Minimum Size of the Sample	No. of Factors	No. of Observed/Manifest Variables Per Factor/Construct	Communalities
100	Five or fewer	Three or More	0.6 or higher
150	Seven or fewer	Three or More	Modest level (0.5)
300	Seven or fewer	<3 (few out of 7)	Lower level (<0.45)
500	Large number	<3 or three or equal to 3	Some with lower level

IV. Data Analysis

The study had different variables in the data set; KMO and Bartlett's tests (Table III) were done to check the correlation and factorize the variables before the actual factorization was done. The KMO (Kaiser-Mayer-Olkin) test was done to see if the sample data was good enough to do factor analysis, and the P-value was found to be more than 0.7 (>0.7), which means that the sample data is good enough to do factor analysis. The understudy data was found to have a commonality value of more than 0.5, which says that the data will be able to explain more than 50% of the variance in the given data set. Altogether the sample has a significant value of more than 1.0 (> 1.0), which further supports the exhaustive factor analysis of the generated values in (Table IV).

Table III: KMO and Bartlett's Test of Factor Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.813
Bartlett's Test of Sphericity	Approx. Chi-Square	962.261
	df	55
	Sig.	.000

*The KMO test measures the sampling adequacy; the KMO value was (p> 0.05), the sample was sufficient for applying the factor analysis, and Bartlett's test of sphericity tests whether the correlation matrix was an identity matrix or not. Bartlett's Test of Sphericity was significant.

Table IV: Rotated Component Matrix, Communalities, Reliability

	Factor Loadings	Communalities	Cronbach's α
Mental Relaxation			
Leisure Time	0.765	.714	0.781
Sleep	0.784	.704	
Daily Routine			
Family Time	0.736	.728	0.791
Eating Habits	0.52	.686	
Literacy			
Academics	0.766	.690	0.438
Multiple Websites	0.833	.648	
Belief			
Awareness	0.76	.482	0.8
Trust	0.823	.698	
Online Search	0.85	.728	
Physicians	0.811	.731	
Faith in Doctors	0.818	.602	

Principal component analysis, **NOTE: Loading Values are taken above value 0.5 and depict communality >0.5 explains more than 50% of the variance of the data.

The above Table is the result of the tests performed in IBM SPSS V 22 Software, where factorized data was fed into IBM SPSS V 23 Software to perform the Confirmatory Factor Analysis (CFA) along with the structural equation model on the theoretically hypothesized model of the variables to check the correlation between the exogenous and endogenous variable of the model and to determine what factors are having a particular impact on various variables in ophthalmology (Fig. 1). For this purpose, Cronbach's alpha (Table V) values are examined to ensure that the grouped factors are strongly related and correlated; the values obtained supported and offered a favourable indication that CFA should be used in our research.

Table V: Variables and Factors

Latent Variable	Sub Variable	Abbreviation
Mental Relaxation		
	Leisure Time	L.T.
	Sleep	S.P.
Daily Routine		
	Family Time	F.T.
	Eating Habits	E.H.
Literacy		
	Academics	Acad
	Multiple Websites	M.W.
Belief		
	Awareness	E.A.
	Trust	T
	Online Search	OH
	Physicians	PC
	Faith in Doctors	B.D.

To carry out CFA and demonstrate that the model is a good fit, the hypothesized path diagram was drawn in AMOS Graphics software to check the association among different variables. All endogenous and exogenous variables are placed, and the error variables are also applied to the required variables. The variables were connected with the arrows to test the theoretically assumed model after that variable was correlated by clicking with the help of plugins to try our research study [41].

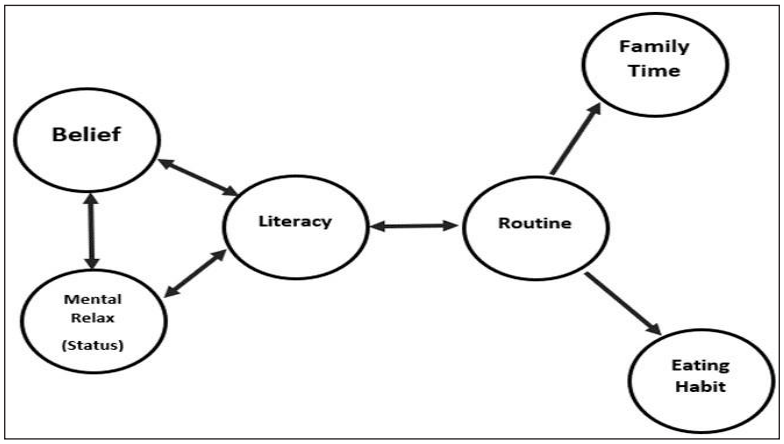

Fig. 1: Schematic Representation of the Hypothetical Model to Determine Factors Influencing Cyberchondria

After performing the tests, the loading number were screened on the arrows to check the model fit. For that, statistical values were limited, and CFI (Comparative Fit Index), RMSE (Root Mean Square Error), and TLI (Tucker Lewis Index) values should come around the ideal weight to be confirmed as the best fit. The desired model was generated, and the statistical values for model fit parameters were checked. The comparative fit index (CFI) is 0.933, Tucker Lewis Index (TLI) is 0.833, and RMSEA 0.059 signifies that the model has achieved a satisfactory result to be called a model fit. And the significant probability level was reached (P = 0.001) [43, 45]. After CFA, the SEM model was prepared and run, as shown below:

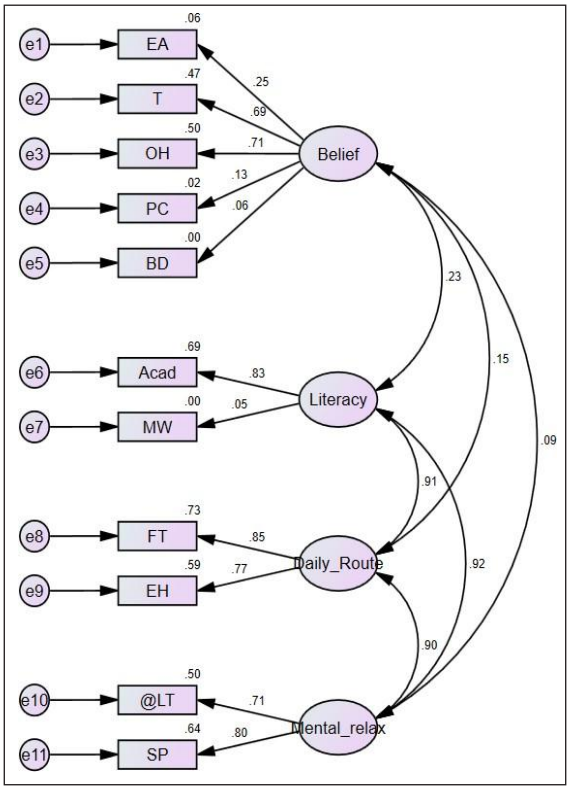

Fig. 2: Amos Diagram Showing Different Factors

V. Results

The above results in (Table VI) was generated after the analysis was performed in AMOS. The variables have a significant impact on each other with a 95% confidence interval as it is substantial as the P significance value is 0.001, which is depicted by the '*' asterisk mark. Using SPSS and AMOS software, our findings suggest the Internet is a place where there is abundant health information present and with such information either fear elevate and amplified or diminished based on information they found. Irrespective of whether the report found relevant to what they were searching for or not, cyberchondriac individuals look for online health information available for their health condition and have trust in results so procured from the internet source and rely on it; this was significantly proven in our study through the statistical test and evident from P value so obtained, also when a person is experiencing anxiety or implicit cyberchondriac behaviour it affects the mental health of an individual which have an impact on specific changes in behaviour which causes stress discomfort to an individual, it offsets a person to sleep distortion and affects the sleep time duration, further cyberchondriac individuals that are experiencing stress or pain due to online health search results tends to have an impact on their day to day activities such as eating habits which could be either skipping of meals or overeating.

Table VI: Table Showing Estimates of Different Factors (Confirmatory Factor Analysis)

			Estimate	S.E.	C.R.	P
OH	<---	Belief	2.832	0.861	3.29	0.001
T	<---	Belief	2.64	0.862	3.063	0.002
EH	<---	Daily_R	0.911	0.064	14.158	***
SP	<---	M_Relax	1.047	0.073	14.288	***

**NOTE: $P \leq 0.05$ statistically significant, *** $P \leq 0.001$ (Strongly Significant)

VI. Limitations

- In our study, most of the respondents are from the adult population, and differentage groups could have widened the scope of the study.
- Our study did not include ailments/disease people search for on the Internet and the source of information.
- The frequency of searching for symptoms on the Internet was not evaluated.

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Journal of Applied Information Science
11 (1) 2023, 31-36
http://www.publishingindia.com/jais

Mobile Agents for an Electronic Marketplace

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Abstract: The mobile agent (MA) paradigm has garnered a significant amount of interest over the course of the recent past few years. In spite of the fact that MAs have been the source of a substantial amount of enthusiasm in the academic community, they have not yet produced a significant number of applications in the real world. One of the most important reasons for this is that there is a dearth of research that quantitatively compares and contrasts the efficacy of conventional methods with that of mobile agents. The study presents an implementation of an e-commerce application that makes use of mobile agents and makes a contribution to such an assessment. The current mobile agent apps that are used in the field of e-commerce are categorized, and the underlying mobility patterns are uncovered. These, in turn, establish a number of different implementation options that make use of the conventional client-server and mobile agent paradigms. This paper outlines the implementation method that should be used when integrating mobile agents into an electronic marketplace. Mobile agent may boost e-commerce and give new approaches for designing intelligent applications. The fundamental elements of e-commerce agents are their autonomy, their flexibility, their capacities to observe, analyze, and act in their encompassing surroundings, as well as the power to interact with other mobile agents to solve complicated issues. The autonomy of agents implies the adaptation to participate in conversations governed by processes not known in advance, while their mobility means such discussions taking place at distant places. This work attempts at integrating adaptability with mobility by explaining the mobile agents emerging in the system and their fundamental interactions. Furthermore, this study explains the reasons why utilization of mobile agents inside the recommended framework.

Keywords: Asymmetric algorithm, Coordinating server, Digital signature, Hash function, Mobile agents, RSA, Symmetric algorithm, Trusted server.

I. Introduction

Computer systems have effectively progressed over time from centrally located monolithic computing units enabling stationary programs to client-server setups that enable sophisticated distributed computing models. The early remote job input terminals used to submit programs to a central computer and the most recent Java applets downloaded from web servers into browsers are examples of limited types of code mobility that have happened throughout this progression. In order to create a massive, loosely connected distributed system, cooperative programs may now move completely across supported platforms in a new phase of development that goes one step further. It remained to be seen if this developmental branch succeeds in moving ahead or finally disappears. However, the technology is interesting and presents a novel computer framework that cannot be easily ignored.

Mobile software agents—programs with a specific aim and the ability to move from one platform where they are suspended to another platform where they restart execution—are the driving forces behind this evolutionary route. A software agent, more specifically, is a program that has the ability to act on behalf of a person or group of people, operate independently to accomplish a task, and communicate with other agents. Auctions, trading, and contract and service negotiation are examples of possible interactions between agents. Agents may either be mobile, able to move between platforms at various periods, or immobile, constantly residing on a single platform. This essay primarily focuses on the security concerns that occur when mobility is involved.

The potential changes of moving code and state information, such as the values of instance variables, the program counter, the execution stack, etc., correspond to a spectrum of varying mobility [1]. A basic agent created as a Java applet, for instance [2], has code mobility thanks to the transfer of class files from a web server to a browser. However, no information on the linked state is given. The Java-based Aglets [3], created by IBM Japan, enable the values of instance variables to be transferred with the code when the agent moves, but not the program counter or execution stack. [4] Created Sumatra that enables Java threads to be carried together with the agent's code during relocation. This provides a more robust kind of mobility than previous methods. Within the mobile agent systems that are the subject of this study, the transfer of code and state information is required.

The proliferation of the World Wide Web (WWW) and the development of applications for electronic commerce (e-commerce) have led to the birth of new business models that are based on the internet. E-commerce being supported has resulted in a need for novel application structure methods that may produce models that are both cost-effective and scalable. These models may be delivered as a consequence of the demand

for innovative application structure approaches. The use of agents in online commerce is, more than any other possibility, the one that has the potential to be the most successful. Applications for electronic commerce make extensive use of the idea of an agent to do a substantial percentage of the work. Agents, which may be thought of as bits of code that carry out activities on behalf of users, are responsible for the bulk of the work, but not all of it. The inclusion of mobile agents into the design of e-commerce application software has only received a modest level of attention so far due to the small amount of work that has been put into it. When it comes to online commerce, it is very important to maintain a clear distinction between traditional agents and mobile agents. As a result, client-server ecosystems have given way to mobile agent systems that make use of a wide variety of distributed computing techniques throughout the course of recent years in the evolution of electronic commerce. In order to construct a large-scale distributed system that is only loosely connected, mobile agents provide the complete mobility of applications that are cooperating across all supported platforms. Mobile agents are goal-oriented and competent software programs that are able to pause execution on one platform and resume operation on another. Mobile agents can also transfer data across platforms. To be more explicit, a mobile agent is able to move freely between different systems and autonomously carry out tasks on behalf of a customer. To put it another way, mobile agents acquire the ability to function autonomously toward the achievement of a goal and to interact with other mobile agents. Agents may either be static, in which case they are confined to a single platform, or dynamic, in which case they are free to roam around between multiple platforms at varying periods.

Mobile agents are also called transportable agents. They are categorized into two types:

- Mobile Agents having a pre-defined route: They have a static migration path.
- Mobile Agents having unknown pathways, i.e., Roamers, have dynamic migration paths. The mobile agents pick their course according to the existing network circumstances.

The pre-defined trajectories of the mobile agents are taken into consideration in this research. When a mobile agent is equipped with capabilities for e-commerce, it is very necessary to take precautions to prevent the agent from being misplaced or duplicated along its journey. Therefore, the development of a dependable, fault-tolerant, and secure agent transfer mechanism that guarantees the performance of mobile agent duties for electronic commerce was the primary objective of the framework's design.

The arrangement of the paper's remaining sections will go as follows, starting with the introduction: The impetus for doing this study is discussed in Section II, which examines the development of mobile agents that assist e-commerce platforms throughout the course of the last ten years. In the next part (Section III), we will explore the suggested framework for the MA navigation of the electronic marketplace. In the Section IV, a more in-depth discussion on the advantages of making use of the suggested framework is presented. The findings of the study are reported in Section V, followed by a discussion of those findings.

II. Literature Review

There has been a significant amount of research conducted in the past about the integration of mobile agents with e-commerce. The section outlines the chronological path of the research on the emergence of mobile agents. [5] stated that distributed systems are increasingly incorporating mobile software agents. Mobile agents could be used for electronic commerce and information retrieval. The most difficult aspect of the issue to resolve is attacks on agents by malicious hosts.

[6] claimed that the broad usage of mobile agents is still hampered by security-related problems, particularly integrity protection in mobile agent technology. The integrity of mobile agents should be guarded against intrusions from malicious hosts and other agents. The authors advocate the usage of dynamically upgradeable agent code as opposed to the conventional belief that mobile agents are made up of invariant code components. Secure mobile agent systems (SMAS), which involve communication between mobile agents and mobile agent servers, were the subject of a research by [7]. The authors suggested that a security shell module in the framework for mobile agents be in charge of mobile agent security. [8] mentioned that in order to support agent-based applications, a fresh distributed reputation management system was proposed. The system assesses the reputation of dependable third-party hosts in real-time using a transaction feedback mechanism. [9] stated that mobile agent systems' main characteristics are intelligence, autonomy, and mobility. The integrity of mobile agents should be guarded against intrusions from malicious hosts and other agents. The authors introduced the Flexible Mobile Agents (FMA), which are made up of flexibly upgradeable agent code portions, allowing for the addition of new agent code modules as well as the deletion of unnecessary code modules based on the needs of the application being executed. The trustworthy server was used by [10] as the intermediary between mobile agents and ecosystem nodes. The authors noted that the trusted server, which manages the security mechanism, controls the system's security. [11] mentioned that the security flaws in mobile agent systems have embarrassed their widespread use. Because the distant hosts that house the mobile agents launch various attacks, mobile agents that move throughout the network are not secure. So the most difficult unsolved issue is mobile agent security. [12] stated that mobile agent security is a key consideration in the design of mobile agent-based e-marketplaces. The system is created to offer a secure and reliable trading environment based on the defined and outlined needs and evaluation criteria. [13] claimed that the

use of mobile agent technology in distributed real-time systems has changed the paradigm. One of the most significant areas of use for mobile agent technology is electronic commerce. A business or firm can use e-commerce and mobile commerce to expand its market to any location. [14] mentioned that the security of mobile agents is a crucial concern in the majority of applications. Mobile agents must be ready to run on various hosts under a variety of security settings. A review of current methods for creating a mobile agent that can defend itself is provided in this study, though the study did not propose the new models for mobile agent's security. [15] mentioned that mobile agents are protected by both recognition and preventive methods. While identification methods are used to look into potential security violations, prevention mechanisms refer to the protection of mobile agents. Code modifications are used to obfuscate the code, making it extremely difficult to analyze and protecting it from reverse engineering. According to [16], a lot of infrastructure support is required for the security of mobile agents, including security, trust, and agent matching protocols. [17] Mobile agents can be used in a variety of contexts, including network administration, electronic commerce, and information retrieval. Security is the biggest issue with mobile agents. This thesis focuses on the ability of mobile agents to make secure purchases. [18] provided a forward-secure undetectable digital signature concept (FS-UDS). Mobile agents who generate digital signatures under the proposed approach are not required to carry the signing key. The necessity of the original signer is combined with the encrypted function at the same time. [19] stated that the total amount of computing time required to confirm the legitimacy of the users might be decreased by using an anonymous authentication technique. Our suggested anonymous authentication method offers greater security and efficiency in terms of calculation cost as compared to earlier anonymous authentication methods. [20] mentioned that when generating digital signatures under the method, mobile agents are not required to carry the private key. The original signer's requirements are merged with the encrypted function to avoid abuse of the signing algorithm. [21] stated that due to their potential to replace conventional client-server applications, mobile agents are attracting academic interest. The authors stated that a mobile agent can migrate independently from one server to another. Network administration, information retrieval, and electronic commerce are among applications that benefit from mobile agents. [22] mentioned that commercial transactions between businesses and customers raise serious issues since they involve a lot of data and sophisticated information. An agent-based analysis of e-payment transactions and associated switching activities is presented in this work.

The scope of the review included relevant research publications published between the years 2000 and 2020. As a direct consequence of the work that is mentioned in this portion, it has been seen that great progress has been achieved in the field of mobile agents, which is an advancement that has been observed. On the other hand, the studies that were discussed earlier provide a solution to the issue by integrating a variety of strategies for ensuring the safety of mobile agents. Up to this point, researchers have experimented with and evaluated a variety of alternative security techniques for mobile agents. On the other hand, each of the research suggested a fresh approach that included novel mechanisms and procedures. This presents a challenge for businesses that make use of mobile agents because every time they are compelled to employ new ways, those methods are laborious, they take a long amount of time, and there is only a small possibility that they will be successful. The research gap that was discovered as a result of this study is that there is an intentional lack of studies studying the up gradation of the current models and not offering totally new methods. This was found to be the case after the study was conducted. The dialogue is then continued by discussing the workflow of the suggested model. The proposed study starts with the presentation of the framework, which is a mix of proposed models.

III. Proposed Framework of the Mobile Agents in an Electronic Marketplace

In this section, we will first determine the types of mobility that are at the foundation of existing MA applications in the field of e-commerce, and then we will define existing MA applications that are used in the field of e-commerce. We explore a wide variety of possible implementations for each of these pattern types by using the time-honored client-server (CS) and model-view-controller (MA) paradigms. The mobility of mobile agents is shown in proposed framework (Fig. 1) that is intended for use in e-commerce.

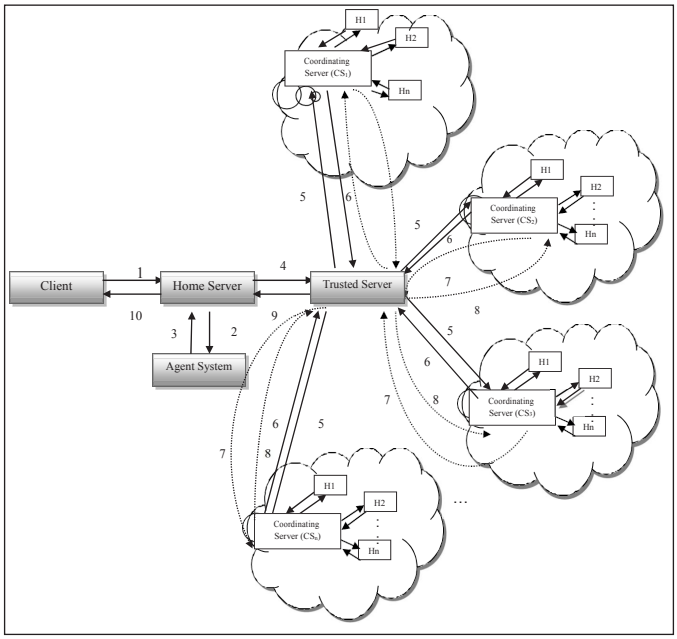

Fig. 1: Architecture for Electronic Marketplace: Branching Pattern

A. Work Flow of the Mobile Agents in an Electronic Marketplace

The complete functionality of the MAs in an electronic marketplace can be described in the following steps:

1. The client first registers itself with the Home Server (HS). In the said architecture, the HS has a built-in Agent System. The HS registers the client for every new request. Once the registration is completed, a Mobile Agent (MA) is created, which traverses from machine to machine to gather information on behalf of the user and is terminated once the process is completed.
2. Along with the request to create the MA, HS also receives the client query.
3. Once all the information has been received from the client, HS sends the service requirements to the Agent System (AS). The AS checks whether the required service exists, and upon confirmation, sends the addresses and names of the service providers to the HS. Upon receiving the response, HS generates the route list for MA.
4. The request is then transferred to a Trusted Server (TS) to device the security mechanism MA.
5. After the security mechanism is put in place, MA is sent to the number of Coordinating Servers (CS), which has a number of Mobile Seller Agents (MSA). It must also be noted that each CS has a number of MA attached to it.
6. The MA from each CS generates the responses based on the client query.
7. When MAs from each of CS gets finished with the required task, CS informs the TS about the completion and updates the MA code.
8. The TS gets notification, updates its directory and notifies each of the CS about the updated status of MAs.
9. The TS then compiles all the responses, and generate response for the HS.
10. The HS evaluates the security status of each MA, updates its directory with the status and responds to client.

Throughout the progression of our study, we uncovered MA as a potentially useful design paradigm for the e-commerce. Our work offers a systematic approach to the deployment of a whole e-commerce-based application over the World Wide Web. The proposed framework elaborates two logical areas of MA implementation in an electronic marketplace.

B. Evaluation Qualitative of the Several MA Design Paradigms

Existing MA applications in e-commerce were categorized, underlying mobility patterns for these applications were discovered, and viable implementation techniques for these mobility patterns utilizing client-server and mobile agent paradigms were examined. According to our previous experience and the findings of this study, the patterns of mobility play a significant part in determining the implementation method that should be used for high-performance applications. We conducted tests to quantitatively analyze the efficacy of these various tactics, making use of the model architecture implementation framework that was recommended. The applications that are most suited for sequential client-server implementations are those in which just a limited quantity of data has to be collected from a small number of distant data sources and the level of processing that is needed is relatively minimal (our experiments provide a good quantitative indication of these parameters). However, these prerequisites do not hold true for the vast majority of uses of e-commerce in the actual world. We find that MAs are an ideal technology for constructing e-commerce applications because they scale well across the aforementioned criteria, and since scalability is one of the requirements of net-centric computing. When there is a substantial amount of information processing that adds to the turnaround time, parallel implementations are beneficial. We demonstrate that mobile implementations are only beneficial when the cost of shipping a mobile agent is lower than the cost of exchanging messages, and this condition is not always met. We also noticed that the enormous quantity of message exchanges (catalogs) and the great number of interactions are typical features of e-commerce systems, and that these qualities are favorable to the deployment of mobile agents. Based on the results of our studies, we were able to determine the performance cross-over points for a variety of implementation methodologies and design paradigms. We are of the opinion that, in the long run, an implementation of the client-server and mobile agent paradigms using a hybrid model would provide outcomes that are superior in terms of performance.

C. Concerns with Software Engineering

Our experience with the deployment of MA reveals that MAs are a superior design paradigm for many real-life e-commerce application development situations. This conclusion was reached as a result of our involvement with MA. Direct mapping between the design of the program and the things in the actual world. MAs provide a great deal of freedom in application design, as well as extendibility and a straightforward method for integrating new functions. It has come to our attention that mobile e-commerce offers a solution that makes marketing both more efficient and more expedient. Users are able to do laborious, repetitive tasks and time-consuming activities such as product finding and comparisons with the assistance of MAs. Because the MA is traveling about to various stores and engaging with people there, the message exchange is taking place locally rather than across the network, which results in a lower burden on the network. We have a quicker reaction to changes because to the fact that the MA is located with all of the logic at the shop, which also offers support for detached operations. MAs

are responsible for the introduction of concurrency, and since the agent carries the client's product filtering logic, we are able to provide support for client-specific functionality at the shops. We were able to establish a causality relationship between the conclusions drawn from our qualitative evaluation experiments and the observations made with the application implementation of the proposed framework with the help of measurements and observations that were provided by our performance analysis experiments that utilized the application mobility pattern. These measurements and observations were in the form of observations and measurements. The framework that has been suggested provides support for client-server as well as mobile agent implementations and has the ability to switch between the two.

IV. Advantages of the Proposed Framework

The following is a list of some of the distinguishing characteristics that mobile agents have in the framework that has been proposed:

- Adaptive learning was suggested as a method of instruction for MAs within the framework. As a result, MAs are able to monitor traffic, find bottlenecks, and choose paths that are more efficient in order to reach the subsequent host.
- The framework used the mechanism of autonomy, in which MAs had the freedom to pick both the next host that they will migrate to and the date of when they would migrate to the next host.
- The ability to wander freely from one host computer to another inside a network is what we mean when we talk about MAs having mobility.
- The data collection methodology was also presented by the framework. According to this framework, MAs could be dispatched to each individual client to perform data analysis and then relay the results back to the server. This would result in a reduction in the amount of strain that was placed on the network.

V. Conclusion

This research is an investigation of the many security measures that are being used for cutting-edge multi-agent systems at the present time. We gathered many articles pertaining to this topic, investigated them, and then presented and analyzed their security ideas. These suggestions included identification, authentication, confidentiality, integrity, and access control techniques for multi-agent systems. We are of the opinion that further research can and should be done in this sector, and we have suggested a framework for MAs to operate within an electronic market. In general, we believe that multi-agent systems are a useful paradigm for carrying out data transactions in a safe manner. Because it is able to facilitate the flow of sensitive data across various nodes, it is capable of resolving a variety of security challenges, including authentication, confidentiality, integrity, and access control. In order to accomplish this goal, a variety of distinct cryptographic methods and approaches are used, each of which is designed to address a particular challenge. We think that a hybrid model implementation of the client-server and mobile agent paradigms would result in a superior application model from a performance standpoint. This is because hybrid models include aspects of both paradigms. The hybrid model would employ a measure of performance cross-over points across many factors to determine the best cost-effective implementation for a certain work at hand. A real-time learning method would help further develop and refresh the knowledge of our performance measure, hence assisting in the better choice of a design paradigm for a work with a given set of parameters. This would be beneficial. Instead of offering a general framework that enables mobility, we think that MA frameworks need to be tailored to the mobility pattern of an application. In order to improve performance, we need an application-specific framework that is tailored to a certain group of mobile apps and the behaviors they exhibit. The safety features of mobile agent systems are taken into consideration by our framework, which is used for the construction of e-commerce-based applications employing MAs. This work is going to be further developed with a comprehensive analysis for payment methods that are compatible with MAs. It is essential to investigate the compatibility of the currently used electronic payment methods with mobile agents.

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Journal of Applied Information Science
11 (1) 2023, 37-44
http://www.publishingindia.com/jais

Design and Implementation of a Self-Contained Device for Monitoring and Alerting Emission: Sensor Based Approach

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Abstract: The goal of this project is to create a device that can measure the pollution emitted by a vehicle by analyzing its exhaust gases. The device is designed to be self-contained and does not require external instruments or certification. It utilizes a gas sensor that detects the level of carbon monoxide in the exhaust and a microcontroller that controls an LCD display to display this information. The system consists of two parts: a sensor node and a server node. The sensor in the sensor node detects the gases, and the data is processed by the microcontroller. Additionally, the device aims to convert the heat produced by the engine into electricity. The server node of the system is responsible for checking the pollutant levels. If the gas pollutant levels exceed a predetermined threshold or safe range, the server node sends two alert messages to the users. The system is also connected to the engine's on/off circuit, and if the user ignores the warnings and continues to operate the vehicle without repairing it, the engine's on/off circuit will be cut and the vehicle will stop moving. The user will only be able to use the vehicle again once they have repaired the pollution in the engine.

Keywords: Microcontroller, Monitoring, Peltier, Pollution, Sensor.

I. Introduction

The large amount of air pollution in cities, which is largely caused by vehicle traffic, requires constant and accurate monitoring if we hope to reduce vehicle emissions. Road transportation is the main contributor to harmful gas emissions in India, accounting for one fifth of total carbon monoxide and nitrous oxide emissions in the air. To address pollution in cities, it is necessary to monitor vehicle emissions and develop strategies to reduce them in the short and long term. The health consequences of vehicle air pollution, including asthma, eye irritation, lung problems, and reproductive issues, can be severe and long-lasting. People living in rapidly growing cities are particularly at risk for poor health.

India's Air (Prevention and Control of Pollution) Act was passed in 1981 and updated in 1987 to address the prevention, control, and reduction of air pollution. The government has established current emission standards for monitoring air pollution, and the information collected helps to mitigate the negative impacts on the environment. In urban areas, taxis, buses, and trucks are responsible for 72% of carbon monoxide and nitrous oxide emissions. Given these concerning circumstances, the Central Pollution Control Board has made it mandatory for large transport vehicles to renew their fuel efficiency (FC) certificate every year, and for light motor vehicles every five years. According to the legislation, every vehicle must also be inspected every three months to receive a Pollution Under Control certificate. Vehicle pollution can be monitored using the Air Quality Index with appropriate sensors. The transmission and communication of data from the sensors is facilitated through innovative approaches such as the Internet of Things and Wireless Sensor Networks, which allow for real-time and reliable data on a large scale.

Although electric vehicles may have lower long-term cost implications, the expense of introducing a new technology to the market is significant. In contrast, developing countries like India and South Africa rely heavily on petrol and diesel for vehicle and home use. When a new car is purchased in these countries, emission certifications are provided, but many people do not renew them. This project focuses on creating field devices to increase individual awareness. The prototype uses a microcontroller and a sensor to analyze vehicle emissions, communicate through GSM, and alert the vehicle user when it is time to service the vehicle.

II. Literature Review

The goal of Abdul-Rahman and Graves (2016) [1] is to use the online development platform Thing Speak to analyze sensor data, including temperature, sound, and potentiometer readings. This data will be displayed in both graphical and excel sheet

formats. Ansari and Alam (2022) [2] the researchers analyzed air quality data collected from IoT enabled devices and stored on cloud infrastructure, which was publicly available on the Indian government website. They examined the data for various states in India and used visualization techniques to understand the impact of air pollution on human life in society. They also used correlation and heat map analysis to examine the relationship between air pollution and certain conditions and found a significant relation. Chaitanya and Kumar (2015) [3] examined the properties of gas sensors for monitoring air pollution and the various gases that contribute to it. They demonstrated how these sensors can be used to detect and measure the concentration of different gases in the air. In the literature survey conducted, there are different approaches developed for monitoring vehicular pollution.

Cordova *et al.* (2007) [4] it is the use of RFID technology to solve transport problems such as accident risk management, traffic rule violations, and vehicle theft identification. In this approach, an RFID tag is placed on each vehicle and its identification is sent to a traffic information database via RFID readers located at toll gates, parking areas, and traffic signal areas. This technology can also be used to monitor the environment and alert authorities to any potential issues. Hassan *et al.* (2022) [5] the study proposes a system in which a private blockchain network is run on a separate board and paired with a microcontroller for use with smart devices. The system utilizes blockchain technology to address challenges such as lightweight, evaporation, storage, and transportation time. Their study aimed to demonstrate how blockchain technology can be used in conjunction with machine learning for food traceability. Additionally, their study highlights how accurate data can be used to prolong shelf life in a supply chain.

Hunshal *et al.* (2017) [6] focused on the issue of both human safety and air pollution in vehicles. They explored ways to address these issues through the use of various technologies or methods. Khedo *et al.* (2010) [7] suggests using wireless sensor networks to monitor air pollution in Mauritius. The proposed system, called the Wireless Sensor Network Air Pollution Monitoring System, would utilize a large number of wireless sensors placed around the island to collect data on air quality. The system would also incorporate a new data aggregation algorithm to combine data, remove duplicates, and filter out invalid readings.

Li and Shimamoto (2012) [8] CO_2 emission reduction system for vehicles can be achieved using an ETC (electronic toll collection) device. These devices are placed at intersections and use signals to communicate with one another and determine traffic flow at each junction. By implementing this system, CO_2 emissions can be reduced. Malhotra *et al.* (2022) [9] their study examines how several well-known brands of virtual assistants are perceived by their users through correspondence analysis. Their results suggest that in addition to fulfilling their basic functions, these devices also create emotional connections with users, such as being perceived as partners, friends, or family members. Their research found differences among the brands studied, with Google Assistant and Alexa standing out as the only ones capable of forming these types of relationships with their users. The findings of their study can inform the development and design of future virtual assistants to enhance the user experience.

In paper Manna *et al.* (2014) [10] used RFID technology to monitor pollution levels in high traffic areas. RFID tags were placed at short intervals along with sensor nodes on the roadside. When the sensor level exceeded a certain threshold, an RFID reader would identify the tag number of the vehicle and send a message to the owner. This approach was implemented to help reduce pollution levels in areas with heavy vehicle traffic. Considering Pavani and Rao (2016) [11] describe the use of the TGS4161 electrolyte carbon dioxide sensor for monitoring pollution levels. This sensor must be calibrated by exposing it to different concentrations of gas, and the sensor output is plotted based on the results. This allows the sensor to accurately measure pollution levels.

For instance, in paper Rushikesh and Sivappagari (2015) [12] discussed a system for monitoring and controlling pollution levels in vehicles using MQ sensors, RFID technology, and Arduino. If the pollution level exceeds a certain threshold, the authorities will be alerted. Vong *et al.* (2014) [13] developed a pollution control system that uses radio-frequency identification (RFID) and lambda sensors. The lambda sensor is mounted on the exhaust pipe and measures the air-fuel ratio in the exhaust gas. When the air-fuel ratio is less than one, it results in increased emissions of carbon monoxide and hydrocarbons. On the other hand, if the air-fuel ratio is greater than one, it leads to an increase in nitrogen oxide emissions. The RFID is connected to the lambda sensor to help identify and monitor the emissions of the vehicle.

III. Description

A. Microcontroller

The ATmega328-based Arduino Uno is a microcontroller board. It features a 16 MHz ceramic resonator, 14 digital input/output pins (6 of which can be used as PWM outputs), 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button. This board is user-friendly and easy to use; all the necessary components to support the microcontroller are included on the board. To get started, simply connect it to a computer via a USB cable and power it using an AC-to-DC adapter or a battery. One notable difference between the Arduino Uno and other boards is that it does not use the FTDI USB-to-serial driver chip. Instead, it has the ATmega16U2 (or ATmega8U2 on version R2) programmed as a USB-to-serial converter. The ATmega328 microcontroller is an 8-bit, high-

performance device from Atmel with low power consumption. It is based on an advanced RISC architecture with 131 powerful instructions, most of which can be executed in a single clock cycle. The ATmega328 has a total of 28 pins and can operate at a maximum frequency of 20 MHz. It has 32 KB of programmable flash memory, 2 KB of static RAM, and 1 KB of EEPROM. It also has various built-in peripherals such as an ADC, USART, and analog comparator. The microcontroller has 23 I/O lines which are divided into three ports: PORT B, PORT C, and PORT D.

- Arduino ATmega328 Microcontroller

The Arduino ATmega328 microcontroller has been programmed for a variety of applications. It can be programmed using the power jack cable, and the execution of the program takes place once it is connected. There are several different types of Arduino boards available on the market. In this project, we will be focusing on the Arduino UNO ATmega328 microcontroller in detail. The Arduino software must be installed on a computer in order to edit and upload programs for specific applications. This software mainly supports the C and C++ programming languages. The Arduino board has various inputs and outputs, and up to 8 input and output ports can be used simultaneously for various applications. Some examples of applications that can be implemented using the Arduino board include controlling a general motor, a stepper motor, or a valve. There are approximately 700,000 Arduino boards in circulation, and the Arduino ATmega328 microcontroller has 14 input and output analog and digital pins (6 of which are PWM pins), 6 analog inputs, and the remaining digital inputs. The power jack cable is used to connect the Arduino board to a computer.

An external battery is used to supply power to the Arduino microcontroller. The Arduino is an open-source microcontroller that does not have any built-in feedback. It has an I2C bus that can transfer data from the Arduino board to output devices. The Arduino board can be programmed over RS232 serial interface connections with Atmega Arduino microcontrollers. The operating voltage range is 5V, and the recommended input voltage for the Arduino microcontroller is 7V to 12V. The DC input current for the Arduino board is in the range of 40 mA. It has different types of memory, including flash memory, EEPROM, and SRAM. The length of the Arduino board is approximately 68.64 mm and the width is about 53.4 mm. There are various types of microcontrollers that can be used, such as 8-bit AVL Atmel microcontrollers and 32-bit Atmel ARM microprocessors. These processors can be used for various engineering projects and industrial applications, such as controlling actuators and sensors.

The ATmega328 microcontroller is the processor for the Arduino board and has 28 pins. These pins can be used to control inputs by transmitting and receiving data to and from external devices. The ATmega328 also has pulse width modulation (PWM) capability, which is used to transmit signals in pulse modulation. It requires an input power supply such as Vcc and Gnd. The IC has both analog and digital inputs, which can be used in various applications.

B. Power Supply

The Arduino microcontroller also has an additional power supply source located at one corner of the board. This power supply port can be used to connect the microcontroller to an external power supply, such as an AC or DC power source. These power supplies provide active power to the Arduino microcontroller. It can accept a range of power supply voltages, but if the voltage exceeds the recommended range, the microcontroller can be damaged. Therefore, it is important to only provide the appropriate range of power supply to the Arduino microcontroller. To ensure proper operation, it is necessary to make sure all connections, including the power supply connection, are properly made. The output pins of the microcontroller can be connected to external devices as needed for various applications. Programs for these applications can be created and edited using the Arduino software, which supports the C and C++ programming languages. These languages are high-level languages.

By using appropriate conditions, we can create a program to carry out specific applications. This program can then be uploaded to the Arduino microcontroller using the power jack cable. Once the program is uploaded to the ATmega328 microcontroller, it can save the program and act as a processor to carry out the process without any errors. By providing analog or digital input to the system, we can control the process of the application. If we need to make changes to the program, we can edit it using the Arduino software and re-upload it to the microcontroller via the power jack cable. There is also a reset button that allows us to reset the program, which means that any previous programs are deleted and the Arduino can be used for other applications. In this way, the Arduino ATmega328 microcontroller can be used for a wide range of applications. These microcontrollers are widely used in the automation industry to control processes and operate systems in an automated mode.

C. Charging Circuit

The charging circuit is used to charge a battery by regulating and stepping down the input current to the desired output. It also prevents current flow from the battery back to the charging circuit by using a diode. To charge a battery from AC power, a step-down transformer, rectifier, filtering circuit, and regulator are needed to maintain a constant voltage, which is then applied to the battery. If only DC voltage is available to charge a lead-acid battery, a DC-DC voltage regulator and additional circuitry can be used. Car batteries are also lead-acid batteries.

The DC voltage is supplied to a DC voltage regulator, such as the LM317. The regulated DC output voltage is then applied to the

battery. There is also a trickle charge mode circuit that reduces the current when the battery is fully charged. The LM317 is a voltage regulator invented in 1970 by Robert C. Dobkin and Robert J. Widlar. Its main function is to regulate voltage and provide a constant voltage without noise interference. For example, if we have a 42 V input and want a 10 V output, we can use the LM317 to get the desired output. The LM317 does not have a maximum voltage, as long as the difference between the input and output voltages does not exceed the maximum differential voltage, which is around 40 V. It can also provide an output current of up to 1.5A for a voltage range of 1.2 V to 37 V. The minimum input voltage for the LM317 is 18 V.

Lead-acid batteries were invented in 1857 by Gaston Planté and have several advantages. They dissipate very little energy, making them efficient and able to work for long periods of time. They also have a low energy-to-weight ratio, are able to deliver high currents, and have a low cost.

D. Battery

An electric battery is a device that stores and supplies electrical energy through one or more electrochemical cells. It is used to power a variety of devices such as flashlights, smartphones, and electric cars. When a battery is supplying electrical power, the positive terminal is called the cathode and the negative terminal is called the anode. The negative terminal is the source of electrons that flow through an external circuit and provide energy to an external device when the battery is connected. The movement of ions within the battery allows for chemical reactions to take place at the separate terminals, which allows for the flow of current out of the battery to perform work. Historically, the term "battery" referred specifically to a device with multiple cells, but it has also come to include devices with a single cell.

E. Clock and Reset Circuit

In digital electronics, the clock and reset circuit play a crucial role in the functioning of a microcontroller. It is important to pay careful attention to these elements from the early stages of design. The clock and reset circuit provide the necessary clock signals to the microcontroller to enable it to function properly.

F. Relay

A relay is an electrical switch that can be controlled by an electrical signal. It is used to connect or disconnect two circuits. Instead of being operated manually, a relay uses an electromagnet to activate the switch. The electromagnet consists of a coil of wire wrapped around a metal core, with the ends of the coil connected to two pins. These pins are used as the supply connections. There are typically two additional contacts called switching points that are used to connect high-amperage loads. There is also a common contact that connects the switching points. These contacts are typically labeled as normally open (NO), normally closed (NC), and common (COM).

G. Fuel Exhaust

Exhaust gas, also known as flue gas, is emitted as a result of burning fuels like natural gas, gasoline, and coal in engines. The type of engine determines how the gas is released into the atmosphere, whether through an exhaust pipe, flue gas stack, or propelling nozzle. Exhaust gas can spread in the air, forming a plume. Motor vehicle emissions, including exhaust gas, contribute significantly to air pollution and can create smog in urban areas. Vehicle emissions can also include crankcase blow-by, which is the escape of gases from the crankcase of an internal combustion engine, and evaporation of unused gasoline. These emissions have been linked to negative health effects and premature deaths.

Emissions from motor vehicles contribute to air pollution and can contribute to the formation of smog in cities. A study by the Massachusetts Institute of Technology (MIT) found that vehicle emissions are responsible for 53,000 premature deaths each year in the United States. Another study by MIT found that traffic fumes cause the deaths of 5,000 people annually in the United Kingdom.

H. Heat

The heat generated during the combustion of fuels in an engine can be quite high, especially in the engine and exhaust parts. Currently, this heat energy is typically not utilized and is considered waste. However, it would be beneficial to find ways to transform this heat energy into a useful form.

I. Thermo Electric Peltier

A thermocouple is a device that can measure temperature by using the thermoelectric effect, which is the direct conversion of temperature differences to an electric voltage. The device consists of two dissimilar conductors forming electrical junctions at different temperatures. It is made up of two unique semiconductors, one n-type and one p-type, and is connected to a thermally conducting plate on each side. When a voltage is applied to the ends of the semiconductors, there is a flow of DC current across the junction, creating a temperature difference. The side with the cooling plate absorbs heat, which is then transferred to the other side with the heat sink. Thermoelectric coolers (TECs) are typically connected side by side and sandwiched between two ceramic plates, with the cooling ability proportional to the number of TECs. The term "thermoelectric effect" includes the Seebeck, Peltier, and Thomson effects.

The Seebeck effect is a phenomenon in which electricity is generated at the junction of two different types of wire when there is a temperature difference between them. This process, which is an example of electromotive force (EMF), produces measurable currents or voltages similar to other EMFs. The Seebeck effect can also modify Ohm's law by creating currents in the absence of a voltage difference.

J. Carbon Monoxide Sensor MQ-7

The MQ-7 gas sensor is made up of micro aluminum oxide ceramic tube, a layer of Tin Dioxide (SnO_2) that is sensitive to gases, measuring electrodes, and a heater all contained in a plastic and stainless steel casing. The heater is used to maintain the necessary conditions for the sensor to function properly. The MQ-7 has six pins, four of which are used to detect signals and the other two to provide heating current. The sensor's surface resistance, Rs, is determined by the voltage signal output of the load resistance, RL, in a series circuit. The relationship between them is described as Rs/RL = (Vc-VRL)/VRL. The SnO_2 layer of the MQ-7 is stable and has excellent long-term stability, allowing the sensor to have a service life of up to 5 years under normal use conditions.

K. Liquid Crystal Display

An LCD (Liquid Crystal Display) screen is a widely used electronic display module. A 16x2 LCD display is a basic module that is often used in various devices and circuits. These modules are preferred over seven-segment displays and other multi-segment LEDs because they can display 16 characters per line on 2 lines. Each character on the LCD is displayed in a 5x7 pixel matrix. The LCD has two registers for commands and data. Some advantages of using an LCD include cost-effectiveness, easy programming, and the ability to display custom characters, animations, and more.

L. Soldering

Soldering is a technique used to join two or more metal components together by melting and flowing a filler metal, known as solder, into the joint. The filler metal has a lower melting point than the base metals being joined, and is typically made up of a combination of tin and lead (Sn and Pb). Soldering is commonly used in the fabrication of printed circuit boards (PCBs), where various electronic components are arranged on the PCB and then soldered in place. Adhesive forces, or surface tension, between the solder and the base metals allow the joint to solidify and create a strong bond. The tools and materials needed for soldering include soldering iron, nose pliers, solder, flux, and a blade or knife. It is important to ensure that the melting point of the solder is lower than the base metals being joined to prevent melting the base metals during the soldering process.

- Soldering Fluxes

In order to make the surfaces ready for soldering, it is necessary to remove any oxides or other obstructing films from the surface of the metal using a flux. The leads should be cleaned chemically or by scraping with a blade or knife, and then coated with a small amount of lead and a bit of the soldering iron. This is known as tinning. Commonly used fluxes include zinc chloride, ammonium chloride, and rosin.

- Solder

Soldering is the process of joining two or more metal surfaces using an alloy with a low melting point. A common example of this is a mixture of tin and lead, which melts at a temperature of 370 °F and solidifies upon cooling. Soldering is often used to connect electronic components on a circuit board. To prepare the surfaces for soldering, a flux is often used to remove any oxide or film that may obstruct the process. The soldering process can be aided by tinning, which involves coating the surfaces to be joined with a thin layer of solder. Solder wires, which often contain flux within the core, can be used for this purpose and may not require additional flux.

The procedure that is involved in soldering process is as follows:

- Create a diagram of the component placement in the circuit. Connect the cord of the soldering iron to the power source to heat it up.
- Clean the leads of the components with a blade or knife and bend them as needed. Apply some flux to the leads, and then use the soldering iron to apply a small amount of molten solder to each lead. It is important to be careful not to overheat the components during this process.
- Mount the components on the PCB, apply flux to the joints, and solder the joints quickly to prevent dry soldering and excessive heating of the components and Wash the residues.
- To remove excess soldering material from a circuit, a de-soldering tool such as a de-solder pump can be used.

- De-Soldering

De-soldering is the process of removing solder from previously soldered connections. One tool commonly used for this purpose is a de-soldering pump, which uses a vacuum to suck the melted solder into a tube when its trigger is activated. To ensure a successful de-soldering process, it is important to use the appropriate soldering iron for the task, coat the soldering iron tip with solder before beginning, keep the tinned parts clean of oxide, and avoid overheating the PCB and devices.

M. EAGLE

EAGLE is a software tool that allows users to design and create electronic circuits and PCBs (printed circuit boards). It has a range of features including a schematic capture editor, a PCB layout editor, an auto-router, and CAM and BOM tools. EAGLE is known for its ease of use, even for those new to PCB design, as well as its open design resources and the ability to expand its capabilities through extensions (ULPs) and compatibility with various workflows. It is developed by CadSoft Computer GmbH.

The three important modules of EAGLE are:

- Schematic Editor

EAGLE, or Easily Applicable Graphical Layout Editor, is a comprehensive electronic design automation software with capabilities including schematic capture, PCB layout design, auto-routing, and manufacturing tools. It is known for its user-friendly interface and extensive library of components, as well as its ability to be customized and extended with various extensions. The schematic editor feature in EAGLE allows users to create a symbolic representation of their design and provide documentation for others to understand the design intent. The software also includes an electrical rule check (ERC) function to verify that all connections are properly defined.

- Layout Editor

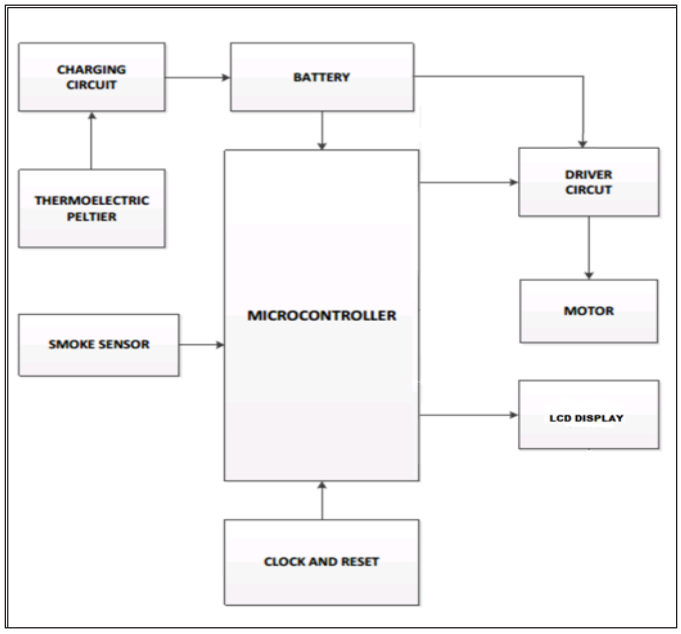
The layout editor in EAGLE is used to create the physical representation of your design, including the placement of components and routing of copper connections between them. It includes advanced features such as the ability to handle different assembly variations and specialized routing for differential pairs. The board created in the layout editor represents the final physical product.

- Autorouter

Paraphrase without plagiarism: "The autorouter function in EAGLE can assist in placing copper traces between components on a circuit board. It can be customized using cost factors to influence its routing behavior and quickly produce effective results. The autorouter operates as a multi-threaded program, allowing for the exploration of multiple routing options and the selection of the most suitable one for the design. It also protects previously routed traces and allows users to decide which nets should be manually routed and which can be handled automatically.

IV. Block Diagram

Fig. 1, shows the block diagram of the model setup.

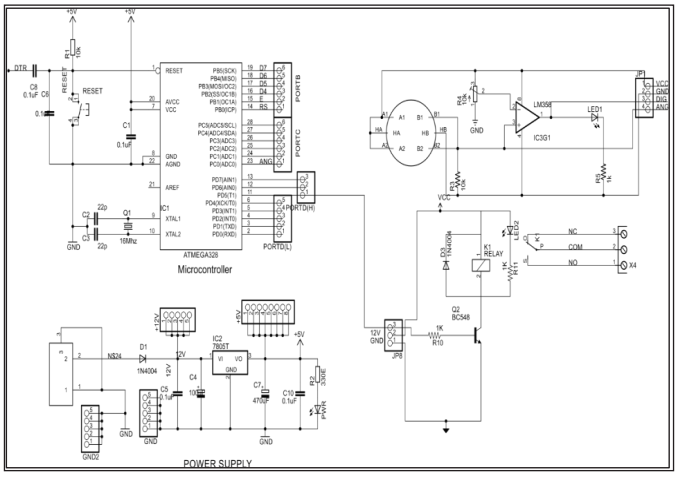


(Source: Primary)

Fig. 1: Block Diagram

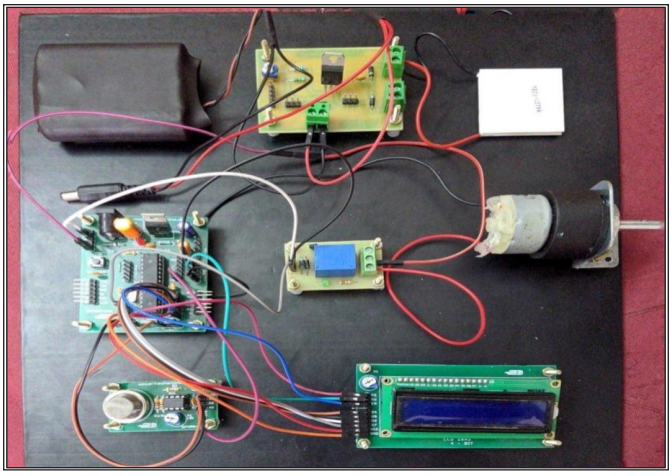
V. Circuit

Fig. 2 and Fig. 3 depict the model's circuit diagram and circuit setup.



(Source: Primary)

Fig. 2: Circuit Diagram



(Source: Primary)

Fig. 3: Circuit Setup

VI. Working

A smoke sensor is installed on the exhaust of a vehicle to measure the level of pollutants in the exhaust gas. The output from the sensor is compared to a predetermined threshold value, which is determined based on the allowed limit of pollutants in a vehicle. If the output from the sensor exceeds this threshold, the microcontroller will stop the vehicle and display a message on an LCD screen indicating that the pollution level is too high.

The thermoelectric Peltier is attached to the exhaust or another heating component of the engine. The Peltier has two surfaces, one of which is attached to the heating component, creating a temperature difference between the two surfaces. This temperature difference generates an electric charge based on the principle of thermocouples, which is used to recharge the battery that powers the microcontroller and other components. A charging circuit is used to recharge the battery because the current produced by the Peltier varies according to the temperature difference.

The vehicle's exhaust gas is monitored by a smoke sensor, which generates an analog output signal proportional to the pollutant concentration. This output is compared to a threshold value set according to the vehicle's allowed limit, and displayed on a 16x2 LCD screen. If the sensor output surpasses the threshold, the microcontroller activates a relay to stop the vehicle and displays a message indicating high pollution.

A thermoelectric Peltier device is attached to a heating component, such as the exhaust, of a vehicle engine. The Peltier has two surfaces, with one in contact with the heat source and the other remaining detached. This creates a temperature difference between the surfaces, causing a thermoelectric current to be generated based on the principle of thermocouples. This current is used to recharge the battery that powers the microcontroller and other components. A charging circuit is utilized due to the fluctuating nature of the current produced by the Peltier, which depends on the temperature difference on its surfaces.

VII. Conclusion

The proposed project is practical and easy to implement. It is also more cost-effective and secure than other available systems. If implemented by vehicle manufacturers, it would be beneficial to consumers. In addition to monitoring pollution, it also continuously tracks CO_2 levels, which can help reduce ozone-damaging chemicals in the atmosphere. This solution has the potential to significantly decrease and control emissions. If implemented on a global scale, it could contribute to the reduction of global warming.

VIII. Applications and Future Scope

The proposed system is a simple and cost-effective solution for monitoring and reducing pollution in vehicles. It can be easily integrated into the manufacturing process by vehicle companies, and eliminates the need for external certification from certified institutions. In addition, the system has the potential to continuously monitor and regulate CO_2 emissions, which can help reduce the amount of ozone-depleting chemicals in the atmosphere and contribute to the reduction of global warming when implemented on a global scale. In the future, the system can be further enhanced and expanded to address other issues and advancements.

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Journal of Applied Information Science
11 (2) 2023, 01-07
http://www.publishingindia.com/jais

Displaying the Gender Differences in Students Satisfaction with Library Resources in Higher Educational Institutions

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Abstract: The focus of the study is to examine the level of satisfaction among students with the library resources (sources of information, facilities and services available) in their respective institutions (academic). For this purpose, comparative analysis (in terms of gender) has been done to find out the difference in the satisfaction level among students. Questionnaire used as an instrument for data collection, from 559 respondents (students). Findings of the study indicate, there is a reasonable level of satisfaction towards the resources (sources, facilities and services) offered to the students, in the academic libraries (that have been surveyed). In addition, results of this study are important for stakeholders (authorities) at higher educational level (the university/college levels). As, it draws attention towards user satisfaction and points out, efforts should be taken by academic institutions to enhance the guidance, quality as well quantity of library resources offered to the students.

Keywords: Gender, Library, Satisfaction, Services, Sources.

I. Introduction

In order, to expand students potential and cultivate their ability to adapt and improve their *self-expression, independent thinking, active inquiry, problem solving* education acts as the basic essential learning process. The "curriculum goals should be life-centered" to develop individuals potential, cultivate scientific knowledge, skills, and help students adapt to the demands of modern life [1]. In this regard, attitude towards educational strategies (instructional) act as the most important factor in students creativity learning. Where teachers, social and cultural factors and experience in learning, revealed significant correlations [2]. Further, libraries invest a huge amount of money every year on the collection development and maintenance of their resources to meet the information need of users. As satisfaction of library users is the major aim of every library system. But to maximize the use of library resources, every library should build up its working strategy and collection keeping in view the need of users and should design a library with changing information environment. The advent of e-resources and increasing use of such materials have reduced the library scenario from physical to virtual. Due to the advent of electronic gadgets, most of the users prefer e-resources to the conventional type. Therefore, to solve the present circumstances that we are facing today, the library should adopt itself (more e-resources) to satisfy the users. Its (libraries) collection must be more or less sufficient for the users, to access their academic requirements. At the same time research and development are increasing, however such collection of reading materials still needs to be expanded. On the other hand, it is evident that previous studies have reflected the importance of measuring the degree of student satisfaction with what is provided to them by libraries and that academic guidance directly affects the improvement of the students abilities in educational achievement through the choice of specialization that is commensurate with their capabilities. Consequently, it affects the outcomes of educational institutions, shows how safe it is to move profoundly towards the goals for which the institutions were established, helps to develop continuous improvement and development plans. Also, determines the level of student awareness with the resources provided to them by the academic institutions [3].

II. Literature Review

To determine the strategies teachers, offer to provide students with experience solving problems in the classroom, a study was conducted. The study revealed that the teachers employed a number of strategies as part of the problem-solving process. However, it was observed that the rate of application of strategies was rather low, even though specific strategies were nominally employed by the teachers. Also, discloses strategies most frequently employed by the teachers during the problem-solving process (adopting a different point of view). While

the strategy of making a drawing was also frequently applied. Moreover, the teachers employed the strategies of intelligent guessing and testing, working backwards, finding a pattern, solving a simpler analogous problem and considering extreme cases, but with lesser frequency. On the other hand, the strategy of organizing data was not used by any of the teachers [4]. To explore the relationship between students problem-solving skills and scientific attitudes in terms of gender, class level and education level of the parents, this study is undertaken. Adopting, *correlational research model*, which is among the general survey models. The sample of the study consisted of 560 students, selected from the *Afyonkarahisar Province, Turkey* by using convenience sampling method. In the study, Problem Solving Inventory for Children (PSIC) and Scientific Attitude Scale (SAC) were applied to collect the data. In the analysis of the data, Pearson correlation analysis, one-way variance analysis and two-way variance analysis were performed. As a result of the analyses, a negative and low-level relationship was found between students problem-solving skills and scientific attitudes. Also, there was a negative and low-level relationship in terms of female students; it was found that this relationship was not significant for male students. It was concluded that problem solving skills and gender did not have a significant and common effect on student's scientific attitudes. In addition, it was determined that students problem-solving skills were not a significant predictor of their scientific attitude [5]. Further, [6] studied the level of satisfaction with the information resources offered by the library and concludes with a number of the important suggestions for the advanced user services and obtain ultimate satisfaction of the users. [7] examine the user's satisfaction with library facilities and the attitude of staff in the library (national). The study found out that the staff in the library should be friendly to users in delivering their library services. In addition, the satisfaction level of users with different information services offered by the library and the kind of information sources were analysed. The study discloses that though the users are satisfied with services and information products there is ample scope for further improvement [8]. On the other side, no significant relationship was found in the frequency of visits to the library between the research scholars (RS) and faculty members (FM) across the libraries. A significant difference was found between RS and FM about availability of required resources, information sources used by them except non-book materials, whereas a significant relationship was found in the opinion of RS and FM satisfaction from the library collection [9]. To investigate the difference between students satisfaction and intention to the continuation of ODL based on gender perspective a study were conducted by [10]. Besides this, study also aims to assess the challenges faced by students in ODL. A survey was conducted and SPSS 26.0 was used to analyse the data. The result found that there is no significant difference in satisfaction and intention to continue usage of ODL among male and female students. This study also revealed that slow internet coverage was the biggest challenge among students in ODL. The finding of this study is expected to contribute to the academicians, policymakers and to take into account the problems faced by students when implementing the new method of teaching and learning. [11] observes satisfaction level of users regarding GC University Library's resources and services. Majority of the users are satisfied with the resource of the library. However, large number of users showed dissatisfaction with the services of computer equipment, research guides, chat service with librarians, online searching catalogue and e-books service.

III. Objectives

- To measure the student's satisfaction with the resources (facilities, collection, services) provided by the libraries (under the scope of study).
- To know the differences between the levels of student satisfaction due to gender.
- To find out the opinion (satisfaction rate) with the overall development of libraries.
- To know the problems (general) faced by library users.
- To determine the problems faced in extracting information from web.

IV. Methodology

For the present study, Questionnaire(s) are found as the most relevant tool for collecting data, as it helps to fetch responses from the participants rapidly. Although, interview procedure is also adopted (wherever feasible) to obtain information pertaining to the raised queries. In order, to evaluate their satisfaction with the library resources. For which, students from seven departments (viz: *History, Political science, Social work, Sociology, Physics, Environment science, Biochemistry)* at University of Kashmir. The questionnaires were divided into five major sections (which incorporates queries related to-services, collection, facilities provided by the libraries, overall development of the libraries, problems faced) and nearly 692 questionnaires were distributed among the respondents (students) within the randomly selected departments. Out of which 559 respondents properly filled the questionnaire(s) and returned back. Thus, an overall response rate is 80.78%. The collected data were tabulated and analysed (Gender-wise analysis has been undertaken) by making use of SPSS to display differences in satisfaction level among the participants (under the scope of study).

V. Data Analysis

A. Satisfaction with the Library Facilities

For determining satisfaction level with the library facilities among male and female participants of the study in the selected departments, collected data is presented in Table I.

Table I: Satisfied with the Library Facilities

Facilities	Gender		Average Mean (A$\overline{X}$)±SD	Significance Value (p)
	Male	Female		
	$\overline{X}$±SD	$\overline{X}$±SD		
Location	2.83±1.133	2.95±1.158	2.89±1.145	> 0.05
Arrangement of books	2.78±1.112	2.84±1.130	2.81±1.121	> 0.05
Furniture	2.61±1.118	2.73±1.139	2.67±1.128	> 0.05
Lighting	2.64±1.178	2.75±1.187	2.69±1.182	> 0.05
Helpfulness of library staff	2.45±1.139	2.64±1.159	2.54±1.149	< 0.05
Reading room	2.67±1.151	2.77±1.151	2.72±1.151	> 0.05
Cleanliness	2.42±1.133	2.59±1.190	2.50±1.161	< 0.05
ICT infrastructure	2.36±1.062	2.48±1.102	2.42±1.082	> 0.05

$\overline{X}$ = Mean; SD = Standard Deviation

Table I reveals that the *Male* respondents shows highest satisfaction level towards *location of libraries* ($\overline{X}$ = 2.83), followed by *arrangement of books* ($\overline{X}$ = 2.78) and *reading facility* ($\overline{X}$ = 2.67). Whereas, for *cleanliness* ($\overline{X}$ = 2.42) and *ICT infrastructure* ($\overline{X}$ = 2.36) least *satisfaction* is noted among them.

Comparable response is received from female participants indicating more satisfaction ($\overline{X}$ = 2.95) towards location of library, followed by *arrangement of books* ($\overline{X}$ = 2.84) and *reading facility* ($\overline{X}$ = 2.77). For *cleanliness* ($\overline{X}$ = 2.59) and *ICT infrastructure* ($\overline{X}$ = 1.16) meagre response is attained from female participants.

In addition to this, based on average mean *library location* (A $\overline{X}$ = .2.89) emerge as the most *satisfied* facility among both the groups (Male/Female), followed by *computer facility* (A$\overline{X}$ = .2.81). While as *cleanliness* (A$\overline{X}$ = .2.50) and *ICT infrastructure* (A$\overline{X}$ = .2.42) appear as the least satisfied facilities.

Although, no significant relation found between gender-wise association and satisfaction level of library facilities ($p > 0.05$). Except for helpfulness of library staff and cleanliness where ($p < 0.05$).

B. Satisfied with the Collection of the Library

Satisfaction level regarding library collection among male and female participants is observed and data collected in this regard is shown in Table II.

Table II: Satisfied with the Collection of the Library

Collection	Gender		Average Mean (AX)±SD	Significance Value (p)
	Male	Female		
Books	2.81±1.094	2.89±1.125	2.85±1.109	> 0.05
Periodicals	2.66±1.035	2.80±1.080	2.73±1.057	> 0.05
Newspapers	2.71±1.167	2.80±1.167	2.75±1.167	> 0.05
Magazines	2.57±1.103	2.71±1.109	2.64 ±1.106	> 0.05
Encyclopedia	2.58±1.022	2.64±1.110	2.61±1.066	> 0.05
Dictionaries	2.88±1.102	2.99±1.127	2.93±1.114	> 0.05
Directories	2.56±1.019	2.68±1.036	2.62±1.027	> 0.05
Biographies	2.61±.953	2.69±1.004	2.65±.978	> 0.05
Maps and Atlases	2.72±1.013	2.77±1.023	2.74±1.018	> 0.05

$\overline{X}$ = Mean; SD = Standard Deviation

Table II reveals that Male participants possess highest ($\overline{X}$ = 2.88) satisfaction towards *dictionaries,* followed by *books* ($\overline{X}$ = .2.81) and *maps* ($\overline{X}$ = 2.72). Whereas, least satisfaction ($\overline{X}$ = .2.56) is observed for *directories* and *magazines* ($\overline{X}$ = 2.57) as the source of information.

Similarly, among Female participants highest satisfaction ($\overline{X}$ = 2.99) found towards *dictionaries* as the source of information, followed by *books* ($\overline{X}$ = .2.89), *newspapers* and as *periodicals* per the response ($\overline{X}$ = 2.80). While as, low response obtained for *encyclopedia* ($\overline{X}$ = 2.64) and *directories* ($\overline{X}$ = 2.68) in this connection.

In addition to this, based on average score *dictionaries* ($A\overline{X}$ =2.93), followed by *books* ($A\overline{X}$ = 2.85) and *newspaper* ($A\overline{X}$ = 2.75) are identified as highly chosen sources of information for satisfying user requirements. On the other hand, *encyclopedia* ($A\overline{X}$ = .1.61) and *directories* ($A\overline{X}$ = .1.62) are recognised as the least satisfied forms of collection in libraries for providing information.

Although the Mann Whitney value is not found significantly associated with gender-wise association in connection to the accessing different forms of information ($p > 0.05$).

C. Satisfied with the Library Services

To access the level of satisfaction with regard to available library services among male/female participants, data is collected and presented in Table III.

Table III: Satisfied with the Library Services

Services	Gender		Average Mean ($A\overline{X}$)±SD	Significance Value (p)
	Male	Female		
Circulation	2.93±1.119	2.66±1.096	2.79±1.107	> 0.05
Cataloguing	2.57±.950	2.63±.971	2.6±.960	> 0.05
Reference service	2.73±1.083	2.79±1.103	2.76±1.093	> 0.05
Internet	2.52±1.099	2.64±1.077	2.58±1.088	< 0.05

$\overline{X}$ = Mean; SD = Standard Deviation

Table III highlights that Male participants ($\overline{X}$ = 2.93) are highly satisfied with *Circulation service* in libraries. Followed by *Reference service* ($\overline{X}$ = 2.73) and *Cataloguing service* ($\overline{X}$ = 2.57). In this connection low response attained towards *Internet service* ($\overline{X}$ = 2.52). Majority of Female respondents ($\overline{X}$ = 2.79) display *high satisfaction level* with Reference service, followed by Circulation service ($\overline{X}$ = 2.66) and Internet facility ($\overline{X}$ = 2.64). Although, least response attained towards Cataloguing service ($\overline{X}$ = 2.63).

Average mean calculations indicate *circulation service* ($A\overline{X}$ = 2.79) as the most satisfied service, followed by Reference service ($A\overline{X}$ = 2.76) and Internet services ($A\overline{X}$ = 2.58).

Moreover, it is observed that Internet service have remarkable association with the gender-wise distribution as $p < 0.05$. But circulation service, reference service as well as cataloguing service does not possess the same bond (based on the calculated value $p > 0.05$).

D. Satisfied with the Overall Development of Libraries

Data collected among the male/female respondents about with the overall development of libraries is shown in Table IV.

Table IV: Satisfied with the Overall Development of Libraries

Satisfied with overall development	Gender	
	Male (N = 836)	Female (N = 820)
	288 (34.4) *	260 (31.7)
χ^2 = .884, df = 1, P > 0.01		

*Figure in parenthesis indicate percentage.

It is observed from Table IV that comparable response among participants (male = 34.4%; female = 31.7%) attained about overall development of libraries. Further p-value ($p > 0.01$) indicates there is no significant relation among gender-wise distribution in selected departments under study towards satisfaction with the development of libraries.

E. Problems Faced by Library Users

To compare the type problems *Male* and *Female* users face in the libraries, data is collected and presented in Table V.

Table V: Problems Faced by Library Users

Problems	Gender		Overall Response
	Male (N = 836)	Female (N = 820)	
Insufficient help	385 (46)	344 (41.9) *	729 (44.0)
Inadequate lib tools	250 (29.9)	228 (27.8)	478 (28.9)
Inadequate networking	214 (25.6)	214 (26.1)	428 (25.8)
Latest books	522 (62.4)	472 (57.6)	994 (60.0)
Lack of cooperation	199 (23.8)	171 (20.8)	365 (22.0)
Slow internet	343 (41)	328 (40)	671 (61.7)
$\chi^2 = 3.260$, df = 6, P > 0.01			

*Figure in parenthesis indicate percentage.

From Table V it is clear that 62.4% *Male* participants and 57.6% *Female* counterparts voicing *lack of latest books* among the commonly faced by them. It is followed by *insufficient help*, as significantly rated in *Males* 46%) as well in *Females* 41.9%). Moreover, for *slow internet Male* and *Female* partakers show identical responses through estimated percentages {i.e., (41%) and 40%) respectively}.

On the other hand, lowest response is recorded for *lack of co-operation* i.e., (23.8%) in *Males* and (20.8%) in *Females*, followed by *inadequate networking* (noted in more than 25%).

Furthermore, statistically, it is observed that the choice of users with respect to different sources of information does not have any notable association with their gender-wise distribution as p > 0.01.

F. Problems Faced in Extracting Information from Web: Gender-Wise

While extracting information from online platforms, certain problems were faced by the male as well as female users in educational institutions (libraries). Table VI displays collected data about the concerned matter.

Table VI: Problems Faced in Extracting Information from Web

Problems	Gender		Overall Response
	Male (N = 836)	Female (N = 820)	
Obsolete information	524 (62.7)	444 (54.1) *	968 (58.5)
Poorly designed website	170 (20.3)	158 (19.3)	328 (19.8)
Retrieval problems	268 (32)	261 (31.8)	529 (31.9)
Dead links	102 (12.2)	100 (12.2)	202 (12.2)
None	134 (16)	108 (13.2)	242 (14.6)
$\chi^2 = 11.517$, df = 6, P > 0.01			

* Figure in parenthesis indicate percentage.

Table VI reveals that majority of male (62.7%) as well as female participants (54.1%) consider *obsolete information* as the major problem they face while retrieving information from web, followed by *retrieval problems* that shows quite similar response (32%) among both the user groups (males/females). While as, 20% of *Male* participants and 19% of *Females* highlight *poorly designed website* as the problem. On the other hand, lowest response recorded for *dead links* (12.2% in males as well in females). However, 16% male and 13.2% female respondents disclose none of the problem. Even mutual response points out *obsolete information* followed by *retrieval problems* are the common problems respondents dealing with. Although, *dead links* attained low response for acting as the hindrance.

Furthermore, statistically, it is observed that the choice of users with respect to different sources of information does not have any remarkable association with their gender-wise distribution as $p > 0.01$.

VI. Findings of the Study

- *Satisfaction Among Male and Female Participants with Library Facilities:* Findings reveal library location ($A\overline{X}$ = .2.89), arise as the most satisfied facility among both the groups (male/female), followed by computers facility (A $\overline{X}$ = .2.81). While as cleanliness ($A\overline{X}$ = .2.50) and ICT infrastructure ($A\overline{X}$ = .2.42) appear as the least satisfied facilities among the male/female respondents within selected departmental libraries.
- *Satisfaction Among Male and Female Participants with the Collection:* Moreover, male as well as female respondents show satisfaction ($A\overline{X}$ = .2.93) with dictionaries, followed by books ($A\overline{X}$ = .2.85) and newspaper ($A\overline{X}$ = .2.75). On the other hand, encyclopedia ($A\overline{X}$ = 1.61) and directories ($A\overline{X}$ = .1.62) are identified as the least satisfied forms of information sources in the surveyed libraries.
- *Satisfaction Among Male and Female Participants with Library Services*: Findings display male participants ($\overline{X}$ = 2.93) are satisfied with circulation service in libraries. In this regard, low response found towards internet service ($\overline{X}$ = 2.52). On the other hand, female participants ($\overline{X}$ = 2.79) are highly satisfied with reference service and least response ($\overline{X}$ = 2.63) retrieved towards cataloguing service. Findings show that small fraction of respondents (33.1%) from different departments are satisfied with the development of libraries.
- *Gender-Wise Results Regarding the Overall Development of Libraries:* Results of the study indicate among the satisfied respondents (66.1%) male participants (34.4%) are having higher satisfaction level with the progress of libraries as compared to the female counterparts (31.7%).
- *Problems Faced by Male and Female Participants:* 62.4% male participants and 57.6% female counterparts illustrate lack of latest books as the main problem they face in libraries, followed by 46% of male participants and 41.9% females specify insufficient help from library staff among the problems they confront.
- *Problems Encountered while Obtaining Information from Web:* Results demonstrates that majority of male (62.7%) and female participants (54.1%) are considering obsolete information as the major problem while attaining information from web, followed by retrieval problems. While as, identical response in male (20%) and in female respondents (19%) is obtained towards poorly designed website for acting as the problem.

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Journal of Applied Information Science
11 (2) 2023, 08-12
http://www.publishingindia.com/jais

Current State of Artificial Intelligence in Caries Detection: A Literature Review

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Abstract: This review article investigates the application of artificial intelligence (AI) in dentistry, explicitly focusing on caries detection. After appropriate filtering, ten relevant studies were carefully examined from PubMed and IEEE Xplore. Bitewing radiographs emerged as the most frequently utilized imaging modality, followed by near infrared transillumination, periapical, intraoral, and radiovisiography images. Different neural networks were employed in these studies to detect the desired variables, and the quality and type of input data substantially impacted the outcomes. The article emphasizes the need for further research, particularly in exploring larger datasets and different image types to enhance the implementation of neural networks in caries detection. While the potential of AI in dentistry for caries detection is promising, continuous research and refinement of methods are vital to harness its capabilities thoroughly. Therefore, ongoing investigations are crucial to advancing dental practice through the effective utilization of AI. The article highlights the necessity for continued exploration and improvement in this evolving field.

Keywords: Artificial intelligence, Caries detection, Neural networks.

I. Introduction

Artificial intelligence (AI) in healthcare has gained significant attention in recent years due to its potential to improve patient outcomes, optimize clinical workflows, and reduce healthcare costs [1]. Medical imaging technologies like X-ray, MRI, and CT scans have been instrumental in detecting, diagnosing, and treating various diseases, including cancer and cardiovascular disease. In dentistry, the emerging field of dental informatics shows great promise in improving treatment and diagnosis, saving time, and reducing stress and fatigue during daily practice [2, 3]. Dental professionals generate vast amounts of data from high-resolution medical imaging, biosensors, and electronic medical records. Computer programs can assist dental professionals in making prevention, diagnosis, and treatment planning decisions [1, 4].

Convolutional neural networks (CNNs) have been used in dentistry to detect periodontal bone loss, caries on bitewing radiographs, apical lesions, and medical image classification. These neural networks can detect, classify, and segment structures such as teeth and caries. However, they require training and optimization using an image database [5].

Dental radiography is a fundamental tool in modern dentistry for the detection, diagnosis, and treatment planning of various dental diseases. There are three main types of dental radiographs commonly used in dentistry: panoramic, periapical, and bitewing radiographs [6].

Panoramic radiographs provide a comprehensive view of the entire oral and maxillofacial region. They are suitable for screening purposes and can aid in detecting various dental conditions, including impacted teeth, tumors, and jaw fractures. Additionally, panoramic radiographs help evaluate the position of the mandibular nerve and the temporomandibular joint (TMJ) [7]. However, they have limited diagnostic accuracy and cannot provide detailed information on individual teeth or the surrounding bone. See Fig. 1.

Periapical radiographs provide detailed information on a single tooth and the surrounding bone. They diagnose various dental conditions, including caries, periodontal bone loss, and apical lesions. Additionally, periapical radiographs are used for endodontic treatment planning and can aid in assessing root canal morphology and detecting root fractures. However, periapical radiographs have a limited field of view and require multiple exposures to capture the entire dentition [8]. See Fig. 2.

Bitewing radiographs detect caries on the occlusal and proximal surfaces of posterior teeth. They provide a more detailed view of the tooth than panoramic radiographs and are more sensitive than clinical examination alone. Additionally, bitewing radiographs help monitor caries's progression and evaluate the quality of dental restorations. However, bitewing radiographs have a limited field of view and do not provide information on the surrounding bone or soft tissue. See Fig. 3.

The choice of radiographic technique depends on the specific dental condition being evaluated and the information required

for diagnosis and treatment planning. Dental professionals should carefully consider the benefits and limitations of each radiographic technique to ensure accurate diagnosis and optimal patient care.

This literature review provides an overview of the current state of artificial intelligence applications in dentistry, focusing on caries detection.

II. Materials and Methods

A search was conducted on April 10, 2023, using electronic databases such as MEDLINE/PubMed and the Institute of Electrical and Electronics Engineers (IEEE) Xplore. MEDLINE/PubMed was the primary database for medical journal manuscripts. IEEE Xplore publishes computer science, electrical engineering, and electronics articles. Among others, Table I shows the strategy that was used. The eligible studies for this review were full manuscripts and conference proceedings that reported using neural networks to detect teeth and caries. No limitations were set on the language or the date of publication. The exclusion criteria were reviews, studies without dental applications, and studies that did not employ neural networks.

III. Results

A. Relevant Data of Included Studies

The selected manuscripts included in this review were published from 2013 to 2023. Table II provides an overview of the critical characteristics of these caries studies. As shown in Table I, the number of published studies increased yearly. The selected studies were conducted in seven countries, with the highest studies conducted in the United States (n = 2), England (n = 2), and Switzerland (n = 2).

B. Caries Detection

In Sarah [9] this study utilized a fully convolutional neural network to detect proximal caries, which was then compared to the traditional method of using dentists. A cluster-randomized cross-over controlled trial was conducted using AI and traditional methods, involving 22 dentists who were asked to detect caries in a pool of 140 bitewings. The results indicated that dentists using AI had a significantly higher mean area under the Receiver-Operating Characteristics curve (0.89; 95% CI: 0.87-0.90) than traditional methods.

Lee [10] used 3000 periapical radiographs to detect dental caries. The dataset comprised 25.9% maxillary premolars, 25.6% maxillary molars, 24.1% mandibular premolars, and 24.4% mandibular molars. The authors used a deep CNN algorithm with weight factors and preprocessed the datasets using a pre-trained Google Net Inception v3 CNN network with transfer learning. The study obtained an accuracy of 89%, 88%, and 82% in premolar, molar, and premolar-molar, respectively, and AUC values of 0.917, 0.89, and 0.845 for premolar, molar, and premolar-molar, respectively.

Table I: Search Strategy

Database	Search Strategy	Search Data
MEDLINE/ PubMed	(Deep learning OR artificial intelligence OR neural network *) AND (dentistry OR dental)	April 10, 2023
IEEE Xplore	(“Full Text Only”: artificial intelligence) OR (“Full Text Only”: neural network)	April 10, 2023

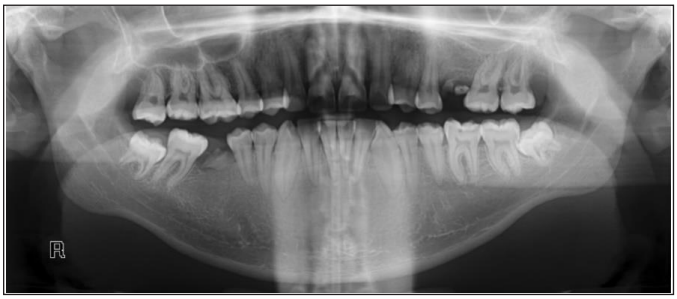

Fig. 1: Panorama X-Ray

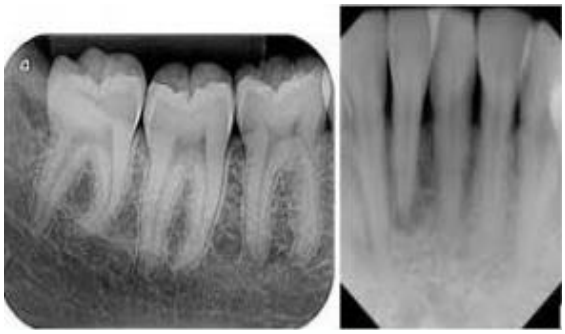

Fig. 2: Periapical X-Ray

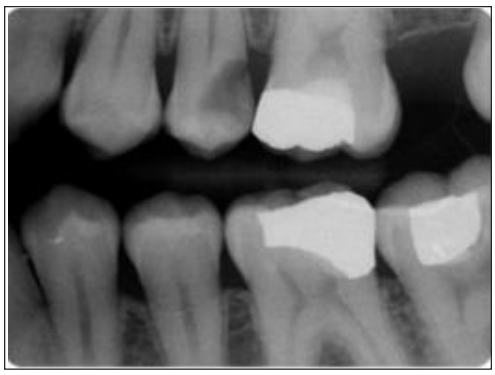

Fig. 3: Bitewing X-Ray

This paper presents a novel approach that integrates image processing techniques with convolutional neural networks to detect proximal dental caries in bitewing radiographic images and classify them based on lesion severity. The algorithm was evaluated using 112 images, and after conducting 2000 iterations, the model's accuracy was found to be 73.3% [11].

Zanella-Calzada [12] analyzed caries concerning socioeconomic and dietary factors using an ANN to determine oral health. The study employed an ANN with seven layers, four dense layers, and three dropout layers. Nine thousand eight hundred twelve subjects were used, with 70% used for training and 30% for testing. The study achieved an accuracy of approximately 0.69 and an AUC of 0.75.

Prajapati [13] employed a convolutional neural network to detect caries in 251 radiovisiography images, achieving an accuracy of 0.875.

In this study [14] convolutional neural networks were utilized to detect proximal caries at various levels of severity on periapical radiographs. The study included approximately 800 periapical radiographs that were randomly distributed. Additionally, different training strategies were employed, such as image recognition (IR), edge extraction (EE), and image segmentation (IS). The achieved area under the curve (AUC) values were 0.805, 0.860, and 0.549 for IR, EE, and IS, respectively.

Geetha study [15] used a back-propagation neural network with a database of 105 intra-oral images to detect caries, achieving an accuracy of 0.971 and a precision-recall curve (PRC) area of 0.987.

The Casalengo study [16] used a deep-learning model to detect and locate dental lesions in near-infrared transillumination images of molars and premolars. The study used 217 images, with 185 for training and 32 for validation. The results showed an area under the curve (AUC) of 85.6% for proximal lesions and 83.6% for occlusal lesions.

Srivasta [17] used a deep, fully convolutional neural network to detect dental caries in 3000 bitewings images. The study obtained a recall of 0.805, a precision of 0.615, and an F1-score of 0.7.

Table II: Caries Detection Main Characteristics

Authors	Journal	Country, Year	Image	Total Image	Neural Network	Outcome
Sarah	Journal of Dentistry	Germany, 2021	Bitewings	140	CNN	AUC
Lee	Journal of Dentistry	England, 2018	Periapical	3000	CNN	Accuracy/ AUC
Maira	MDPI stays neutral	Brazil, 2022	Bitewing	112	CNN	Accuracy
Zanella-Calzada	Bioengineering	Switzerland, 2018		9812	ANN	Accuracy/ AUC
Prajapati	5th International Symposium on Computational and Business Intelligence	United Arab Emirates, 2017	Radiovisiography image	251	CNN	Accuracy
Xiujiao	MDPI stays neutral	China, 2022	Periapical	800	CNN	AUC
Geetha	Health Information Science and Systems	Switzerland, 2020	Intraoral radiographs	105	Back-propagation neural network	Accuracy/ Precision recall
Casalengo	Journal of Dental Research	USA, 2019	Near-infrared transillumination	217	CNNs for semantic segmentation	AUC
Srivastava	NIPS 2017 workshop on Machine Learning for Health (NIPS 2017 ML4H)	USA, 2017	Bitewing	3000	deep fully convolutional neural network	Recall/Precision/F1-Score
Schwendicke	Journal of Dentistry	England, 2019	Near-infrared light transillumination	226	Resnet18 Resnext50	AUC/Sensitivity/Specificity

IV. Discussion

The purpose of this review was to present an overview of the current state of artificial intelligence in detecting various dental conditions including caries. Neural networks can consist of one or multiple layers, with interconnected nodes or neurons facilitating signal transmission within the network. These networks generally have three layers of neurons: input (receives information), hidden (extracts patterns and performs internal processing), and output (presents final network output). The training process entails the optimization of parameters, and this framework is being utilized not only for teeth detection but also across diverse industries to facilitate progressively intricate decisions. Numerous alternatives exist in this regard. Nonetheless, our outcomes might require rephrasing to ensure clarity. For example, despite our findings, a dearth of guidance persists regarding the choice of suitable methods customized for the healthcare sector [7]. Neural networks have been proven beneficial in medicine and dentistry due to their capacity to handle vast amounts of data for analysis, diagnosis, and disease monitoring. Deep learning has become an increasingly valuable tool in the medical field and is starting to impact dentistry. Based on the publication year of the studies examined in this review, 2019 saw the highest number of articles published in this area [4].

The studies mentioned above highlight the effectiveness of deep learning models and image processing techniques in detecting dental caries from various radiographic images. In Sarah's study [9] a controlled trial was conducted involving 22 dentists who examined 140 bitewing radiographs. The AI-assisted dentists achieved a significantly higher mean AUC (0.89) than traditional methods. Lee [10] used a dataset of 3000 periapical radiographs and employed a deep CNN algorithm with transfer learning. Their approach achieved accuracies ranging from 82% to 89% for different tooth types and AUC values of 0.845 to 0.917. This study [11] proposed an algorithm combining image processing techniques with convolutional neural networks for proximal caries detection on bitewing radiographs. The model achieved an accuracy of 73.3% after evaluating 112 images.

Using an ANN, Zanella-Calzada [12] investigated the relationship between caries and socioeconomic and dietary factors. Their study achieved an accuracy of approximately 0.69 and an AUC of 0.75 with a dataset of 9812 subjects. Prajapati [13] used a convolutional neural network to detect caries in 251 radiovisiography images, obtaining an accuracy of 0.875. The study [14] employed convolutional neural networks for proximal caries detection on periapical radiographs. Their model achieved AUC values ranging from 0.549 to 0.860 using training strategies on approximately 800 radiographs.

In Geetha's study [15] a back-propagation neural network was utilized and a dataset of 105 intra-oral images. The model achieved an accuracy of 0.971 and a PRC area of 0.987. Casalengo [16] focused on near-infrared transillumination images of molars and premolars. Their deep learning model achieved AUC values of 85.6% for proximal lesions and 83.6% for occlusal lesions using a dataset of 217 images. Srivasta [17] utilized a deep, fully convolutional neural network for caries detection in 3000 bitewing images, achieving recall, precision, and F1-score values of 0.805, 0.615, and 0.7, respectively.

In conclusion, the studies demonstrate that deep learning models can enhance the accuracy of caries detection in radiographic images and could be complementary to traditional methods in dental diagnosis. Further research and validation studies are needed to optimize these models' performance and clinical application.

V. Conclusions

In conclusion, dental radiography is an essential diagnostic tool in dentistry, and the application of artificial intelligence in this field is promising. The studies discussed in this review demonstrated the potential of deep learning algorithms in accurately and efficiently detecting dental caries, with some achieving results comparable or even superior to those of human dentists. These AI models can potentially improve the accuracy and speed of diagnoses, leading to earlier detection and treatment of dental caries, ultimately resulting in better patient outcomes. However, more studies are needed to assess the reliability and generalizability of these algorithms before they can be implemented in routine clinical practice. Overall, the future of dental radiography looks promising with the integration of AI, and we can expect continued advancements in this field.

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Journal of Applied Information Science
11 (2) 2023, 13-20
http://www.publishingindia.com/jais

Agent and Multi-Agent System through Artificial Intelligence with Distributed Environment

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Abstract: Agent is an autonomous entity and has the ability to act on behalf of others, can understand the changes in the environment and react according to environment with the help of features like mobility, learning ability etc. An agent can be a person, a machine, a piece of software. Agents are autonomous, flexible and active according to the environment. We can say that Agents are acute and suitable for pro-active and social behavior. In this paper discuss about agents, starts from definitions, types of agent, architecture of agent and mobile agent with distributed environment. For developing latest pattern software application we can use software agents. So agent-based computing is best for software development and new revolution in software.

Keywords: Agents, Artificial intelligence, Distributed environment, Information security, Security agents.

I. Introduction

Artificial Intelligence (AI) and agent systems are very closely related to each other [1]. AI is based on the mechanism of intelligence e.g., the ability to learn, plan but Agents are based on integrating these same mechanism. This difference will be seen to all the problems that are associated with agents.

II. Agents Classification

The main classes of agents are defined as follows:

- Reactive agents
- Goal-based agents
- Utility-based agents
- Interface agents
- Mobile agents
- Information-gathering agents
- Multi-agents
- Collaborative agent systems

Some agents are hybrids, which exhibit properties of more than one of the categories listed above [2]. The eventual aim of most intelligent agent research is to develop smart agents, which would be fully autonomous and able to learn and cooperate with other agents.

A. Reactive Agents

Reactive agent (Reflex agent) is a production system where inputs from the environment are compared with rules to determine which actions to carry out. They work on the basis of defined rules [3]. An example of a reactive agent is the automatic mail filter that many e-mail systems now possess. This mail filter examines each e- mail as it arrives and compares it against a set of rules, or templates, and classifies it accordingly. A common use for such systems is to reject so-called “junk mail” or “spam” [4]. A reactive agent does not tend to perform well when its environment changes or when something happens that it has not been told about. Example, an e-mail–filtering system might have problems when it receives an e-mail that is entirely in Chinese. This type of situation can be handled by written new rules but agents can deal with such type of situations.

B. Goal-Based Agents

These are very complicated as compared to reactive agents. This type of agents following a predetermined set of rules, a goal-based agent acts to try to achieve a goal. This can do with searching Technology and through planning. For example, be given the goal of finding pages on the Internet that are of interest to an Artificial Intelligence researcher. This can do with the searching technique and through planning.

C. Utility-Based Agents

These worked as goal-based agents, but they used to increase their utility value with achieving goal. This value can be used as the happiness of the agent or how successful it is being. It may also take into account how much work the agent needs to do to achieve its goals. Let us go to our example from the previous section of an agent that searches for pages on the Internet that are of interest to Artificial Intelligence researchers [5]. The utility-based agent can use knowledge about the Internet to follow the most worthwhile paths from one page to another. This can be done by using heuristic-based search techniques to minimize the time.

D. Interface Agents

An interface agent can be thought of as a personal assistant. These are independent agents; carry out tasks on behalf of a human user. Interface agents collaborate with the user, but do not need to collaborate with other agents although in some cases, interface agents can learn by seeking advice from other agent [6]. For example for using new software package used for help as manual guide. Such an agent has the ability to observe what the user does and make suggestions for better ways to perform those tasks [7]. It is also able to assist the user in carrying out complex tasks, possibly learning as it does so.

E. Mobile Agents

These types of agents are able of moving from one place to another. In the case of mobile robots, this literally means moving in physical space. In the case of mobile software agents, this mobility usually refers to the Internet or other network [8]. An agent that is not mobile is static. Mobile agents travel from one computer to another, gathering information and performing actions as needed on the basis of that information [9]. A computer virus can be thought of as a form of mobile agent, although most viruses are not intelligent, merely autonomous. Without intervention of human these types of agents can work or they work independently [10]. They follow a fixed set of rules that tells them how to infect a computer and how to reproduce. The main advantages of mobile agents are in efficiency [11].

Using a large amount of bandwidth, which can be avoided if the agent is able to physically move to the remote server and query it locally.

F. Information-Gathering Agents

The Information agents known as the information-gathering agents, are usually used on the Internet so these are also sometimes called the Internet agents [12]. An information agent is used to help a user find, filter, and classify information from the vast array of the sources available on the Internet. Information agents may be static or mobile. Some information agents are capable of learning, whereas the behavior of others is fixed. Additionally, information agents can be collaborative or can work independently of other agents [13]. The distinctive feature of an information agent is the function that it provides, rather than the way it works.

G. Multi-Agents

These systems are composed of multi-agents that interact with each other to achieve a common goal. These systems worked on artificial intelligence, economics and sociology.

H. Collaborative Agent Systems

These types of agent systems are Multi-agent systems in which the agents collaborate with each other to achieve goals. This property, of cooperating to achieve a common goal, is known as benevolence [14]. Collaborative agents typically do not have the ability to learn, although some have simple learning abilities [15]. As with multi-agent systems, the idea is that a combination of many simple agents can solve a problem that each agent individually would not be able to solve.

III. Agent Architecture

Agent architecture is the basic study of independent components that carries effective behavior. These range from purely reactive or behavioral architectures that operate in a simple stimulus – response fashion, such as those based on the subsumption architecture, at one extreme, (BDI) model, at the other extreme to more deliberative architectures. In between the two lie hybrid combinations of both, or layered architectures, which attempt to involve both reaction and deliberation in an effort to adopt the best of each approach [16]. So agent architectures can be divided into four main groups: logic based, reactive, BDI and layered architectures [17]. Logic-based (symbolic) architectures draw their foundation from traditional knowledge-based systems techniques in which an environment is symbolically represented and manipulated using reasoning mechanisms. The advantage of this approach is that human knowledge is symbolic so encoding is easier, and they can be constructed to be computationally complete, which makes it easier for humans to understand the logic. The disadvantages are that it is difficult to translate the real world into an accurate, adequate symbolic description, and that symbolic representation and manipulation can take considerable time to execute with results are often available too late to be useful.

A. Reactive Architectures

Implement decision-making as a direct mapping of situation to action and are based on a stimulus – response mechanism triggered by sensor data. Unlike logic-based architectures, they do not have any central symbolic model and therefore do not utilize any complex symbolic reasoning [18]. The key ideas realized this architecture are that an intelligent behavior can be generated without explicit representations and abstract reasoning provided by symbolic artificial intelligence techniques and that intelligence is an emergent property of certain complex systems. Subsumption-designed agents perceive conditions and act, but do not plan. The advantage of this approach is that it will perform better in dynamic environments as well as that they are often simpler in design than logic-based agents. Fig. 1 shows subsumtion architecture for robot navigation.

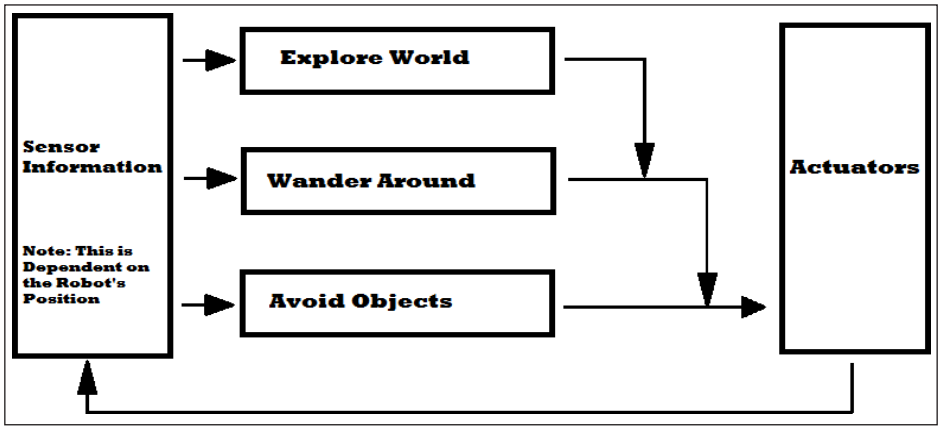

Fig. 1: Subsumption Architecture for Robot Navigation

B. BDI (Belief, Desire, Intention) Architectures

BDI **a**re probably the most popular agent architectures [19]. They have their roots in philosophy and offer a logical theory which defines the mental attitudes of belief, desire and intention using a modal logic. One of the most well-known BDI architectures is the Procedural Reasoning System (PRS). Fig. 2 defines the PRS agent architecture. This architecture is based on four key data structures: beliefs, desires, intentions and plans, and an interpreter.

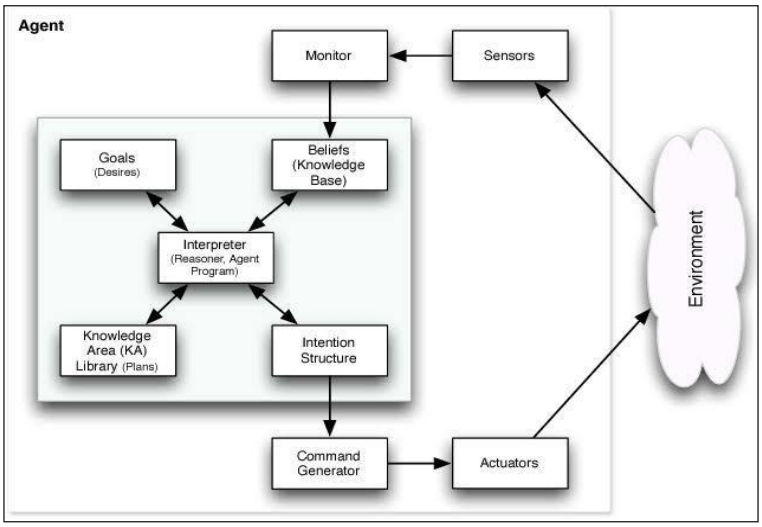

Fig. 2: The PRS Agent Architecture

In the PRS system, beliefs represent the information an agent has about its environment, which may be incomplete or incorrect. Desires represent the tasks allocated to the agent and so correspond to the objectives, or goals, it should accomplish. Intentions represent desires that the agent has committed to achieving [20]. Finally, plans specify some courses of action that may be followed by an agent in order to achieve its intentions. These four data structures are managed by the agent interpreter which is responsible for updating beliefs from observations made of the environment, generating new desires (tasks) on the basis of new beliefs, and selecting from the set of currently active desires some subset to act as intentions [21]. Finally, the interpreter must select an action to perform on the basis of the agent's current intentions and procedural knowledge.

C. Layered (Hybrid) Architectures

Allow both reactive and deliberative agent behavior. To enable this flexibility, subsystems arranged as the layers of a hierarchy are utilized to accommodate both types of agent behavior. There are two types of control flows within a layered architecture: horizontal and vertical layering. In horizontal layering, the layers are directly connected to the sensory input and action output which essentially has each layer acting like an agent. The main advantage of this is the simplicity of design since if the agent needs n different types of behaviors, then the architecture only requires n layers. However, since each layer is in effect an agent, their actions could be inconsistent prompting the need for a mediator function to control the actions.

The vertical layer architecture eliminates some of these issues as the sensory input and action output are each dealt with by atmost one layer each (creating no inconsistent action suggestions). The vertical layered architecture can be subdivided into one-pass and two-pass control architectures [22]. In one-pass architectures, control flow from the initial layer that gets data from sensors to the final layer that generates action output. In two pass architectures, data flow up the sequence of layers and control then flow back down. The main advantage of vertical layered architecture is the interaction between layers is reduced significantly to m 2(n-1). The main disadvantage is that the architecture depends on all layers and is not fault tolerant, so if one layer fails, the entire system fails.

IV. Mobile Agents

Can be also defined as computational software those are capable of roaming different WANs. While on tour, a mobile agent interacts with foreign hosts and gathers information on behalf of its owner who has initiated it. After performing its duties set by the owner, the mobile agent comes back to the originating source/owner [23]. In mobile computing environment, users can access information independent of their location. But accessing this information should not restrict mobility of users. From data management point of view, mobile users can handle only fraction of data since mobile devices are having limited resources. The development of low cost and yet portable mobile devices have enabled mobile users to work from anywhere, at anytime. Distributed Environment itself is a term which covers all types of environments where distribution is done over any of the functional or non functional parts are distributed or over the whole system [24]. It may be distributed systems, client/server system, distributed database management system, distributed computing, remote execution etc. In my work the term “Distributed Environment” is used as I have stressed on the distributed database system which is non-homogeneous (i.e. heterogeneous). There are different significant benefits of using mobile agent in applications those are generally works in distributed environment. It is not so that the applications which are built using the mobile agent concept cannot build without mobile agent (using static agent). But the use of static agent will make the cost on higher side.

A. Mobile Code Paradigms

There are four basic types of Mobile Code Paradigms.

- Client/Server
- Code on Demand
- Remote Evaluation
- Mobile Agents

In case of all the systems mentioned above, the basic elements are:

Data: This basically contains the result-set fetched by the system while in execution.

Code: Code is the section with which different modules necessary for the functionality of the system.

Program Stack: It contains the current status of the program.

(i) Client/Server Paradigm

It is the most widely used paradigm. Here, in this paradigm the services are offered by a server and the service is consumed by one or more, generally remote clients.

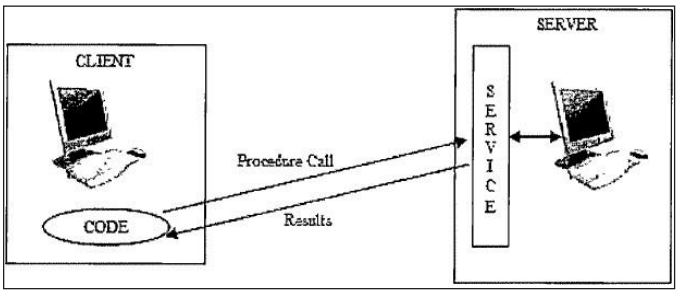

Fig. 3: Client/Server Paradigm

The Fig. 3 depicts the client/server paradigm. Here in the figure, in the client side, the “CODE” form which a procedure in the server is called and the server executes the procedure and returns the results back to the client. Few examples are RPC, Web-Services, CORBA, EJBs etc. [25]. Here, in client/server system, the data element is mobile and both the code and the program stack element are static. The systems, which follow the Mobile Agent and distributed environment [9, 11]. Client/server paradigm, are easy to implement and hence this paradigm is very popular and wide-spreading.

(ii) Code on Demand Paradigm

In this paradigm, the server has different procedures for service to the client and client will get the service from the server. But the service, the client wants, is transferred to the client from the server. When the code for the particular processing is received

by the client, the code is executed to perform the task for the client. Fig. 4 represents the Code on Demand paradigm. Here, in the figure, the "Code-1" is responsible for the request, from the client, for "Code-2" in the server. The server, on receiving the request, transfers the "Code-2" to the client. Client, on receiving the "Code-2", it executes the code to carry out the task. Fig. 4 depiticts the code on demand paradigm. In this paradigm, the data element and the program stack is static but the code element is mobile. Centralized code base and simplicity in updating the software are main advantages of such type of systems.

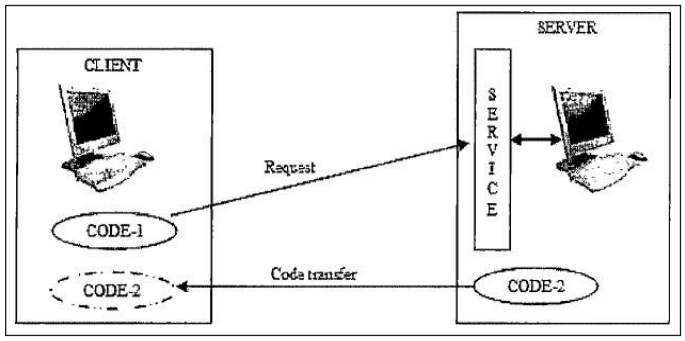

Fig. 4: Code on Demand Paradigm

(iii) Remote Evaluation Paradigm

In this paradigm, the client has the code for execution but transfers the code to the server and the server executes the code and returns the results to the client.

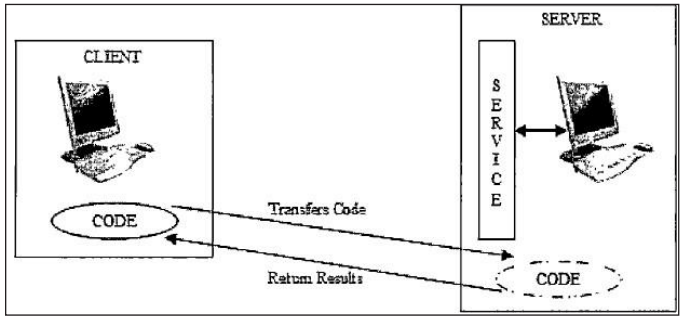

Fig. 5: Remote Evaluation Paradigm

The Fig. 5 represents the Remote Evaluation paradigm'. Here in this paradigm, the "Code" (in the client side), that is to be executed, is transferred to the server and the server, on receiving the "Code" executes it and sends the results back to the client. In this paradigm, the data element and the program stack is static but the code element is mobile.

(iv) Mobile Agent Paradigm

The Mobile Agent paradigm actually derives from two different disciplines and they are Artificial Intelligence and Distributed Systems. The artificial intelligence helped in creation the concept of an agent and the distributed system defines the concept of code mobility across a network. According to standard definitions, mobile agents have everything that a non-mobile agent has; agents are autonomous, reactive, proactive and social. In addition to these mobile agents are also movable, i.e. they can migrate between platforms in order to accomplish the assigned task. In this paradigm, the case lies in remote execution of component. The component sends itself or another on-behalf of itself, to a remote host. The component moves with its code and data. In case of state of the state it may remain intact or modified depending upon the implementation. Unlike the case with remote execution, the component (i.e. mobile agent) will be deciding for itself that whether it wishes to move to an alternate location or not. There are number of advantages of mobile agents over their static counterpart. Thus mobile agents include some of the benefits like reduction in communication costs, limited local resources, easier coordination, asynchronous computing etc. Mobile agents, sometimes called mobile objects, constitutes of Code (behavior), Data, Execution State and Itinerary. These elements are bundled together and are able to move as single unit. In case of stationary objects, which only consist of Code (behavior) and Data. In case of both, the behavior is represented by interfaces but in case of stationary objects as they do not move, the Code and Data can be platform dependent. Mobile agents, on the other hand, can move and therefore, their code, data, execution state and itinerary must all be portable, or at least convertible from and into portable forms.

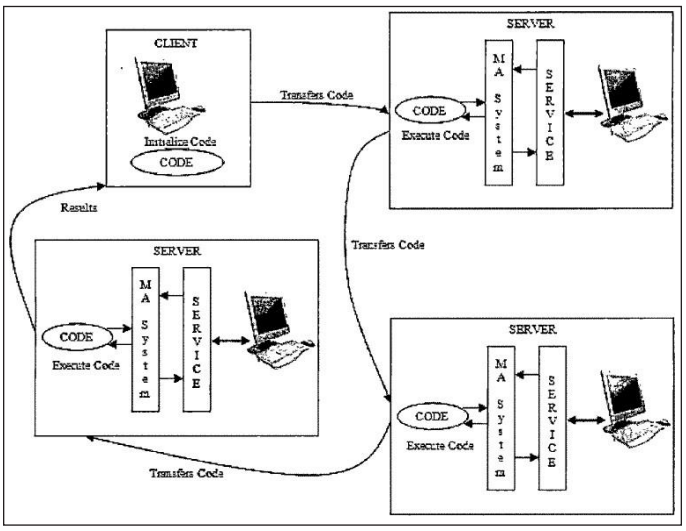

Fig. 6: Mobile Agent Paradigm

Fig. 6 represents the concept of mobile agent paradigm. In the figure, the code in the client in initialized and after initialization the code is transferred to a server. When the mobile code receives the server the Mobile Agent System executes the code. After executing the code, the server then sends the code to another server for execution. And thus after reaching the last server the code is again executed and the overall result of all the executions is sent back to the client.

V. Distributed Environment

A distributed database is logically a single database but actually it spreads in different computers in a network. In case of distributed database there must be multiple DBMSs running at each computer and there exist co-operation between them.

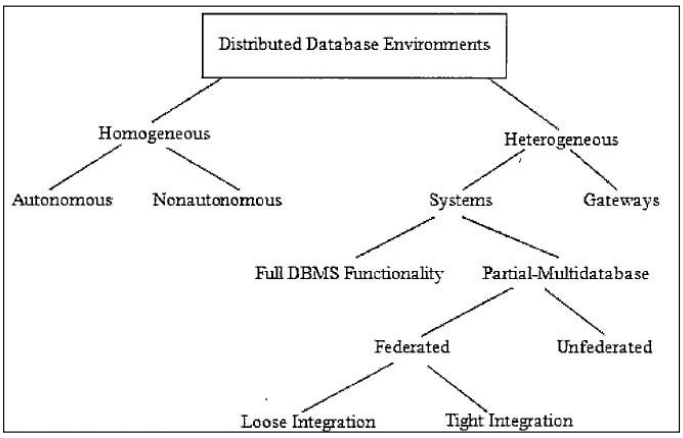

Fig. 7: Distributed Environment

The Fig. 7 represents the range of distributed database environments.

A. Homogeneous Distributed Database

This environment architecture is very simple and therefore it is much easy to design and manage. In this environment all sites/node must have the same DBMS. Also all the sites should agree to cooperate in processing user requests. This type can be divided into two categories:

- *Autonomous:* In autonomous kind, each DBMS at each node/site works independently. They pass messages back and forth to share data updates.
- *Non Autonomous:* In non autonomous kind, there must be a central or master DBMS, who coordinates database access and update across the nodes/sites. But in general, each site/node has to surrender some part of its autonomy in case of right change the schema or these software.

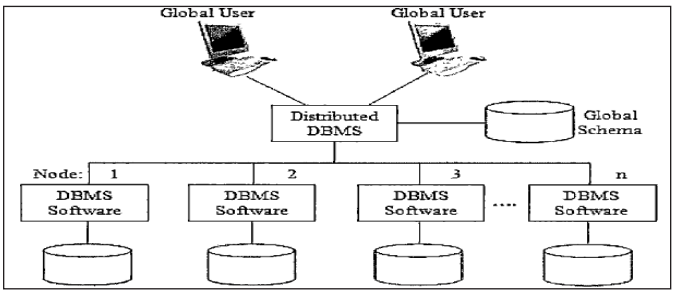

Fig. 8: Non-Autonomous Homogeneous Distributed Database Environment

The Fig. 8 depicts a non-autonomous homogeneous distributed database environment. There are few characteristics those define this kind of environment and they are as follows:

- Data can be distributed across all the nodes.
- At each node/site same DBMS is used.
- The distributed DBMS manages all data.

All users access the database through one global schema (database definition). This global schema is just the union of all the local database schemes.

B. Heterogeneous Distributed Database

In this kind of distributed database environment, the sites/nodes are not bound to use the same schema and software. Since there are differences in schemas at the sites/nodes, therefore problem arises in the processing of queries and transactions. Also, the sites may not be aware of each other. Heterogeneous systems are useful when each of the sites/nodes may have their own hardware, software and data structure which may not be compatible. In heterogeneous system, translations are required to allow communication between different sites/nodes. Systems Supports some or all of the functionality of one logical database. Full DBMS Functionality supports all of the functionality of a distributed database; Partial-Multi database supports some features of a distributed database. Federated Supports local databases for unique data requests. Loose Integration Many schemas exist, for each local database, and each local DBMS must communicate with all local schemas. Tight Integration One global schema exists that defines all the data across all local databases. Unfed rated requires all access to go through a central coordinating module.

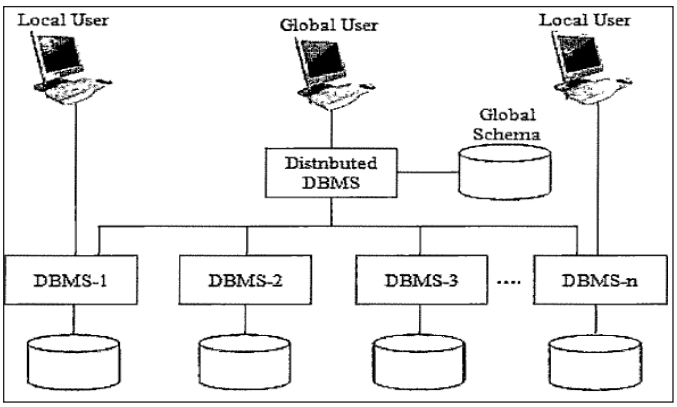

Fig. 9: Non-Autonomous Heterogeneous Distributed Database Environment

The Fig. 9 represents a heterogeneous environment which can be defined by the following characteristics:

- Gateways: Gateways are simple paths created to other databases.

- Data are distributed across all the nodes. Different DBMSs may be used at each node. Some users require only local access to databases, which can be accomplished by using only the local DBMS and schema. A global schema exists, which allows local users to access remote data [9]. The adoption of a particular Distributed Database Environment for the design development of a system is basically depends on the conditions/flexibilities demanded by the system to be developed.

VI. Conclusion

So we conclude that the agents focused on the part of many sub-fields of computer science and artificial intelligence. Agents are being used in a more and more wide variety of applications, ranging from comparatively small systems such as email Filters to large, open, complex, mission critical systems such as air traffic control.

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Journal of Applied Information Science
11 (2) 2023, 21-28
http://www.publishingindia.com/jais

A Study on Latest Developments in Artificial Intelligence (AI) and Internet of Things (IoT) in Current Context

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Abstract: The latest developments in Artificial Intelligence (AI) and the Internet of Things (IoT) have transformed the current context of technology and society. AI and IoT are now indispensable components of modern businesses, industries, and daily life. In AI, breakthroughs have been achieved in natural language processing (NLP), computer vision, and machine learning algorithms. Cutting-edge NLP models, such as GPT-3, have demonstrated remarkable language understanding capabilities, enabling more sophisticated chatbots, virtual assistants, and automated content generation. Computer vision advancements have led to improved object recognition, image synthesis, and video analysis, enabling applications in areas like autonomous vehicles, surveillance, and medical imaging. The convergence of AI and IoT has been a game-changer in various industries. IoT devices equipped with AI capabilities enhance data analysis and decision-making processes. AI-powered IoT solutions have revolutionized healthcare by enabling remote patient monitoring, predictive maintenance in industrial settings, and smart home automation for consumers. This amalgamation has opened up possibilities for real-time data-driven insights and autonomous systems. Challenges related to AI and IoT persist, including data privacy concerns, cybersecurity risks, and ethical considerations. As the deployment of AI and IoT continues to expand, addressing these issues becomes crucial to ensure the responsible and ethical use of these technologies. In conclusion, the latest developments in AI and IoT have significantly impacted the current context of technology and society. They have unlocked unprecedented opportunities for innovation, automation, and data-driven decision-making. However, careful consideration of ethical implications and proactive measures to address security concerns are essential to fully harness the potential of these transformative technologies in a sustainable and inclusive manner.

Keywords: Artificial intelligence, Automation, Data-driven decision-making, Internet of things, Sophisticated chatbots, Transformative technologies, Virtual assistants.

I. Introduction

In the fast-paced and technologically-driven world of today, Artificial Intelligence (AI) and the Internet of Things (IoT) stand at the forefront of innovation, driving transformative changes across various industries and aspects of daily life. These cutting-edge technologies have witnessed exponential growth and adoption, fundamentally altering the current context of technology and society. AI, the simulation of human intelligence in machines, has experienced remarkable advancements in recent years. Its applications have expanded from simple tasks to complex problem-solving and decision-making processes. Concurrently, the IoT, a network of interconnected devices capable of collecting and exchanging data, has revolutionized the way we interact with our surroundings. Together, AI and IoT have become symbiotic, leveraging each other's strengths to create a powerful force driving unprecedented progress. This study delves into the latest developments in AI and IoT in the current context, exploring their individual advancements and the synergies arising from their integration. It aims to shed light on how these technologies are shaping industries, economies, and daily life, and the challenges and opportunities they present [1]. With AI's breakthroughs in natural language processing, computer vision, and machine learning, machines can now understand and interact with humans in more intuitive and human-like ways. NLP models, such as GPT-3, have brought about new possibilities in virtual assistants, language translation, and content generation. Meanwhile, computer vision advancements have enabled intelligent image and video analysis, leading to applications in areas like autonomous vehicles, healthcare diagnostics, and augmented reality. The convergence of AI and IoT has further intensified the potential of both technologies. AI-powered IoT

devices can process and analyze vast amounts of data collected from sensors and devices in real-time, leading to data-driven insights and predictive capabilities. This has led to significant improvements in healthcare, supply chain management, industrial automation, and smart cities, among other areas. However, the rapid integration and deployment of AI and IoT have not been without challenges. Ethical considerations, data privacy concerns, and cybersecurity risks have emerged as significant issues that demand attention and mitigation. As AI and IoT become more pervasive, understanding and addressing these challenges are crucial to ensuring responsible and secure use of these technologies [2]. Throughout this study, we will explore the latest developments in AI and IoT, their impact on various sectors, and the potential implications for society. By understanding the current context and the potential future trajectories of these technologies, we can better grasp their transformative power and responsibly harness their benefits for a better and more sustainable future.

II. Review of Literature

- "Artificial Intelligence and the Internet of Things: A Comprehensive Survey" by Mehdi Mohammadi and colleagues (2020) - This survey paper provides an extensive overview of the latest developments in AI and IoT and explores their integration and applications across various domains. It discusses AI techniques used in IoT data analytics, predictive maintenance, and anomaly detection. The paper also addresses the challenges related to data privacy, security, and interoperability in AIoT systems [3].
- "Recent Advances in Deep Learning for IoT Big Data: A Survey and Taxonomy" by Chaomin Luo and colleagues (2019) - Focusing on the intersection of AI and IoT, this paper presents a comprehensive survey of deep learning techniques applied to IoT big data analysis. It highlights recent advancements in deep learning architectures for tasks such as time series prediction, anomaly detection, and smart grid management. The study also evaluates the challenges and potential solutions in implementing deep learning models in resource-constrained IoT environments [4].
- "Artificial Intelligence and the Future of Work: Human-AI Collaboration in the Age of IoT" by Erik Brynjolfsson and Andrew McAfee (2017) - This influential work discusses the implications of AI and IoT on the future of work and society. It explores the concept of human-AI collaboration and emphasizes the need for new workforce skills and organizational structures to leverage the potential of these technologies effectively. The book provides valuable insights into the transformative impact of AI and IoT on the labor market and offers recommendations for policymakers and business leaders [5].
- "IoT-Enabled Intelligent Transportation Systems: Advances, Challenges, and Future Directions" by Yan Zhang and colleagues (2021) - Focusing on the application of IoT and AI in transportation systems, this paper presents the latest developments in smart and connected transportation. It discusses AI-driven solutions for traffic management, vehicle-to-vehicle communication, and autonomous vehicles. The study also addresses the challenges of implementing these technologies, such as cybersecurity and privacy concerns [6].
- "Advances in Natural Language Processing Using Transformer Models" by Vaswani and colleagues (2017) - This seminal paper introduces the transformer model, a fundamental architecture underlying many state-of-the-art NLP models, including GPT-3. It highlights the remarkable progress in NLP tasks achieved through transformer-based approaches and their implications for AI applications, including virtual assistants, sentiment analysis, and language translation [7].
- "The Rise of Edge AI: A Survey" by Ma and colleagues (2020) - With the increasing prevalence of IoT devices generating massive amounts of data, this survey paper explores the rise of Edge AI, which brings AI processing closer to the data source. It discusses the advantages of Edge AI in reducing latency, improving data privacy, and enhancing real-time decision-making. The study also addresses the challenges of deploying AI algorithms on resource-constrained edge devices [8].
- "Ethical and Social Implications of AI and IoT: An Integrative Review" by Floridi and Cowls (2019) - This review paper examines the ethical and social implications of AI and IoT technologies. It discusses issues related to bias and fairness in AI algorithms, data privacy, and the impact of AIoT on individual autonomy and human rights. The study emphasizes the importance of a responsible and human-centric approach to the development and deployment of AI and IoT systems [9].

III. Major Four Broad Forms of AI in Use Today, Ranging from Simple and Almost Mechanical to Complex and Almost Human

The four broad forms of AI in use today, ranging from simple and almost mechanical to complex and almost human, are as follows:

i. *Reactive Machines:* Reactive machines are the simplest form of AI and operate based on predefined rules without any memory or learning capabilities. They can analyze the current situation and provide responses based on programmed rules, but they lack the ability to learn from past experiences or adapt to new situations. Classic examples of reactive machines include chess-playing programs that analyze the board and make moves based on predetermined strategies without considering their previous games [10].

ii. *Limited Memory:* Limited memory AI systems have the ability to learn from past data and experiences to make informed decisions. They can analyze historical data, identify patterns, and use that information to improve their performance over time. However, their learning is limited to specific tasks or domains, and they do not possess general intelligence. Self-driving cars are an example of limited memory AI, as they can learn from their past experiences on the road to improve their driving behavior but lack broader cognitive abilities [11].

iii. *Theory of Mind:* Theory of Mind AI refers to systems that can understand and interpret human emotions, intentions, beliefs, and desires. These AI systems can recognize human emotions, communicate effectively, and respond appropriately in social situations. Although still in the early stages of development, some chatbots and virtual assistants are incorporating elements of theory of mind to create more natural and empathetic interactions with users.

iv. *Self-Aware AI:* Self-aware AI is the most advanced form, where machines possess a level of consciousness and self-awareness. This level of AI is still speculative and largely the subject of science fiction, as it involves machines having a sense of self, consciousness, and introspection. Self-aware AI would be capable of understanding its own emotions, thoughts, and actions, and potentially having subjective experiences. At present, self-aware AI remains a theoretical concept and is not yet realized in practice [12].

It is important to note that while AI technology has made significant progress, current AI systems primarily fall into the first two categories - reactive machines and limited memory. AI with theory of mind or self-awareness remains a topic of theoretical research and speculation, with many ethical and philosophical questions surrounding their potential development and implications for society.

IV. Major Objectives of the Study

- To identify and analyze emerging trends in AI and IoT in Indian context.
- To explore how AI and IoT technologies can be integrated and leverage each other's capabilities for enhanced performance and efficiency.
- To assess the impact of AI and IoT on different industries, businesses, and society as a whole.
- To examine ethical and legal implications of AI and IoT including data privacy, bias in AI algorithms, security risks and their potential societal impacts.
- To evaluate security measures, vulnerabilities, and potential threats in AI and IoT systems and propose strategies to enhance data protection and privacy.
- To understand the existing policy and regulatory frameworks related to AI and IoT adoption and explore potential areas for improvement.

V. Analyze Emerging Trends in AI and IoT in Indian Context

- *AI in Healthcare:* AI applications in the Indian healthcare sector have been gaining momentum. From AI-powered medical imaging for faster and more accurate diagnostics to telemedicine platforms that provide remote healthcare access. AI has shown promise in improving healthcare delivery, especially in rural and underserved areas [13].
- *Industrial IoT (IIoT) in Manufacturing:* The manufacturing industry in India has been embracing IIoT to enhance operational efficiency, predictive maintenance, and overall productivity. IoT-enabled sensors and devices have been integrated into production lines and supply chains, enabling real-time monitoring and data-driven decision-making.
- *Smart Cities Initiatives:* Several Indian cities have been adopting IoT technologies to transform into smart cities. IoT solutions are being used to optimize urban services, including smart traffic management, waste management, energy consumption, and public safety [14].
- *AI in Agriculture:* India's agriculture sector is witnessing the integration of AI and IoT to address challenges such as water management, crop monitoring, and pest detection. AI-powered agricultural drones and IoT sensors are being deployed to improve crop yields and optimize resource usage.
- *AI in Financial Services:* The financial sector in India is exploring AI applications in areas like fraud detection, customer service chatbots, and personalized banking services. AI-driven algorithms are being used to analyze financial data and make data-driven investment decisions.
- *AI-Driven E-Commerce:* AI is transforming the e-commerce landscape in India, providing personalized product recommendations, chatbot-based customer support, and more efficient supply chain management.
- *Edge Computing for IoT:* With the increasing adoption of IoT devices, edge computing has emerged as a trend

in India. Edge computing enables reducing latency and bandwidth requirements.

- *AI in Education:* The education sector in India is exploring AI to enhance learning experiences through personalized content, smart tutoring systems, and automated assessment tools.
- *AI for Language Diversity:* India's linguistic diversity has prompted research and development in AI applications for Indian languages. AI-driven natural language processing tools are being developed to understand and process regional languages.
- *AI-Driven Governance:* The Indian government has been exploring AI applications to improve governance and public services. AI-powered chatbots and virtual assistants are being used for citizen engagement and information dissemination.

While these trends indicate a growing interest and adoption of AI and IoT in India, several challenges remain, such as data privacy, security, skill gaps, and ethical concerns. As technology continues to evolve, it is crucial for India to develop a robust regulatory framework and foster a skilled workforce to harness the full potential of AI and IoT for the nation's growth and development.

VI. AI and IoT Technologies can be Integrated and Leverage Each Other's Capabilities for Enhanced Performance and Efficiency

Absolutely! AI and IoT technologies have complementary strengths that, when integrated, can significantly enhance performance and efficiency across various applications. Here are some ways in which the integration of AI and IoT can lead to powerful outcomes:

- *Real-Time Data Analysis:* IoT devices generate massive amounts of data from sensors and connected devices. AI algorithms can process and analyze this data in real-time, providing valuable insights and actionable information. For example, in industrial settings, AI can analyze IoT sensor data to predict equipment failures, enabling proactive maintenance and reducing downtime [15].
- *Predictive Maintenance:* By combining IoT data with AI's predictive capabilities, organizations can implement predictive maintenance strategies. AI algorithms can learn patterns of equipment behavior from historical data collected through IoT devices and predict potential failures before they occur, thereby optimizing maintenance schedules and minimizing disruptions.
- *Autonomous Systems:* Integrating AI with IoT enables the development of autonomous systems. For instance, self-driving cars use AI algorithms to interpret data from various sensors (e.g., cameras, LiDAR, radar) to make real-time decisions on steering, acceleration, and braking, resulting in safer and more efficient driving [16].
- *Personalized Experiences:* AI and IoT together can deliver personalized experiences to users. For example, in the retail sector, AI can analyze IoT-generated data from connected devices like beacons and smart shelves to understand customer behavior and preferences, allowing for personalized recommendations and targeted marketing.
- *Energy Efficiency:* AI algorithms can optimize energy consumption by analyzing data from IoT sensors that monitor energy usage in buildings or industrial facilities. By using AI-driven insights, organizations can identify areas for energy optimization and reduce overall consumption.
- *Smart Healthcare:* IoT devices in healthcare can collect patient data, such as vital signs and activity levels. AI can then analyze this data to provide personalized treatment plans and early disease detection, improving patient outcomes and reducing healthcare costs.
- *Enhanced Security:* AI can strengthen IoT security by detecting anomalies and potential threats in real-time. AI algorithms can continuously monitor IoT networks for abnormal behavior, helping to prevent security breaches and unauthorized access to devices and data [17].
- *Natural Language Interaction:* Integrating AI with voice-controlled IoT devices enables natural language interaction. AI-powered virtual assistants can understand and respond to voice commands, making IoT devices more user-friendly and accessible.

In summary, the integration of AI and IoT technologies can unlock a wealth of possibilities, leading to more intelligent, efficient, and responsive systems. This combination allows organizations and industries to make data-driven decisions, automate processes, and create innovative solutions that can drive significant benefits across various sectors. However, it is crucial to address data privacy, security, and ethical considerations when implementing AI and IoT solutions to ensure responsible and secure use of these technologies.

VII. Impact of AI and IoT on Different Industries, Businesses, and Society as a Whole

AI and IoT have had a profound impact on different industries, businesses, and society as a whole. Their integration has

led to transformative changes and brought forth numerous opportunities and challenges. Here are some of the key impacts:

- *Healthcare*
  - Remote patient monitoring through IoT devices enables real-time data collection and analysis, leading to improved patient outcomes and reduced hospital readmissions.
  - AI-powered medical imaging helps in early and accurate diagnosis, leading to better treatment decisions.
  - Predictive analytics assists in identifying high-risk patients, allowing healthcare providers to intervene proactively.
  - AI chatbots and virtual health assistants provide personalized health information and support, enhancing patient engagement and education.
- *Manufacturing and Industry*
  - IoT-enabled smart factories optimize production processes, reduce downtime, and enhance overall efficiency through real-time data monitoring and analysis.
  - Predictive maintenance using AI and IoT helps identify potential equipment failures, minimizing downtime and reducing maintenance costs [18].
  - Supply chain management benefits from improved visibility and real-time tracking of products and shipments, leading to streamlined operations and reduced wastage.
- *Transportation and Logistics*
  - AI-powered route optimization in logistics improves delivery efficiency, reducing fuel consumption and emissions.
  - Autonomous vehicles, enabled by AI and IoT, have the potential to enhance road safety and reduce traffic congestion.
  - IoT-based tracking and monitoring of goods in transit improve supply chain visibility, reducing theft and spoilage risks.
  - Retail and Customer Service.
  - AI-driven personalized product recommendations based on customer behavior and preferences enhance the shopping experience, leading to increased sales and customer satisfaction.
  - AI-powered chatbots provide 24/7 customer support, improving response times and reducing customer service costs.
  - IoT-enabled smart shelves and inventory management systems optimize stock levels, reducing inventory carrying costs.
- *Agriculture*
  - IoT sensors monitor soil moisture levels, weather conditions, and crop health, enabling precise irrigation and reducing water wastage.
  - AI-based predictive analytics assists in crop yield forecasting and optimal resource allocation, increasing productivity and reducing input costs.
  - Smart farming solutions enable real-time monitoring of livestock and animal health, improving animal welfare and productivity.
- *Energy and Utilities*
  - AI-driven energy management systems optimize energy consumption and demand response, resulting in energy efficiency and cost savings.
  - IoT-enabled smart grids enhance energy distribution and reduce energy losses during transmission.
  - AI analytics for fault detection and predictive maintenance improve the reliability and performance of utility infrastructure.
- *Finance and Banking*
  - AI-powered fraud detection systems can identify and prevent fraudulent transactions, enhancing security and safeguarding customer assets.
  - AI-driven chatbots offer personalized financial advice and support, improving customer engagement and satisfaction.
  - IoT-enabled wearables and devices can provide real-time data for personalized insurance premium pricing and risk assessment.

VIII. Impact on Society as a Whole

- AI and IoT have the potential to create new job opportunities in fields such as data science, AI development, and IoT management.
- Increased automation may lead to workforce displacement in some industries, necessitating upskilling and retraining efforts.
- AI and IoT raise ethical concerns regarding data privacy, bias in algorithms, and potential misuse of technology.
- Smart cities powered by AI and IoT can lead to improved urban living, reduced pollution, and enhanced public services.

In conclusion, the combined impact of AI and IoT on industries, businesses, and society as a whole is multifaceted. While these technologies offer unprecedented opportunities for efficiency, innovation, and improved quality of life, careful consideration of ethical, regulatory, and societal implications is essential to maximize their benefits and mitigate potential risks.

IX. Ethical and Legal Implications of AI and IoT Including Data Privacy, Bias in AI Algorithms, Security Risks and Their Potential Societal Impacts

Ethical and legal implications of AI and IoT, including data privacy, bias in AI algorithms, security risks, and their potential societal impacts, are critical considerations as these technologies become increasingly pervasive. Here are some key points to highlight in each area:

- *Data Privacy*
  - Data collected by IoT devices often include personal and sensitive information about individuals, such as location, health data, and behavioral patterns. Ensuring the privacy and security of this data is paramount.
  - Unauthorized access to IoT data can lead to identity theft, stalking, or misuse of personal information. Inadequate data protection measures can result in data breaches, affecting millions of individuals and damaging trust in technology.
- *Bias in AI Algorithms:*
  - AI algorithms are trained on vast amounts of data, and if the training data is biased, the algorithms can perpetuate and amplify those biases, leading to unfair and discriminatory outcomes.
  - Bias in AI can result in discriminatory hiring practices, biased loan approvals, or skewed criminal justice decisions.
- *Security Risks:*
  - The interconnection of IoT devices creates a vast attack surface, making them vulnerable to cyber-attacks. Compromised devices can be weaponized to conduct large-scale cyber-attacks, such as Distributed Denial of Service (DDoS) attacks.
  - IoT devices with weak security features can be hacked, leading to privacy breaches, unauthorized access, and potential control of critical infrastructure.To mitigate security risks, robust encryption, regular software updates, and the use of security standards are essential [19].
- *Societal Impacts:*
  - Automation and AI-driven technologies can lead to job displacement in certain industries, potentially creating economic and social challenges.
  - Dependence on AI and IoT for decision-making can raise concerns about the loss of human autonomy and the accountability of algorithmic decisions.
  - Unequal access to AI and IoT technologies can exacerbate existing social inequalities, creating a "digital divide" where certain populations are left behind.
- *Addressing Ethical and Legal Implications:*
  - Strong data protection laws and regulations are needed to safeguard user privacy and establish clear guidelines for data collection and usage.
  - Transparent and explainable AI models can help to address bias, providing insights into the decision-making process and enabling corrective measures.
  - Industry standards for security practices and regular security audits are vital to minimize security risks.
  - Ethical AI frameworks and guidelines should be developed to promote responsible AI research and development.
  - Collaboration between policymakers, industry stakeholders, and experts is necessary to create comprehensive policies that balance innovation with ethical considerations.

Overall, it is crucial to adopt a holistic approach that considers the ethical and legal implications of AI and IoT throughout the entire lifecycle of these technologies. By ensuring responsible development, deployment, and usage, we can harness the transformative potential of AI and IoT while safeguarding individual rights, privacy, and societal well-being.

X. Data and Facts on a Study on Latest Developments in Artificial Intelligence (AI) and Internet of Things (IoT) in Current Context

- *AI Developments:* Advancements in Natural Language Processing (NLP): NLP has seen significant progress, with models like GPT-3 (Generative Pre-trained Transformer 3) gaining popularity for their ability to generate human-like text, answer questions, and perform language-related tasks.
- *Reinforcement Learning:* There have been notable advancements in reinforcement learning, enabling AI agents to learn through trial and error, making it particularly valuable in robotics and autonomous systems.
- *Ethical AI:* As AI applications become more widespread, there has been increasing focus on ethical AI development and responsible deployment. Researchers and organizations are working on mitigating bias, ensuring transparency, and addressing the societal impacts of AI.
- *AI in Healthcare:* AI has found applications in medical imaging analysis, drug discovery, personalized medicine,

and patient data analytics, leading to improved diagnostics and treatment options.

- *AI in Autonomous Vehicles:* Self-driving cars and autonomous vehicle technology continue to evolve, with major players in the automotive industry investing in AI-based solutions.
- *IoT Developments: Growth in Connected Devices:* The number of IoT devices continues to grow rapidly, with applications across industries such as smart home systems, wearables, industrial IoT, and smart city initiatives [19].
- *Edge Computing:* To address issues of latency and bandwidth in IoT networks, edge computing has gained traction. It allows data processing and analysis to occur closer to the source, reducing the need to transfer large amounts of data to centralized servers.
- *IoT Security:* As the number of IoT devices increases, so does the concern over security vulnerabilities. Efforts are being made to enhance IoT device security and implement best practices to protect against potential cyber-attacks.
- *IoT and AI Integration:* Combining AI with IoT has led to more intelligent and efficient systems. AI algorithms are increasingly being used to process and analyze data from IoT devices, enabling better decision-making and automation.

It's important to note that the AI and IoT fields are constantly evolving, and new developments may have occurred since my last update. For the most current and accurate information, I recommend referring to reputable sources, research papers, industry reports, and news outlets that cover technology developments in real-time.

XI. Conclusion

AI has made significant strides, especially in natural language processing (NLP) and reinforcement learning. The emergence of advanced models, such as GPT-3, has demonstrated the potential of AI to perform human-like language-related tasks, leading to various applications in chatbots, virtual assistants, and content generation. There is a growing emphasis on ethical AI development and responsible deployment. As AI technology becomes more prevalent, stakeholders are increasingly aware of the potential risks, including bias, transparency, and societal impacts. Researchers and organizations are working to address these concerns to ensure AI is used in a fair, transparent, and accountable manner. AI has found promising applications in the healthcare sector, with advancements in medical imaging analysis, drug discovery, and patient data analytics [20]. These developments have the potential to improve diagnostics, personalize treatment plans, and enhance healthcare outcomes. AI has continued to play a crucial role in the development of autonomous systems, particularly in the automotive industry with self-driving cars. However, challenges such as safety, regulatory compliance, and public acceptance remain critical considerations for widespread adoption. The Internet of Things (IoT) has seen significant growth, with an increasing number of connected devices across various domains, including smart homes, wearables, industrial IoT, and smart cities. Integration with AI technologies has allowed for more intelligent and efficient IoT systems, enabling better data analysis and decision-making at the edge. The rise of IoT devices has also highlighted the importance of robust security measures. Efforts are being made to enhance IoT device security and protect against potential cyber-attacks, given the potential risks associated with compromised devices [21].

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Journal of Applied Information Science
11 (2) 2023, 29-34
http://www.publishingindia.com/jais

Fraud App Detection using Sentimental Analysis

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Abstract: This project aims to develop a fraud app detection system using sentiment analysis. The system leverages Java 1.8 Spring Boot, React, HTML, CSS, JavaScript, and Bootstrap to create a robust web application. The methodology involves collecting user reviews and comments, preprocessing the data, and applying sentiment analysis models to determine sentiment scores. The system then uses predefined fraud criteria to flag potentially fraudulent reviews. Integrating the system into a Java Spring Boot backend and visualizing results using React provides real-time monitoring and investigation. Continuous improvement, user feedback handling, and effective model selection ensure enhanced accuracy and adaptability to evolving fraudulent patterns. This project presents an integrated fraud detection system for user reviews, utilizing sentiment analysis within a Java 1.8 Spring Boot backend and React frontend. It encompasses data collection, preprocessing, sentiment analysis, and predefined fraud criteria to flag suspicious reviews. Real-time monitoring and investigation capabilities are offered through an intuitive web interface. The project's commitment to continuous improvement, user feedback integration, and effective model selection ensures adaptability to evolving fraudulent patterns, enhancing accuracy and preserving the credibility of online platforms in an era where user-generated content profoundly influences consumer decisions.

Keywords: Fraud apps detection, Sentiment analysis, Technological development.

I. Introduction

Sentiment is an emotion or attitude that is brought on by the client's emotions. As consumer opinions are gathered and mined to determine an app's rating, sentiment analysis is also known as opinion mining. Information is gathered, analysed, and then classified as either positive or negative depending on how it is felt. People always research the app's reputation among users before making a purchase. Sentiment analysis is a procedure that gathers and analyses a sentence's opinion or sentiment using natural language processing (NLP) [1]. It is well-liked since many people choose to heed user recommendations. It is beyond the control of manual procedures to analyse enormous amounts of reviews and to aggregate them into an effective choice because the number of opinions in the form of reviews, blogs, etc. are expanding continuously. Sentiment analysis converts these actions into automated procedures with minimal human assistance. Because different phrase forms express thoughts and opinions in different ways, it is not always possible to have a single strategy that works for all situations. Sentence terms that are also referred to as opinion words, such as wonderful, beautiful, bad, etc., cannot tell an opinion sentence from a non-opinion sentence. Even if a conditional statement lacks an opinion, it may contain numerous sentimental phrases or sentences. It can be challenging to discern the orientation of attitudes on themes or qualities in conditional phrases because they have certain distinctive traits of their own. Positive, negative, or neutral sentiment orientations are the different types of opinions. Sentences that explain implications

or potential outcomes are known as conditional sentences. Many different types of conditional connectives can be used to form these sentences. A conditional sentence contains two clauses: the condition clause and the consequent clause, that are dependent on each other. Their relationship has significant implications on whether the sentence describes an opinion [2].

II. Literature Survey

This paper hopes to see customers making spam diagrams or audit spammers. They see a couple trademark practices of survey spammers and model these practices with a particular ultimate objective to perceive the spammers. Creators endeavor to display the running with phones. Regardless, spammers may target particular things or things that accumulate keeping in mind the end goal to develop their effect. Second, they tend to leave trade specialists in their evaluations of things. In paper, creators have examined the issue of finding half and half shilling assaults on rating data. The philosophy relies upon can be used for dependable thing proposals and semi-managed learning. This paper shows a Hybrid Shilling Attack Detector or Hy SAD for short, to deal with this issue [3].

Nowadays, the majority of us use mobile devices with iOS or Android operating systems, and we frequently use the functionality of the play store or app store. A wide variety of software is available on both markets, however unfortunately some of those programmes are fake. Both data theft and device damage are possible with these apps. Thus, they must be labelled in order for store patrons to recognise such programmes. To manage the data, feedback, and application evaluation, we suggest a web application. As a result, it will be simpler to determine whether or not an application is fraudulent. The online application allows for the simultaneous processing of many applications. Most of us use mobile devices these days that run Android or iOS, and we routinely cannot always find reliable or honest product reviews online. As a result, the admin will assess the reviews and comments, making it easy for the admin to decide whether the application is honest or dishonest.

III. Methodology

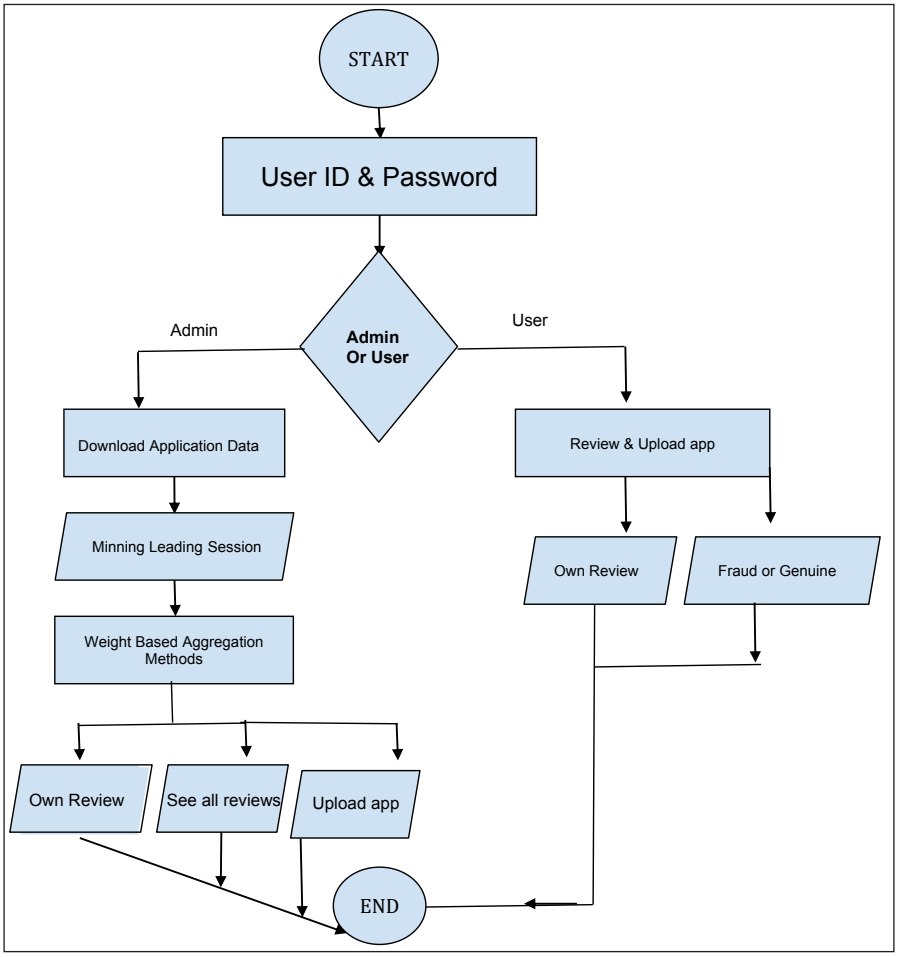

Fig. 1: Flowchart

Data Collection: Data collection serves as the foundational step in understanding user sentiments and experiences related to the app. By systematically gathering user reviews, comments, and feedback, you compile a rich and diverse dataset that reflects a wide spectrum of opinions and viewpoints [4]. App stores provide insights directly from users, social media platforms offer real-time reactions, and your own database could contain historical data for analysis. This multi-source approach ensures a holistic representation of user sentiment.

The collected data not only captures positive and negative feedback but also nuances and trends in user opinions. User reviews often contain valuable insights into specific app features, performance, customer support, and overall satisfaction. The amalgamation of these diverse perspectives creates a comprehensive dataset that forms the basis for subsequent analysis.

Incorporating data from various sources fosters a more accurate understanding of user sentiment, enabling you to develop a well-informed fraud detection system. By encompassing both structured app store reviews and more informal social media commentary, you gain a more complete picture of user perceptions. This, in turn, enhances the credibility and effectiveness of the subsequent steps in your project, such as sentiment analysis and fraud criteria definition.

Data Preprocessing: In the data preprocessing phase, the text data undergoes a series of transformations to optimize it for analysis. First, special characters, URLs, and unnecessary symbols are removed, ensuring that the text is devoid of extraneous elements. Subsequently, the process of tokenization divides the text into individual words or tokens, facilitating granular analysis. To maintain consistency, all text is converted to lowercase, mitigating the influence of case variations. Further refinement involves the removal of common stopwords like “and,” “the,” and “is,” which have limited significance in sentiment analysis. Lastly, stemming or lemmatization reduces words to their base or root form, enhancing dimensionality reduction and improving data coherence [5]. These combined preprocessing steps establish a structured and clean textual foundation that is well-suited for accurate sentiment analysis and subsequent fraud detection.

Sentiment Analysis: Perform an appropriate sentiment analysis model for the task we are using NLP to achieve the goal. In this project, sentiment analysis serves as a pivotal component for detecting fraudulent app reviews. The sentiment analysis process involves evaluating the sentiment expressed in user reviews and comments to determine whether they are positive, negative, or neutral. This analysis aids in gauging user satisfaction and identifying potentially fraudulent content.

The collected user reviews and comments undergo preprocessing, including text cleaning, tokenization, lowercasing, and possibly stopword removal. After this preprocessing, sentiment analysis models are applied to generate sentiment scores for each review. These scores quantify the sentiment of the text, allowing for a more objective assessment of user opinions.

The sentiment scores obtained from the sentiment analysis models are then used to inform the fraud detection algorithm. This algorithm incorporates predefined fraud criteria that flag reviews with sentiment scores falling within specific ranges or exhibiting certain patterns. Reviews with extremely negative sentiment or containing keywords associated with fraudulent behavior might trigger flags.

By leveraging sentiment analysis, the project is able to automate the process of identifying potentially fraudulent reviews. Reviews that express unusually negative sentiment or deviate from the expected sentiment distribution can be flagged for further investigation. This systematic approach enhances the accuracy and efficiency of the fraud detection system.

Incorporating sentiment analysis into the project enables the system to quantitatively assess user sentiments, providing valuable insights for detecting suspicious content. This analysis, coupled with the system’s integration into a Java Spring Boot backend and visualization using React, creates a comprehensive solution for real-time monitoring and fraud detection in app reviews.

Evaluation

Fraud Criteria: Established criteria to identify fraudulent or suspicious reviews based on the sentiment scores obtained from the sentiment analysis model. For example, reviews with very negative sentiment or specific keywords related to fraud may be flagged. Evaluation in this project involves the establishment of fraud criteria used to identify potentially fraudulent or suspicious reviews. These criteria are developed based on the sentiment scores derived from the sentiment analysis model. For instance, reviews displaying extremely negative sentiment or containing particular keywords associated with fraudulent activity are earmarked for further scrutiny. This systematic approach ensures that flagged reviews align with specific patterns indicative of potential fraud. The fraud criteria provide a quantifiable framework to assess the legitimacy of user reviews and contribute to the overall accuracy and effectiveness of the fraud detection system [6].

Fraud Detection Algorithm

Sentiment Scoring: Apply the sentiment analysis model on the preprocessed data to get sentiment scores for each review or comment.

Flagging: Implement an algorithm to flag reviews that meet the fraud criteria.

User Feedback Handling: Develop a mechanism for users to provide feedback on flagged reviews. This feedback will be used to improve the accuracy of the fraud detection system over

time.

Integration: Integrate the fraud detection system into your Java Spring Boot backend to automatically process user reviews and comments.

Visualization and Reporting: Create a user interface using React, HTML, CSS, and JavaScript to display the analyzed sentiment and flagged reviews for further investigation.

Testing and Deployment: Thoroughly test the system to ensure it functions correctly. Deploy the fraud app detection system to your production environment. This project aims to build a fraud detection system for app reviews using sentiment analysis. It involves applying sentiment analysis models to user reviews, generating sentiment scores that quantify the tone of each review. These scores are then utilized in an algorithm that automatically flags reviews based on predefined fraud criteria. To enhance accuracy, the system incorporates user feedback on flagged reviews, allowing continuous refinement. The system is integrated into a Java Spring Boot backend for streamlined processing, while a React-based interface visualizes sentiment scores and flagged reviews, facilitating investigation. Rigorous testing ensures reliability before deployment to the production environment, providing users with a reliable tool to identify potentially fraudulent reviews and improve overall review authenticity [7].

IV. Experimental Results

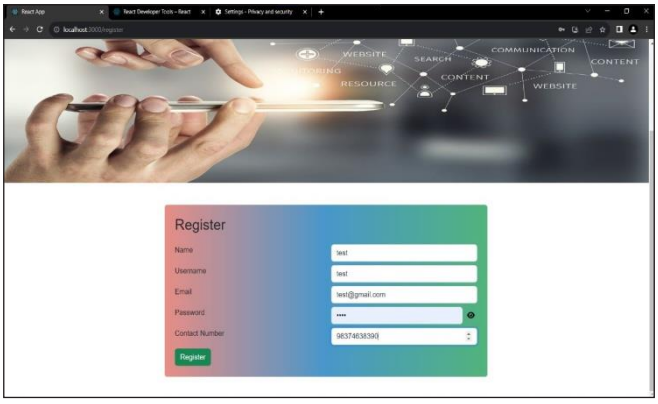

Fig. 2: Registration Page

This project focuses on the development of a fraud app detection system that utilizes sentiment analysis techniques. The system harnesses a technology stack including Java 1.8 Spring Boot, React, HTML, CSS, JavaScript, and Bootstrap to establish a robust web application [8]. The project methodology encompasses several stages: firstly, gathering user reviews and comments from various sources. Subsequently, the collected data undergoes preprocessing steps, including text cleaning and tokenization. Sentiment analysis models are then employed to generate sentiment scores that reflect user sentiments.

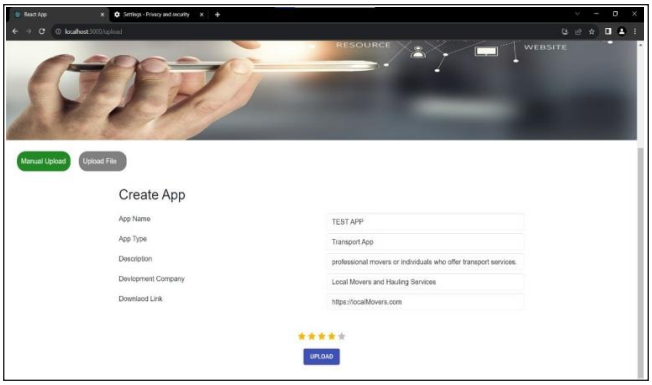

Fig. 3: Manual Upload

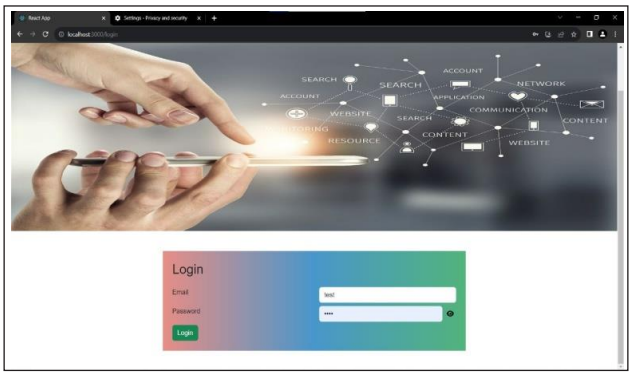

Fig. 4: Login Page

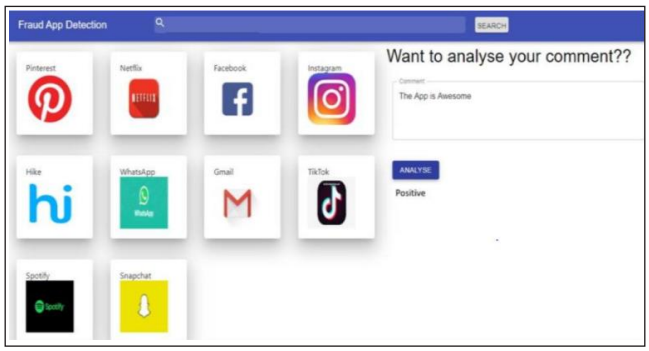

Fig. 5: Detection of Fraud App

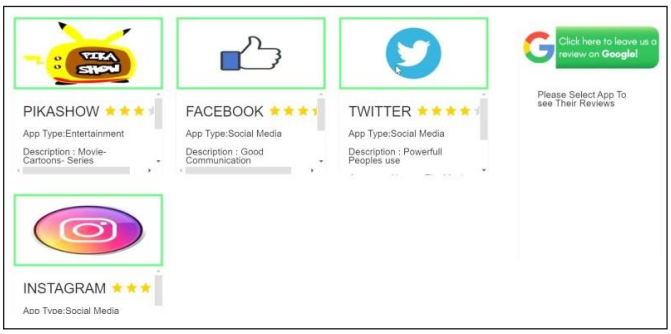

Fig. 6: Rating and Reviews

Implementing a robust fraud detection system for app reviews entails several key steps. Data collection involves gathering user feedback from diverse sources, such as app stores and social media platforms. Prior to analysis, data preprocessing tasks, including text cleaning, tokenization, lowercasing, stopword removal, and stemming or lemmatization, ensure data consistency and quality. Applying sentiment analysis models, which could include machine learning or deep learning techniques, quantifies user sentiment in each review. This stage provides insight into user satisfaction or dissatisfaction.

The evaluation phase involves defining criteria for identifying fraudulent reviews, often characterized by very negative sentiment or keywords associated with fraud. These criteria serve as guidelines for the fraud detection algorithm. The algorithm utilizes sentiment scores obtained from the sentiment analysis model to flag reviews meeting the established fraud criteria. This algorithmic approach aids in automating the identification of suspicious reviews for further review.

Integration of additional methodologies enhances the system's effectiveness. Aspect-based sentiment analysis dissects feedback by app components, offering more precise insights. Ensemble models combine sentiment analysis methods for improved accuracy. N-gram analysis captures nuanced sentiments expressed through phrases. User behavior analysis examines review history and posting patterns to identify potential fraudulent users. Incorporating time series analysis reveals trends and sudden shifts in sentiment that may suggest fraudulent activity [9].

The results of an effective fraud detection system encompass enhanced accuracy in identifying suspicious content, reduced fraudulent activity, improved user trust in reviews, and informed app development decisions. As false positives and negatives decrease over time, user experiences improve, contributing to a more reliable app rating ecosystem. The system's continuous learning and refinement adapt to evolving fraudulent tactics. Ultimately, an accurate fraud detection system safeguards business reputation, saves costs, and promotes transparent and trustworthy user experiences. Regular assessment and adjustment of methodologies ensure the system's adaptability to dynamic review landscapes and evolving user behaviors.

The core functionality of the system revolves around the application of predefined fraud criteria. These criteria are used to flag reviews that exhibit characteristics potentially indicative of fraudulent behavior. The integration of this system within a Java Spring Boot backend, along with visualization through React, offers a comprehensive web-based solution. This integration facilitates real-time monitoring and the ability to investigate flagged reviews promptly.

A commitment to continuous improvement is integral to the project's success. The system is designed to incorporate user feedback, enabling refinements based on real-world usage and insights. The selection of appropriate sentiment analysis models plays a crucial role in achieving accurate results [10]. Moreover, the system's adaptability is emphasized, ensuring its capacity to effectively identify and respond to evolving fraudulent patterns.

In summary, this endeavor aims to create a powerful fraud app detection system by employing sentiment analysis. Through the utilization of cutting-edge technologies like Java Spring Boot and React, the project strives to provide a seamless user experience for monitoring and mitigating potentially fraudulent reviews. By following a structured methodology, incorporating user feedback, and ensuring model accuracy, the resulting system endeavors to uphold the integrity of app reviews and user trust.

V. Conclusion

Through the use of online social networking research, this study successfully developed an improved feeling characterisation technique for peculiarity location. Utilising tweet data as a contextual investigation, the feasibility of the suggested technique is demonstrated. Using the suggested technique, the strangeness estimate designs were efficiently identified and translated. The Contextual analysis demonstrated the usefulness and dominance of the method. When it comes to handling conclusion design characterizations, given the acceptance of our method in light of an unnatural state of anger that has become stronger with similar grouping assignments carried out by annotators. This investigation gives fresh ideas for describing a robust opinion examination method using information from web-based networking media to distinguish instances or examples of inconsistency. The tactic will apply in situations like design changes after a while. This should be really profitable. for businesses to secure their administrative hub, for government innovators and political aspirants to understand the rationale behind their ongoing research arises, and for other intimate associations to become more refined their clients' brand assurances and incentives.

Implementing fraud app detection using sentiment analysis involves collecting user feedback, preprocessing the data, applying sentiment analysis models, and developing a fraud detection algorithm based on predefined criteria. Integrating this system into a Java Spring Boot backend and visualizing the results using React, HTML, CSS, and JavaScript allows for real-time monitoring and investigation of potentially fraudulent activities. Continuous improvement, user feedback handling, and effective model selection are critical for enhancing the system's accuracy and adapting to evolving fraudulent patterns.

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Journal of Applied Information Science
12 (1) 2024, 01-06
http://www.publishingindia.com/jais

Digitalisation of Travel Industry: Investigating the Role of Artificial Intelligence, Cloud Computing and Machine Learning in Developing Smart Tourism Ecosystem

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Abstract: Innovative communication and information technologies have dramatically upgraded service ecosystem right from information search, product-mix offerings, product delivery, feedback etc. In travel industry, artificial intelligence, cloud computing and machine learning technologies etc. have increased interaction & transparency across a business network; improved service personalization & interaction and perform various functions through descriptive, diagnostic, predictive and prescriptive analytics. Digitisation tools such as Internet of Things (IoT), Artificial Intelligence (AI), Virtual Reality (VR) and Augmented Reality (AR), Mobile check-in apps, AI-powered chatbots etc. have simplified the traveller decision-buying process, reduced cost and increased organization's resilience to innovate product and service offerings. It has improved customer experiences-beginning with an online travel agency, a virtual tour search engine, buying tickets online, checking in at destination, sightseeing, checking out and returning home safely. Travel sector is benefitted with enhanced competitiveness, increase in the scale of information impact, improved financial efficiency, reaching new audiences, more visibility of brands, ease in customer acquisition & retention and exploration of new tourist products. To accelerate the growth and its intensive percolation, there is a need to place worker well-being, ethical considerations in development of intelligent interactive system and consider research and innovation on continuous & sustainable manner.

Keywords: Artificial intelligence, Cloud computing, Machine learning.

I. Introduction

The role of tourism in accelerating economic growth through job creation, contribution to government revenue, foreign exchange earnings, strengthening local infrastructure and local communities, conservation of natural environment, cultural assets & traditions, reduction of poverty & inequality and promotion of international collaboration is recognized across globe. During 2022, over 960 million tourists travelled internationally. Most visited destinations by international tourist arrivals in 2021 were France (48.4 million), Spain (31.2 million), United States (22.1 million) and Turkey (29.9 million). Finland is the most well-travelled country in the world, followed by US. India is

positioned at 54th among 117 countries in the world in terms of tourist inflow and its contribution to GDP is 89% more compared to 2022 and projected growth for 2023 is 5.1% (WEFT & TDI, 2021).

To support travel activities, Indian Govt. has initiated campaigns like Public-private partnership, Chintan Shivir, Apni Pehchaan, Apni Dharohar, Travel for LiFE besides organizing webinars under Dekho Apna Desh, quiz programmes, essay writing and poster making competitions at YUVA Tourism Clubs, IHMs, IITTMs, Schools, to create awareness about history, heritage, tourism among masses. Innovative communication technologies aid travelers to plan their trip, booking tickets for destinations, create & share trip experiences and offer feedback to industry players. At industry level, it encourages enterprises to increase market share, offer directions for product improvement, implement creative ideas to allure travels. The paper focuses on innovative travel technologies in information dissemination, improving service-mix, ease destination connectivity, evaluate performance and create value for travelers.

II. Review of Literature

The tourist industry thrive on collection & dissemination of uninterrupted flow of information to travelers, travel agencies, hoteliers, suppliers and all stakeholders so that they promptly respond to requests, increase their productivity & profitability and create favourable influence on tourist experiences and their revisit intentions [1] [2]. This is assured through digital transformation and its adaptation which focus on data management and its retrieval to benefit travelers [3]. Several innovative tools are transforming tourist industry such as artificial intelligence, data security, ML, IoT, robots, augmented reality, 3D printing, mobile Internet etc [4].

Artificial intelligence like human intelligence can assess the environment, adapt and quickly respond in solving problems [5] [6]. These technologies are the outcome of advances in AI algorithms, speed in processing capacities and development of computer architectures to derive information from massive amounts of data [7]. Recently the concept of super-intelligence and Hybrid AI has amalgamated different activities to create memorable experiences for tourists [8] [9]. AI Artificial intelligence systems rest on big data and its volume, velocity, variety, veracity, value and volatility [10]. It facilitate users with relevant information to take optimal decision which result in more sustainable tourism [11] [12]. With the emergence of service robots, the service delivery has become prompt and customized.

Cloud computing embraces IT infrastructure and service – mix to customers on pay-as-you-use basis. It application increase the capacity or add capabilities dynamically without investing in new infrastructure, training new personnel, or licensing new software [13]. Furthermore, Cloud computing provides limitless flexibility, better reliability & security, absence of investment in training new personnel or licensing new software, business-consumer interaction, capability enhancement through addition of services, geographic information services which improves effectiveness of tourism resource management [14] [15] [16]. The term `Machine Learning' is first coined in 1959 by Arthur Lee Samue to connote computational tools to make accurate assessment and forecasting [17]. It identify patterns in the existing data, develop algorithms & statistical model-based theories and perform the most accurate possible prediction and generalizability [18] [19] [20]. The integration of technology with management concepts enables the enterprises to understand traveler's characteristics, sentiments, loyalty besides improve sales forecasting, identify fraud, analyse reviews produced on social media and define more efficient key performance indicators [21] [22].

III. Artificial Intelligence and Travel Industry

Artificial Intelligence(AI) by eliminating human error, deliver prompt customer services, improve personalization & interaction, data analysis and guarantee fast response times, even with minimal staff. The specific usage of AI are:

- It can respond to travelers' queries 24/7 basis and can deliver customized services through chatbots and instant messaging apps.

- It collect, analyse and enhances the institutional ability to sort relevant data quickly from customer feedbacks, reviews, surveys etc.
- Travel related services can be provided during prime time through voice-based digital tools through robots.
- It can forecast weather patterns, trends in flight schedules on the basis of past flight data etc. and results are made available to concerned stakeholders. Information relating to disruption in flights and how issues can be resolved are also provided to travelers.
- It enables hospitality industry to understand communication and engagements of sentiments and emotions of travelers in social media channels.
- It also enables industry to optimally set prices during times of high or low demand periods.
- AI technology assist airport security personnel in sorting & scanning baggage, scan images and detect possible threat items. These ease and save the work of airport authorities.
- Through facial recognition using AI, enables to entice individuals in particular area which need safety and security especially tourists.
- It renders personalized services through websites such hotels, flights, train, cab facilities, travel related bookings so that convenience and comforts at optimal rates are provided to travelers.
- Travel products can be provided through online retailers based on past purchases or browsing.
- Al helps in optimizing revenue management in travel and tourism industry.
- Software based on AI can forecast price fluctuations in hotel room rates, flight fares, and other products and services within the industry, so that industry and customers are better understand fluctuations in prices and take necessary actions accordingly.
- Through predictive analytics, AI can be used to assess airplane maintenance requirements before they arise, thereby can take action promptly without causing any disruption and upheaval.
- Al helps to improve employee management and scheduling, allocation of work to each employee, deployment of senior staff in each shift, availability & deployment of contractual staff, the necessary time off between two shifts etc.
- Based on online tracking system, transaction histories, and personal preferences of travelers, AI can facilitate loyalty programmes for its members and influence re-visit intentions of customers.
- Based on pattern recognition, behavioral analysis and previous fraud cases, AI identifies payment fraud and alerts can flag suspicious activity for human intervention.
- A 360^{o} virtual tour of destinations, restaurants, hotels, parks, monuments provide live experiences to travelers from their own home. It also allows travelers to share their digital experiences with nearby persons through AI tools.
- Al powered assistants enable visitors to control room temperature in hotels and obtain tourist information from nearby location, without interacting with hotel staff.
- Al designed robots enables to greet guests when they arrive at their destination, cleaning & luggage handling, food preparation & food service, detection of concealed weapons at airports etc., thereby reducing human-to-human contact.
- It facilitates contactless payments in exigencies at times when access to cash, credit card / debit card are denied, thereby helping loyal customers.
- Cyber security threats especially phishing attacks and ransom ware attacks which create fear in the minds of travelers can be minimized through AI software and tools.
- By installing sensors in luggage cases, it helps travelers at airports. Recognition technology further enhances institutional interactions with prospective travelers.

- With Virtual Positioning System, small streets and destination can easily be located.

IV. Blockchain Technology and Travel Industry

Block chain reduces cost and confusions in the process of data sharing among stakeholders of hospitality and travel industry.

- It enables to trace the location of luggage especially during international travels when it changes hands multiple times.
- Recognition technology replaces document verification which can drastically reduce check-in times at airport.
- It allows travel companies globally to accept and make payments using Bitcoin and other cryptocurrencies.
- It allows travelers to access their loyalty points during travel more easily.
- It empowers travel businesses to undertake property management including rented property on behalf of travelers for short period at least cost due to absence of middlemen or commission agent.
- It facilitates travelers to directly contact hosts for short term stay and pay for stays.
- The Winding Tree platform aids booking and tracking of baggage without involvement of third-party. The system paves for greater transparency.
- Through in-house block-chain project introduced by TUI called *'Bed-Swap', inventories can be moved between* different points of sale in accordance with demand.
- NFTs powered by cloud computing technologies are digital assets connecting the industry with local artists. This will benefit artisans through sale and industry through customer loyalty schemes.
- iTravel applications allows peer to peer (P2P) exchange of information about hotels, restaurants, places or other point of interest.
- It allows the tour operators to customized travel package including booking of flight, hotels, local transportation, catering etc.
- Through Instagram, Pinterest etc. travel experiences can be shared, thereby selecting optimal destination-mix on the basis of reviews, travel blogs, feedback or recommendations.

Several cloud based applications such as Winding Tree, Webjet-tracks, Sandblock's blockchain technology, Traveler Digital services etc. provides consultation at minimum cost, promptly correct booking inaccuracies, share travel data among travelers and travel service providers.

V. Machine Learning and Travel Industry

Machine learning (ML) performs various functions through descriptive analytics, diagnostic analytics, predictive analytics and prescriptive analytics. It rely on Logistic regression, Linear regression, decision tree, classification, segmentation or clustering, dimension reduction and association rules methods. The specific benefits of ML are:

- It equips Front Desk Attendants and Customer Care Representatives of travel companies with Chatbot enabling personalized services at low cost. It also enables companies to analyse information collected through Chatbot in assessing the requirements and directions for improvements.
- Machine learning models can accurately forecast the best time to travel for a destination without relying on secondary sources of information.
- ML enables travel companies to analyse travelers' emotions, enticing trouble spots and correcting in advance, thereby helping travel industry to grow. The use of Natural Language Processing enables travel companies to derive meaning from reviews, blogs etc.
- It assists travel companies to segment travelers on the basis of metric characteristics and selecting target customers to reach with distinct service-mix. For example Humtourist, a tourism company which was earlier getting bad reviews,

used ML to offer innovative activities ranging from leisure to adventure in Manhattan area.

- Virus assassination robots are one of the current innovations implemented in hotels. These virus assassination robots locate virus & germs and destroy those using UV lights and disinfectants.

VI. Conclusion

Digitalisation through AI, cloud computing and ML have revolutionalised the travel industry to an unimaginable peak. It is likely to create more job opportunities, efficiency and productivity in all travel operations. It allows the travelers to access wide variety of information and co-create value in building smart tourism destinations. However, there is need to innovate, stablise and sustain travel industry by worker well-being, observing ethical consideration during interaction, securing safety & security in data storage, maintaining transparency in exchange process and undertaking research and innovations on continuous & sustainable manner.

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Journal of Applied Information Science
12 (1) 2024, 07-17
http://www.publishingindia.com/jais

Game Theory Approach: Profit Calculation in Business

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Abstract: Business is back bone of transaction between buyer and supplier firms. Evolution of internet has helped customers to do shopping online 24X7 using online shopping portal, this lead to categorization of e-commerce into B2C, B2B, C2C etc. Identifying the authentic manufacturer and suppliers is difficult as the online transactions are carried on. There are so many ways for finding out the authentic stackeholder. Here in this paper two stages have been made in first stage a game theory concept is used to identify authentic suppliers the manufacturer can choose for finding the reliable supplier's using Extensive decision tree with perfect information as decision metrics. In second stage after filtering the suppliers again Stackelberg model is used for analysis of profit and selecting suppliers who will gain huge profit. Overall, a comprehensive framework for analyzing the profitability of businesses using game theory principles. It can help manufacturer make informed decisions about their strategies and provide insights into the competitive landscape of the market.

Keywords: Extensive decision tree, Manufacturer, Stackelberg model, Supplier firms.

I. Introduction

Business firms, also known as companies or corporations, are organizations that engage in commercial, industrial, or professional activities with the aim of generating profit. These entities may be privately owned, publicly traded, or state-owned. Business firms can vary greatly in size, from small startups to multinational conglomerates with operations in multiple countries. The primary objective of business firms is to generate revenue by providing goods or services that meet the needs of their target market. They do this by developing products, services, or solutions that are valuable, unique, and relevant to their customers. Business firms must also manage their resources efficiently to ensure that they can deliver their products or services at a competitive price point. Business firms are typically structured as a hierarchy, with a board of directors at the top, followed by executive management, middle management, and front-line employees. The board of directors sets the strategic direction of the company and oversees the executive management team, who are responsible for the day-to-day operations of the business. Business firms also have various departments that are responsible for different aspects of the business, such as finance, marketing, human resources, and operations. These departments work together to ensure that the company is functioning effectively and efficiently.

Game Theory aids in the comprehension of scenarios involving decision-makers due to its potential in creating behavioral models can become a tool used in the area of formulating or redesigning logistic strategies of supply chains. Game theory involves a significant part of decision making process under uncertainty conditions. Nash equilibrium is a concept in game theory that describes a stable state of a game where no player can improve their payoff by unilaterally changing their strategy, given that all other players keep their strategies unchanged. In other

words, it is a situation where each player's strategy is optimal, given the strategies of the other players to understand the concept of Nash equilibrium, let us first define a few terms. A game is a situation where two or more players interact with each other, and each player's payoff depends on the strategies they choose and the strategies chosen by the other players. A strategy is a plan of action that a player chooses to achieve their objective in the game.

Stackelberg equilibrium can be found using backward induction, which involves working backwards from the end of the game to determine the optimal strategies of each player. The leader's optimal strategy is determined by assuming that the follower will choose their best response to the leader's action. The follower's best response, in turn, is determined by assuming that the leader will choose their optimal strategy. There are limitations to the Stackelberg equilibrium concept. One limitation is that it assumes that both players have perfect information about each other's preferences and strategies, which may not be the case in real-world situations. Another limitation is that it assumes that the leader is able to commit to their chosen action, which may not always be feasible.

Paper is organized in the following manner introduction in Section I, Literature Survey in Section II, System design in Section III followed by Result Analysis in Section IV.

II. Literature Survey

"A game-theory based model for analyzing e-marketplace competition", in this authors Jianya Zheng and Weigang focuses on the Bertrand model, which is a game-theory model that assumes sellers compete by setting prices for their products. The model assumes that customers always choose the cheapest option available, and if two or more sellers offer the same product at the same price, they split the market share evenly [1]. The paper discusses the assumptions of the Bertrand model, including the assumption that sellers have perfect information about each other's prices and costs. It also discusses the prediction of the Bertrand model, which is that in a perfectly competitive market, sellers will set prices equal to their marginal cost. The paper then discusses the strategic behavior that sellers can engage in to gain an advantage over their competitors. This includes undercutting their competitors' prices, differentiating their products, and coordinating with other sellers in the market [1]. The paper also discusses game-theory models that can be used to analyze e-marketplace competition, including the Cournot model and the Hotelling model. The paper concludes by emphasizing the importance of game theory in analyzing e-marketplace competition. By understanding the incentives and behaviors of competitors, sellers can develop effective pricing and marketing strategies to gain a competitive advantage in the market [1]. The paper also notes that while game theory provides a powerful framework for analysis, it is important to keep in mind the limitations and assumptions of these models when applying them to real-world situations.

"Stakeholder power in e-business adoption with a game theory perspective", in this author Barbara Roberts adopted the e-business technologies is a complex process that involves multiple stakeholders with different levels of power and influence. This paper presents a game-theory based model to analyze the power dynamics among stakeholders in the e-business adoption process. The model considers three types of stakeholders: the firm, the customers, and the competitors [2]. The firm has the power to adopt e-business technologies, which can provide benefits such as cost savings and improved customer service. However, the adoption of these technologies can also have negative consequences, such as reduced customer loyalty and increased competition. Customers also have power in the e-business adoption process, as they can choose to adopt or reject e-business technologies [2]. They may be reluctant to adopt these technologies if they perceive them as difficult to use or if they are concerned about privacy and security issues. Competitors also have power in the e-business adoption process, as they can respond to the firm's adoption of e-business technologies by adopting similar technologies or by offering alternative products or services. The game-theory model analyzes the strategic interactions among these stakeholders and identifies the conditions under which the firm is most likely to adopt e-business

technologies. The analysis considers factors such as the costs and benefits of adoption, the level of competition in the market, and the preferences and power of the stake holders.

"Analysis on Pirate Game from the perspective of experimental economics and game theory", in this author Yunjia Huang uses Pirate Game. The Pirate Game is a classic game theoretic problem that is often used in the study of bargaining and cooperation. In this game, a group of pirates must decide how to divide a fixed amount of treasure. However, if a majority of pirates do not agree with the distribution, then the pirate proposing the distribution will be thrown overboard and the next pirate in line will propose a new distribution [3]. The game continues until a proposal is accepted. This paper aims to analyze the Pirate Game from the perspective of experimental economics and game theory. Experimental economics is a branch of economics that uses controlled experiments to test economic theories, while game theory is a branch of mathematics that studies strategic decision- making in situations of conflict and cooperation [3]. The authors conducted a series of laboratory experiments to study the behavior of participants playing the Pirate Game. They found that, on average, the pirates in the game were able to reach a fair distribution of the treasure, even though the outcome was not always optimal from a game theoretic perspective.

"Nash Equilibria of 2-Player Finite Simultaneous Move Games", in this authors Qianqin Chen, Ruiqiu Ou and Jianmei Yang titled this paper where Nash Equilibria of 2-Player Finite Simultaneous Move Games is a seminal work in game theory, published by John Nash in 1950 [4]. It lays out the basic concepts of Nash equilibrium, which has become one of the most important ideas in game theory and has applications in many fields, including economics, political science, and biology. The paper begins with a definition of a game, which is essentially a set of rules that govern the behavior of two or more players. Nash then introduces the concept of a strategy, which is a plan of action that a player can take in the game [4]. This defines a pure strategy as a single action that a player can take, and a mixed strategy as a probability distribution over the set of pure strategies. Nash then defines the concept of a Nash equilibrium, which is a set of strategies, one for each player, such that no player can improve their outcome by unilaterally changing their strategy. In other words, each player is playing the best response to the other player's strategy. Nash shows that every finite game has at least one Nash equilibrium, and provides a proof of this result [4]. The paper then goes on to provide several examples of games and their Nash equilibrium. These include the prisoner's dilemma, the battle of the sexes, and the matching pennies game. In each case, Nash shows how to find the Nash equilibrium and discusses the implications of the equilibrium for the players.

"Nash Equilibrium Seeking with Infinitely-Many Players", Paul Frihauf, Miroslav Krstic, and Tamer Basar, The concept of Nash equilibrium has been an important tool in game theory for understanding the behavior of multiple decision makers. However, much of the work on Nash equilibrium has focused on the case of finitely-many players. In this paper, the authors extend the theory of Nash equilibrium to the case of infinitely-many players. The authors begin by introducing a model of a game with an infinite number of players, where each player chooses a real number as their strategy [6]. They then define the notion of a Nash equilibrium in this setting, which is a set of strategies such that no player can improve their payoff by unilaterally changing their strategy. The authors then prove some key results about Nash equilibria in this setting. In particular, they show that if a game has a Nash equilibrium, then it has infinitely-many Nash equilibria [6]. They also prove a version of the folk theorem, which states that any payoff vector that is achievable in a repeated game can be achieved as a Nash equilibrium in a one-shot game. Next, the authors consider the problem of finding a Nash equilibrium in a game with infinitely-many players. They propose a modification of the best-response dynamics, where players repeatedly update their strategies to improve their payoff. They show that this modified dynamics converges to a Nash equilibrium under certain conditions on the game. Finally, the authors apply their theory to the case of oligopoly competition, where a small number of firms compete in a market [6]. They show that their results provide a new way of analyzing

competition in such markets, which can lead to new insights into the behavior of firms and the market outcomes. Overall, this paper provides a rigorous and comprehensive analysis of Nash equilibrium in the case of infinitely-many players. The authors' results have important implications for a wide range of fields, from economics to computer science to biology.

"Numerical Method for Finding a Static Stackelberg-Nash Equilibrium: The case of Favorable Followers", in this authors S. Moya and A. Poznyak uses Stackelberg-Nash equilibrium. Stackelberg-Nash equilibrium is a concept in game theory that describes a scenario in which a player, known as the leader, chooses their strategy first, and then the followers, known as the followers, choose their strategies accordingly to maximize their payoffs. The paper focuses on the scenario where the followers have a favorable outcome if they match the leader's strategy. The authors extend the FFSNE algorithm to the case of games with multiple followers, and they demonstrate its effectiveness in several numerical examples [5]. The authors propose a numerical algorithm for computing the Stackelberg-Nash equilibrium in games with favorable followers, which they call the "Follower- Favorable Stackelberg-Nash Equilibrium" (FFSNE) algorithm. The algorithm consists of two main steps: the first step involves finding the leader's best response function to the follower's strategy, while the second step involves finding the follower's best response function to the leader's strategy [5]. The authors then show that the FFSNE algorithm is computationally efficient and demonstrate its effectiveness in several numerical examples [5]. They also compare the FFSNE algorithm to other existing numerical methods for computing Stackelberg-Nash equilibrium and show that it outperforms them in terms of convergence speed and accuracy.

"Stackelberg-equilibrium of pricing and inventory decisions in a supply chain", Anwar Mahmood, The paper proposes a model for analyzing pricing and inventory decisions in a supply chain. The paper focuses on a two-level supply chain consisting of a single supplier and a single retailer [7]. The supplier is assumed to have complete information about the demand and production costs, while the retailer has limited information about the demand. The paper develops a Stackelberg game model to analyze the interaction between the supplier and the retailer [7]. The supplier is assumed to be the leader, who first sets the wholesale price and the production quantity. The retailer, who is the follower, then decides on the retail price and the order quantity. The paper considers two different scenarios: one where the retailer has a fixed order quantity and one where the retailer can vary the order quantity [7]. The paper shows that in both scenarios, the Stackelberg equilibrium exists, and the supplier's optimal wholesale price and production quantity depend on the retailer's order quantity and the market demand. The paper also shows that the Stackelberg equilibrium can lead to a win-win situation for both the supplier and the retailer, where both parties can achieve higher profits compared to a situation where they act independently [7]. The paper further extends the model to include inventory decisions by the retailer. In this extended model, the retailer is assumed to face a fixed ordering cost and a holding cost for excess inventory. The paper shows that the Stackelberg equilibrium in this extended model exists and the optimal decisions of both the supplier and the retailer depend on the market demand and the inventory cost parameters. The paper concludes by highlighting the importance of coordination between the supplier and the retailer in a supply chain. The model proposed in the paper can help the parties to coordinate their decisions and achieve higher profits. The model can also be extended to more complex supply chain structures and can be used to analyze different scenarios and decision-making situations.

III. System Design

This section presents the proposed system and implementation details of the Profit Calculation of Business Firms using Game Theory.

A. Proposed System

The system design of profit analysis model is shown in the Fig. 1.

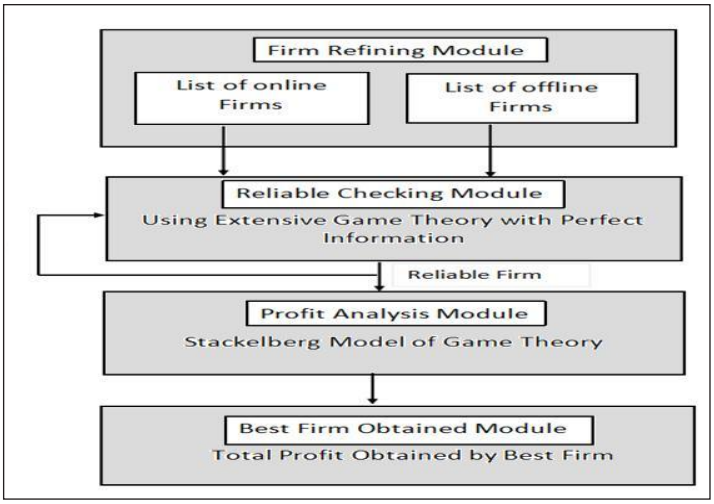

Fig. 1: System Design of Profit Analysis Mode

This model consists of four different modules namely, firm refining module, reliable checking module, profit analysis module and best firm obtained module.

Firm Refining Module: This module checks for the different firms which are involved in doing business both online and offline. The active firms who sale the product in short duration of time are short listed. The list of online firms, list of offline firms and list of manufacturers are obtained from this module.

Reliable Checking Module: In this module, reliability of the online and offline firms is checked using extensive game theory with perfect information.

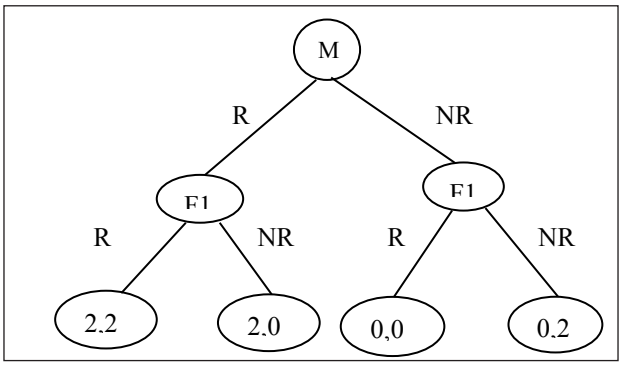

Fig. 2: Extensive Decision Tree with Perfect Information

The Fig. 2 shows two players involved in doing business online. One player is manufacturer represented as "M". The other is business firm1 identified as F1. The manufacturer actively participates in the game. The manufacturer has two moves, reliable represented as 'R' and not-reliable represented as 'NR'. The player becomes active after the manufacturer decides which action to chose. The business firm F1 has two strategies to choose. The strategies are reliable and non-reliable. The values (2,2) , (2,0), (0,0), and (0,2) are called payoff values. The strategy that has been selected by manufacturers is R. The supplier also selects R. Their payoff is (2,2), For the strategy (R, NR) the payoff is (2,0), For the strategy (NR, NR) the payoff is (0,0) and for the strategy (NR, R) the payoff is (0, 2). The business firm F1 has two strategies to choose. The strategies are reliable and non-reliable. The values (2,2), (2,0), (0,0), and (0,2) are called payoff values. Unlike dominant strategy, the Nash equilibrium doesn't always lead to the most optimal outcome. It just means that an individual chooses the best strategy based on the information they have. The strategies are reliable and non-reliable.

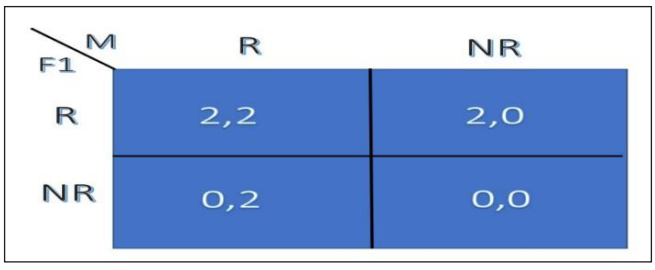

Fig. 3: Payoff Matrix to Check Reliability

Profit Analysis Module: In this module, Stackelberg model is used to find out the profit**.** The Stackelberg model is a leadership model that allows the firm dominant to set its price first. Subsequently, the follower firms optimize their production and cost. It was formulated by Heinrich Von Stackelberg in 1934. Let us assume a market with three players – A, B, and C. If A is the dominant force, it will set the product's price first. After that, firms B and C will follow the price set and adjust their production basis supply and demand patterns accordingly.

The first two scenarios will result in an equilibrium condition after a time-lapse where the profit maximization functions will serve as the determinants. In case 3, a warfare situation will occur as equilibrium will be difficult to establish. Therefore, it can be expected such a loggerhead stance can only be eliminated if there is a collision or failure of the weaker firm leading to a monopoly in the market. Finally, in case 4, the profit maximization expectations will not hold, and they must revise. That gives rise to the Cournot condition.

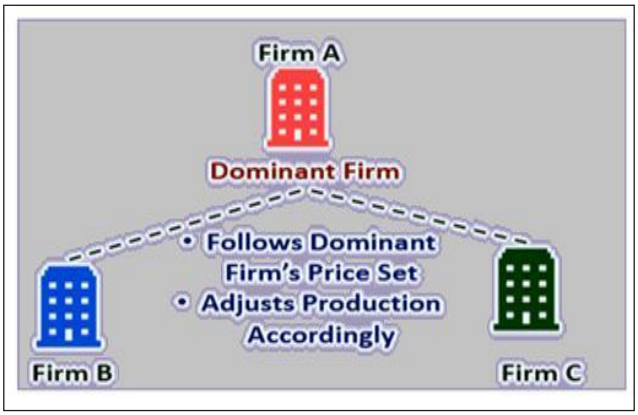

Fig. 4: Stackelberg Model

B. Assumptions in Stackelberg

A duopolistic can sufficiently recognize market competition based on the Cournot model. Each firm aims to maximize its profits based on the expectation that the decisions of its competitors will not be affected by its output. It assumes perfect information for all players in the market. Note: An underlying assumption with the Cournot model is that the operating firms cannot collude and must seek to maximize profits based on their rivals' decisions. However, models such as Stackelberg, Cournot, and Bertrand have assumptions that do not always hold in real markets. While one firm may follow Stackelberg's principles, the other might not.

The following steps can help solve a basic problem based on the Stackelberg model:

- Write the demand function for the market.
- Write the cost functions for both firms A and B in the market.
- The individual reaction functions in the duopoly are found by taking the partial derivates of the profit function.
- Assume firm A as a leader, and obtain the profit maximization equation for firm A, substituting firm B's profit function in firm A equation.
- Solve for firm B as being the follower.

The following circumstances are possible if two firms, A and B, participate in a duopolist competition:

- Firm A chooses to be the leader, and B wants to be the follower.
- Firm B chooses to be the leader, and A wants to be the follower.
- Both A and B want to be the leaders.
- Both A and B choose to be followers.

Stackelberg's model remains an important strategic model in economics. This model is useful to a firm when it realizes profitability prospects under the first-mover advantage concept. A practical instance where leaders show commitment to the first move is capacity expansion. It is assumed that one cannot undo the action. In principle, Stackelberg's strategy is important where the first mover, the leader, acts irrespective of the follower's movement.

C. Manually Profit Calculation using Stackelberg Model for Two Firms

Consider MC=4

P=10000/2(QA +QB)

Calculation for Firm "B" :

MAX QB => PQB - MC*QB

MAX QB => (100 - 2QA - 2QB)QB - 4QB

MAX QB =>100QB - 2QAQB - 2QB2 - 4QB

MAX QB => 96QB - 2QAQB - 2QB2 = 0

Differentiate W.R.T. QB

$\partial\pi/\partial$QB , 96 - 2QA - 4QB = 0

4QB = 96 - 2QA

QB = 96/4 - 2/4 QA

QB = 24 -1/2 QA ----------(1)

Calculation for Firm "A" :

MAX QA => PQA - MC*QA

MAX QA => (100 - 2QA - 2QB)QA - 4QA

MAX QA => (100 - 2QA -2[24 - 1/2QA] QA - 4 QA)

MAX QA => (100 -2QA - 48 + QA) QA - 4QA

MAX QA =>(100 -2QA - 48 + QA) QA - 4QA

MAX QA => (52 - 2QA + QA) QA - 4QA

MAX QA => (52 - 2QA2) - 4QA

48QA - QA2 = 0

Differentiate W.R.T. QA

$\partial\pi/\partial$QB , 48QA - QA2 = 0

48 - 2QA = 0

QA = 48/2

QA = 24 ----------(2)

Substitute eqn (2) in eqn (1)

QB = 24 - 24/2

QB = 12

Substitute QA & QB values in P

P = 100 - 2(24 + 12)

P = 100 - 2(36)

P = 100 - 72

P=28

Best Firm Obtained Module: This module gives the total profit obtained by the two best firms who are reliable. Farther they manufacture the products together to earn the profit.

The Fig. 5 shown above is the Usecase diagram for proposed system. It provides detail and clear description about the Proposed System. Considering the two actors which are represented by stick diagram, namely Business Firm1 and Business Firm2. The rectangle box is termed as system which consists of n number of usecase.

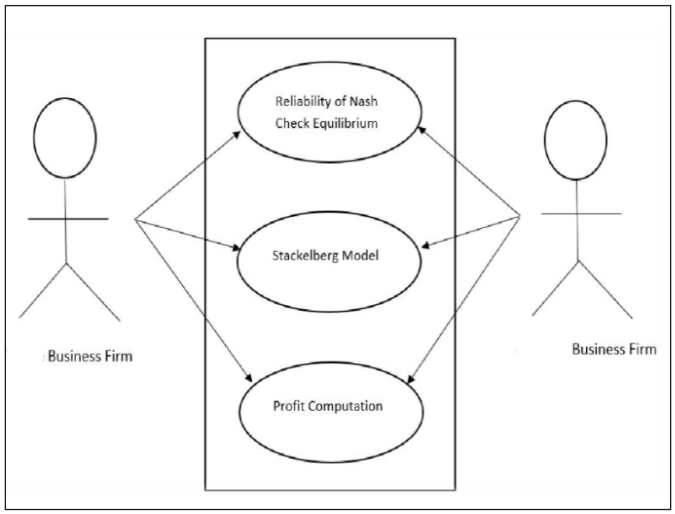

Fig. 5: Usecase Model of Business Firms

According to this model this have three usecase has been used, they are Reliability of Nash, Stackelberg Model, Profit Computation.

- *Reliability of Nash Equilibrium:* Nash equilibrium helps to find the reliable firms among the set of firms.
- *Stackelberg Model:* Stackelberg is used to compute the profit among the reliable firms which is obtained by applying Nash equilibrium.
- *Profit Computation:* By considering the two major firm, can obtain the highest profitable firm. Hence this firm is selected by manufacturers.

D. Implementation

Algorithm:

```
1.Import Random module
2.While(I<n)
   a)Selection of Manufacturer,Firm1 and Firm2
   b)Reliability checking module using extensible decision    tree with perfect Information
   i)If(a>=c and a>=e and a>=g and b>=d and b>=f and      b>=h)
        1)print PAYOFF matrix
         2)Print Manufacturer ID,Firm1 ID,Firm2 ID are satisfied     by Nash equilibrium
        3)Profit calculation from Stackelberg Model
                a) Selection of maximum cost required to   manufacture product.
                b) Print Firm1 ID and calculate the following for quantity of product manufactured by Firm1
                Quantity of products manufactured byFirm1(Qa)=(10000-maximum cost)/4
              Print Qa
                c) Print Firm2 ID and calculate the following for quantity of product manufactured by Firm2
                Quantity of products manufactured by Firm2(Qb)=((10000- maximum cost)/4)-(0.5*Qa)
              Print Qb
              d) Calculating Proft
                   Total Profit=10000-2*(Qa+Qb)
   else
     Print Payoff Matrix
      Print Manufacturer,Firm1 and Firm2 are not satisfied by Nash  Equillibrium
```

Alogrithm 1: Filtering of Unreliable Stakeholder using Game Theory

IV. Result Analysis

This section gives information of output obtained; same is represented in the form of snapshot.

A. Snapshots of User Interface

Login Page

Fig. 6 shows the login page for the proposed system. Technology used is HTML, CSS and JavaScript .Login page consists of two login options namely Admin login and Manufacturer login. Here the Admin and Manufacturer should enter name and password to get logged in.

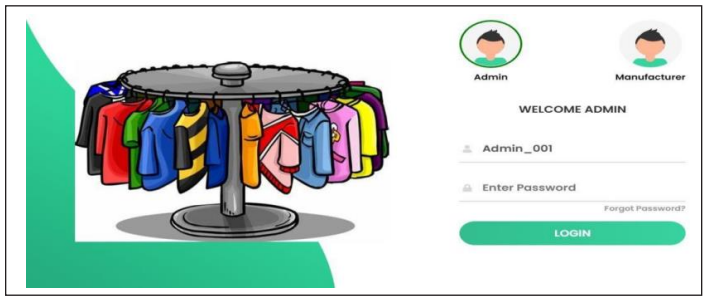

Fig. 6: Login Page

Admin Login

Fig. 7 shows the list of manufacturers. They include Saree, Sassy Skirts, Denim hits, Floral prints and Jumpsuit manufacturers.

Fig. 7: Admin Login

List of Saree Manufacturers

Fig. 8 shows the list of Saree Manufacturers among the firms is obtain by clicking on Saree manufacturer option. The table consists of Manufacturer_ID, Manufacturer and Type.

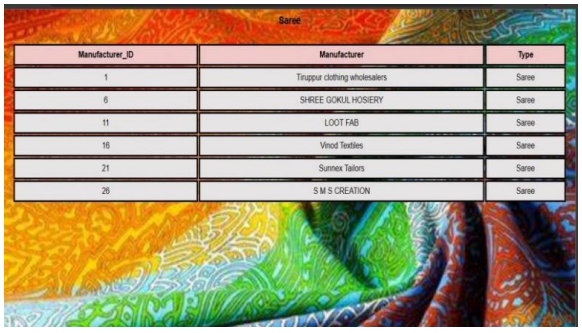

Fig. 8: Saree Manufacturer List

List of Foral Prints Manufacturers

Fig. 9 shows the list of Floral Prints Manufacturers among the firms is obtain by clicking on Floral Prints manufacturer option. The table consist of Manfacturer_ID, Manufacturer and Type.

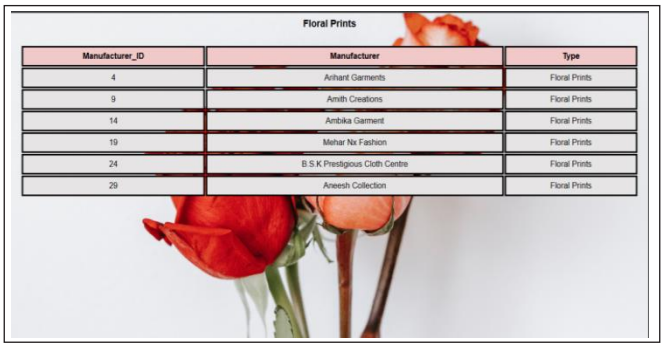

Fig. 9: List of Floral Print Manufacturer

List of Jump Suit Manufacturer

Fig. 10 shows the list of Jumpsuit Manufacturers among the firms is obtain by clicking on Jumpsuit manufacturer option. The table consist of manufacturers ID, Manufacturer name and type.

Fig. 10: List of Jumpsuit Manufacturers

Manufacturer Login

Fig. 11 shows Manufacturer Login. It includes firm1 and firm2 datasets.

Fig. 11: Manufacturer Login

List of Firm1 and Firm2

Table I and Table II shows list details of the information sold by the Firm1 and Firm2. It includes information about names of the Firms, Price, Color and Type. In the column name, firms name are mentioned, price consist of price, followed for color and type of product they sell.

TABLE I: FIRM1 PRODUCT SELLING DETAILS

F1	Name	Price	Color	Type
1	Inweave	5899	Orange	Saree
2	Anubhulee	4899	Navy Blue	Sassy Skirt
3	Nayo	3699	Red	Denim Kurta
4	Ahika	1350	Black	Saree
5	Libas	2050	Grey	Ethnic wear

TABLE II: FIRM2 PRODUCT SELLING DETAILS

F2	Name	Price	Color	Type
1	Mehar Nx Fashion	5899	Orange	Saree
2	Varshni Garments and Fashions	4899	Navy Blue	Sassy Skirt
3	Prashanth Mens Fashion	3699	Red	Denim Kurta
4	Vinod Textiles	1350	Black	Saree
5	Gopi Textiles	2050	Grey	Ethnic wear

B. Test Cases

Test Cases are divided into two cases. These cases are discussed below.

Case 1: Checking for Reliable Firm using Nash Equilibrium

Table III shows the reliability list obtained after applying Nash Equilibrium. It consists of Manufacturer_ID, Manufacturer_Name, Firm1_ ID,Firm1_Name, Firm2_ID, Firm2_Name and Nash Equilibrium.

For example, consider Manufacturer_ID 8, Manufacturer_Name Amith Creations, with Firm1_ ID as 20, Firm1_Name as Libas, Firm2_ID as 7, Firm2_Name as Anouk has satisfied the Nash Equilibrium.

For example, consider Manufacturer_ID 11, Manufacturer_Name Leher Men's Designers, with Firm1_ID as 10, Firm1_Name as indi inside, Firm2_ ID as 9, Firm2_Name as Kalini has not satisfied the Nash Equilibrium.

Table III: Reliability List Obtained from Nash Equilibrium

Manufacturer_ID	Manufacturer_ Name	Firm1_Id	Firm1-Name	Firm2_ID	Firm_2 Name	Nash equilibrium
8	Amith Creations	20	Libas	7	Anouk	Satisfied
28	Anand Apparels	8	Louis	10	Indi INSIDE	Satisfied
11	Leher Men's Designers	10	Indi INSIDE	9	Kalini	Not Satisfied
26	Shri Mahalaxmi Agencies	25	Basacrafts	19	Sangria	Satisfied
27	Aneesh Collection	23	Myshka	8	Louis	Satisfied

Case 2: Profit Obtained by Joint Venture using Stackelberg Model

Table IV shows the profit by both firms selling the product manufactured by the Manufacturer obtained after applying Stackelberg Model. It consists of Manufacturer_ID, Manufacturer_Name, Firm 1_ID, Firm 1_Name, Firm 2 _ID , Firm2_Name and Profit.

For example, consider Manufacturer_ID 19, Manufacturer_Name Mehar Nx Fashion, with Firm 1_ID as 27, Firm1_Name as Libas, Firm 2_ID as 16, Firm 2_Name as Divyank has profit of 6189.25 rupees.

Consider Manufacturer_ID 16, Manufacturer_ Name Vinod Textiles, with Firm1_ID as 2, Firm1_ Name as Anubhutee, Firm 2_ID as 29, Firm 2_Name as Anouk has profit of 4802.5 rupees.

Table IV: Profit Obtained from Stackelberg Model

Manufacturer_ ID	Manufacturer_Name	Firm1_Id	Firm1-Name	Firm2_ID	Firm_2 Name	Profit in Lakhs
19	Mehar Nx Fashion	27	Libas	16	Divyank	6189.24
25	Varshini Garments and Fashions	11	Varanga	25	Busan	6039.25
19	Mehar Nx Fashion	16	Seoul	17	Libas	5642.5
11	Loot Fab	27	Libas	1	Kvsfab	5179.75
16	Vinod Textiles	2	Anubhutee	29	Anouk	4802.5

V. Conclusion

The use of game theory in calculating the profit of business firms provides a comprehensive framework for understanding the competitive dynamics of the industry. Game theory models can help firms make strategic decisions by considering their actions in relation to the actions of competitors. By identifying the different strategies available to them and their competitors, firms can make informed decisions that maximize their profits. Through game theory analysis, firms can identify their optimal profit strategy. The Nash equilibrium concept in game theory can help firms determine the best strategy to adopt, given the

actions of their competitors. In essence, game theory analysis can help firms anticipate the actions of their competitors and prepare for them accordingly. Overall, game theory provides a useful tool for analyzing the profit of business firms, and it can help firms make better-informed decisions. However, it is important to note that game theory models are based on certain assumptions, and they may not always accurately reflect the complexities of the real world. Nonetheless, game theory provides a solid foundation for firms to analyze their profit and make strategic decisions.

Future Enhancement

Present work calculates the profit only for clothing but we can make this project further enhanced by applying the same strategies and methods for automobiles and many other applications.

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Journal of Applied Information Science
12 (1) 2024, 18-28
http://www.publishingindia.com/jais

Use of E-ShodhSindhu in PG Colleges of Amritsar District: An Analytical Study

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Abstract: Libraries all across the world are promoting faster, more affordable and better ways to make electronic information resources available to all types of information searchers through their current global network. The creation of the proper infrastructure for libraries that are a part of the network environment, especially academic libraries, has undergone a revolution thanks to INFLIBNET. The creation of the N-LIST program for colleges is crucial to advancing higher education. The member colleges have access to a wealth of information for a little monthly fee that may be accessed with just one click. The study looked at how the faculty of three famous colleges of Amritsar uses the E-Shodh Sindhu College Component (N-LIST) resources and made some important suggestions.

Keywords: Databases, E-ShodhSindhu, e-Books, e-Journals, e-Resources, N-LIST.

I. Introduction

The role of libraries in the system of higher education is important. No education system can sustain itself and accomplish its set goals and objectives without a proper infrastructure for information and knowledge. Libraries balance the needs of both the person and the institution while making low-cost, wise purchases. The information landscape is evolving more quickly. There are numerous causes for this transformation. Due to the accompanying benefits, library patrons are beginning to demand more resources in electronic format [1]. The way that consumers now retrieve information has moved from traditional to electronic resources as a result of the enormous advancements in information communication technology (ICT). E-resources are one of the most important information sources for academics, teachers, scientists and other professionals. E-resources are becoming more and more important in academic libraries every day. E-resources have a significant impact on students' academic and research work since academic libraries are primarily used by professors, researchers, and students. By adapting to evolving demands and developments, one could increase the applicability and relevance of materials to the diverse needs of library patrons [2]. Remote locations have easy access to electronic resources. Electronic resources reduce information overload and address storage issues. Sources from print are being digitalized. For the academic community, electronic information sources are becoming more and more crucial. The development of technology has prompted libraries to expand their holdings. The e-resources are the most well-known of all [3]. In 1988, the University Grants Commission established INFLIBNET. For libraries, especially those in colleges and universities to be a part of the networked environment INFLIBNET has taken the initiative to make a significant transformation. A consortium would need to be established to fully utilize this infrastructure and provide speedy access to information. More services are now available, including the ability to borrow from others, access to full-text publications from worldwide vendors, building digital libraries,

organizing and gaining access to Internet resources, etc [4]. The biggest evolutionary initiatives in India for university and college library users to access e-resources for students, researchers, and professors from colleges include INFLIBNET and INDEST-AICTE Consortium's N-LIST program. These ground-breaking actions include making scholarly resources available, such as e-books, databases, abstracts of sessions, and other virtual resources available to users, assisting colleges with their research and development [5].

II. Review of Literature

- Jadhar and Bansode [6] in their study explored the role of librarians in accessing N-LIST e-resources. The study was carried out on colleges that were affiliated with Savitribai Phule Pune University and have N-LIST membership. A total of 80 questionaries were distributed and filled 60 received back 96.7% of respondents consider that they have adequate infrastructure needed for N-LIST. The study found that the majority (71.6%) of respondents consider N-LIST e-resources to be easy to search and 65%t consider them as economical resources, so they acquire them for their users. 90% of respondents consider that they use orientation methods to promote the use of N-LIST e-resources followed by notice boards (65%), e-mails (55%), library websites (48.3%) and library user guides (36.6%). As N-LISTis considered to be an economical and cost-effective resource for the library, so 63.3% of respondents marked that its subscription has no effect library's annual budget. The study put forward a few suggestions more publicity, regular orientation/training programs, and skilled staff will help enhance the use of N-LIST e-resources.
- Kaur and Kathuria [7] Libraries must give their patrons unrestricted access to services and a supportive environment to assist their academic success. To find out how satisfied customers were with the library website, resources, infrastructure, and services, 202 patrons of the Punjab Agricultural University Library participated in a survey. The research found that among students, graduates, research scholars and faculty users, there were differences in the degree of satisfaction and awareness of library services and facilities. Only postgraduate students have access to a required credit-based course; thus, the other users are unaware of the services and amenities the library provides. The survey findings revealed a substantial relationship between user awareness of the library website, user education programs, ICT infrastructure, library resources and services, efficiency, and staff attitude. Student and teacher happiness is directly impacted by changes to the library's resources and services, ICT infrastructure and staff productivity and attitude. The study also revealed that UG students were less aware of the library web page than PG students, research scholars, and faculty members. The study concluded with various suggestions for the enhancement of library use and user satisfaction.
- Dhuri and Lobo [8] conducted a study on N-LIST e-resources use during the pandemic. The data was collected with the help of Google form which was distributed among library users of academic colleges in Goa. A total of 100 forms were sent and 82 out of which responded. The study found that 91% of respondents were aware of N-LIST e-resources while 8.5% were not aware. 61% of respondents got awareness about e-resources from librarians. 82.9% of respondents considered that N-LIST e-resources were the best substitutes for conventional resources. The major purpose for accessing N-LIST e-resources was for assignments/ projects (81.7%) followed by rearing study notes (42.7%), general reading (36.6%), and teaching (32.9%). Current information (76.8%) and easy-to-locate information (65.9%) were the most liked features of accessing N-LIST resources. E-journals (64.6%) were more preferred in comparison to e-books (35.4%). The study highlighted the major problems faced while accessing N-LIST resources were poor internet (34.1%), system problems (29.3%), lack of guidance (19.5%), and varied search patterns (17.1%). They also listed various benefits for accessing N-LIST resources which

were 24X7 availability (84.1%), a wide variety of resources (72%), reliable information (68.1%), and time-saving (30.5%). 79.26% of respondents consider that N-LIST e-resources were the most reliable, authentic sources of information during the pandemic.

- Rani and Kaur [9] in their study revealed that 100% of the respondents were aware of e-resources. 60.30% of respondents always prefer to use 'author name' for searching e-resources followed by often using the author's name (21.90%) for the same. 70.30% of respondents search through title followed by often use title (22.40%). 58.90% of respondents used 'keywords' always followed by often use (24.20%). 41.60% of respondents used always Year of publication followed by some time (26%) and often (22.80%). 53.40% of respondents used journal names always followed by often (26%). 62.10% of respondents used the subject always followed by often (26.90%).
- Mondal and Bhatt [10] carried online survey to examine the use of e-resources by the research scholar and PG students of the University of Dhaka. The study investigated awareness, methods and obstacles to reading and accessing e-resources. The study explored that both research scholars (70%) and PG students (8%) were aware of e-resources and accessed them regularly. The majority of respondents i.e., research scholars (92%) and PG students (87.10%) accessed electronic resources for their research work. The study found that PG students (74.19%) and research scholars (60%) faced an insufficiency of computers in the library for accessing electronic resources to fulfil their information needs. The study found that the most suitable electronic resources for both PG students and research scholars were e-books and e-journals. On the other hand, the most suitable format was PDF. The respondents considered the non-availability of full-text documents (41.94%) and the slow speed of the Internet network (45.16%), restriction (36%), and non-cooperation of library staff (24%). and traditional resources fulfilling their needs (4%) were the major reasons for not accessing electronic resources.
- Sharma and Khera [11] The purpose of their study was to investigate how undergraduate (MBBS) and graduate (MD/MS) students at Maharaja Agrasen Medical College Agroha, Hisar, used and were aware of online resources. Out of the 100 questionnaires issued, 88 were returned with the responses were completed. The survey indicated that 95.4% of respondents across all categories were familiar with and frequently used electronic resources. The majority of respondents (81.82%) indicated that their primary motivation for using electronic resources was to "upgrade their medical knowledge," followed by patient care (48.86%) and accessing medical databases (34.09%). Only 21.59% of respondents said they preferred to access PubMed. Examining the consumption trends and availability of e-resources among users was the primary goal of this study.
- Sushma and Ramesha [12] The purpose of this study was to determine how well-versed and frequently used web-based library and information services were among the faculty members and research scholars of Bangalore University. A well-designed structured questionnaire was used to collect data. A total of 100 questionaries were distributed and 91 filled were received back. The study found that the majority of respondents were aware (92.3%) of web-based e-resources while 7.7% were not aware. The study shows that the majority (70.32%) of respondents used both print and electronic resources, while 28.58% of respondents used only electronic or online resources and only 1% of respondents preferred the print version of library resources. Maximum (58.24%) respondents daily accessed e-resources followed by 2-4 times a week (27.47%), once a week (10.99%), and only 3.3% occasionally. 92.4% of respondents considered that e-resources improve the ability to do research and 61.54% considered that it saves time.

III. Objectives of the Study

The main objectives of the study are as under:

- To know the use of the library and e-resources available through the N-LIST program.
- To discover the preferred mode of awareness of N-LIST e-resources.
- To find out the faculty members preferred e-resources from N-LIST e-resources.
- To know the satisfaction level and necessity of e-resources for the library.

IV. Methodology

The present study intends to describe the use of e-ShodhSindhu resources by faculty of three very famous and old colleges having glorious history of Amritsar (Punjab). Therefore, the investigator has adopted a survey method for data collection through a well-structured questionnaire.

Scope of Study: The scope of study for the current paper is limited to three colleges of Amritsar district from Punjab. These colleges have had N-LIST membership from the period of 2010 i.e., when this program started.

- BBK DAV College, Amritsar
- Khalsa College Amritsar
- Hindu College, Amritsar

V. Brief Introduction of the Sample Under Study

- *BBK DAV College, Amritsar:* BBK DAV College for Women, which is 56 years old, is a leader in the nation's higher education landscape. It was established in 1967 under the auspices of the DAV College Managing Committee, New Delhi, with the stated intention of bringing education benefits to women while balancing tradition and modernity. This multi-faculty school, which aspires to combine traditional courses with professional and vocational education, is a great example of what a women's college can accomplish for the advancement of women. The focus of the college is on the extremely creative and effective management of all of its resources, including both human and physical ones.

  The library at the college is well-stocked, multi-story, cutting-edge, computerized, and air-conditioned. It is the centre of action all year long and is housed in an impressive, well-lit, and ventilated edifice. The completely computerized library, which has more than 66,000 books, 153 national and international periodicals, 132 popular magazines, and 20 newspapers, operates on an open-access basis and is supplemented by a reprographics department. It contains spacious reading rooms [13].

Subject-Wise Detail of the Sample Under Study

Subject	No. of Respondents
Computer Science	15
Philosophy & Psychology	11
Languages	6
Social Sciences	3
Sciences	6
Arts & Recreation	3
History & Geography	7
Total	51

- *Khalsa College, Amritsar:* The founders of the Singh Sabha Movement founded Khalsa College, the top-most institution of higher study, in 1892. The high ideals of the great Gurus served as an inspiration to them. They envisioned it as a developing institution that would work tirelessly to maintain a high standard of mental and physical excellence for the benefit of the next generation. The campus's design and the architectural splendor of its buildings amply show the creators' intentions. The students have access to great facilities due to a completely computerized library with a barcode system. Over 2,03,301 books are available in the library as a whole. One of the best book collections is housed there, which gives it distinction. Due to the College Library's associate membership in "INFLIBNET," employees and students can now access periodicals and books online [14].

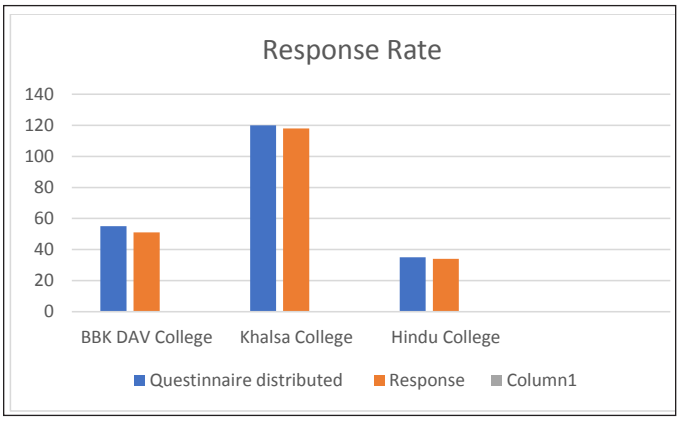
Subject-Wise Detail of the Sample Under Study

Subject	No. of Respondents
Computer Science	21
Philosophy & Psychology	17
Languages	26
Social Sciences	18
Sciences	24
Arts & Recreation	3
History & Geography	9
Total	118

- *Hindu College, Amritsar:* Eminent figures like the late Shri Gopal Dass Bhandari and other distinguished philanthropists created the Hindu College in Amritsar in 1924. The institution has been providing commendable services in the areas of education and culture for the past 95 years. One of the top colleges in Amritsar is Hindu College, which stands out on the national horizon as a source of high-quality higher education. A multi-faculty school that seeks to combine conventional courses with professional and vocational education. Additionally, we place a strong emphasis on each student's personality's healthy, balanced development. The NAAC has given the college an "A" grade in accreditation. The college provides the perfect fusion of science and social issues, tradition and modernity, moral principles, and business savvy. More than 25000 print volumes are freely available in the library. The bookshelves' contents are organized and thoroughly classified by the internationally recognized DDC (Dewy Decimal Classification) classification system. The library has print subscriptions to over 100 national and international periodicals, magazines, and newspapers [15].

Subject-Wise Detail of the Sample Under Study

Subject	No. of Respondents
Computer Science	5
Philosophy & Psychology	4
Languages	8
Social Sciences	6
Sciences	7
Arts & Recreation	1
History & Geography	3
Total	34



A total of 210 questionnaires were distributed personally to the faculty members of the colleges under study. Out of these, 203 (96.66%) filled-up questionnaires were received back.

VI. Data Analysis and Findings

Table I: Visit to College Library and Use of E-Resources

Name of College (No. of Respondents)	Visit to College Library (N/%)	Use of E-Resources (N/%)
BBK DAV College, Asr (51)	51 (100.0)	51 (100.0)
Khalsa College, Asr (118)	118 (100)	118 (100)
Hindu College, Asr (34)	34 (100)	34 (100)
Total (203)	203 (100)	203 (100)

Table I shows that all the respondents (i.e., 100%) visit to their college library and use e-resources to fulfill their information needs.

Table II: Frequency of Library Visit and Use of E-Resources

Name of College (No. of Respondents)	Frequency							
	Library Visit (N / %)				E-Resources Usage (N / %)			
	Daily	Weekly	Fortnightly	Occasionally	Daily	Weekly	Fortnightly	Occasionally
BBK DAV College, Asr (51)	2 (3.92)	47 (92.16)	2 (3.92)	-	-	45 (88.24)	1 (1.96)	5 (9.80)
Khalsa College, Asr (118)	20 (16.95)	70 (59.33)	25 (21.19)	3 (2.55)	10 (8.48	35 (29.67)	65 (55.09)	8 (6.78)
Hindu College, Asr (34)	1 (2.94)	28 (82.35)	5 (14.70)	-	-	33 (97.05)	-	-
Total (203)	23 (11.33)	145 (71.42)	32 (15.76)	3 (1.47)	10 (4.92)	113 (44.66)	66 (32.51)	13 (6.40)

Table II reveals that 71.42% of respondents visit the library weekly followed by fortnightly (15.76%). On the other hand, only 11.33% of respondents are regular visitors to the library. The percentage of passive users who visit the library rarely is comparatively very low i.e., 1.47%. The study finds that the maximum respondents of BBK DAV college (92.16%) weekly visit the library followed by Hindu college (82.35%).

In the case of frequency of use of e-resources the collected data shows that 44.66% of respondents access e-resources weekly followed by 32.51% fortnightly and a very less numbers of respondents use daily (4.92%) and occasionally (6.40%). The study finds that maximum respondents of BBK DAV college (88.24%) weekly access e-resources followed by Hindu college (97.05%) and respondents from Khalsa college prefer to access fortnightly (55.09%).

Table III: Awareness of E-ShodhSindhu (N-LIST) Programme

Name of College (No. of Respondents)	Fully Aware (N / %)	Partially Aware (N / %)	Not Aware (N / %)
BBK DAV College, Amritsar (51)	44 (86.27)	7 (13.73)	-
Khalsa college, Asr (118)	53 (44.92)	60 (50.85)	5 (4.24)
Hindu College, Asr (34)	33 (97.05)	1 (2.94)	-
Total (203)	130 (64.40)	68 (33.49)	5 (2.46)

Table III shows that 64.40% of respondents are fully aware of the e-ShodhSindhu (N-LIST) e-resources whereas 33.49% of respondents are partially aware of it. Surprisingly, 2.46% of respondents are not aware of it. The study finds that the maximum number of respondents of BBK DAV (86.27%) and Hindu College (97.05%) are fully aware.

Table IV: Mode of Awareness About E-ShodhSindhu (N-LIST) E-Resources

Name of the College (No. of Respondents)	Mode of Awareness About E-Resources (N / %)				
	College Website	Orientation Prog.	Library Staff	Teachers	Colleagues
BBK DAV College, Asr (51)	8 (15.69)	7 (13.73)	36 (70.59)	-	
Khalsa College, Asr (118)	3 (2.55)	8 (6.78)	25 (21.19)	37 (31.36)	45 (38.14)
Hindu College, Asr (34)	-	-	22 (64.70)	1 (29.4)	10 (29.41)
Total (203)	11 (5.41)	15 (7.38)	83 (40.88)	38 (18.71)	55 (27.09)

Table IV reveals that 40.88% respondents are getting awareness about e-ShodhSindhu (N-LIST) e-resources through library staff followed by 27.09 from colleagues and only 7.38% through their library orientation program and college website (5.41%). The study finds that the maximum number of respondents of BBK DAV (70.59%) and Hindu college (64.70%) got awareness from library staff while in Khalsa college from teachers (31.36%).

Table V: Average Time Spent on Accessing E-Resources Per Week

Name of the College (No. of Respondents)	Average Time Spent on Accessing E-Resources Per Week (N / %)			
	Less than 1 hr.	1-5 hrs.	6-10 hrs.	More than 10 hrs.
BBK DAV College, Amritsar (51)	51 (100)	-	-	-
Khalsa College, Asr (118)	118 (100)	-	-	-
Hindu College, Asr (34)	33 (97.06)	1 (2.94)	-	-
Total	202 (99.50)	1 (0.50)	-	-

Data collected in Table V revealed that 99.50% of respondents use e-resources for less than 1 hour and only 0.5% for one hour.

Table VI reveals that e-journals are more preferred resources in E-ShodhSindhu (N-LIST) e-resources, as 43.84% always and 37.43% most of the time use e-journals in E-ShodhSindhu (N-LIST) e-resources. In the case of e-books 27.09% of respondents use most of the time and 10.34% always. On the other hand, 33.49% of respondents most of the time use online databases and only 22.16% use always.

TABLE VI: PREFERENCE SOURCES WHILE SEARCHING E-SHODHSINDHU (N-LIST) E-RESOURCE

Name of College	E-Journals					E-Books					Databases				
	Always	Most of the Time	Sometime	Rarely	Never	Always	Most of the Time	Sometime	Rarely	Never	Always	Most of the Time	Sometime	Rarely	Never
BBK DAV College, Asr (51)	3 5.88	37 72.55	11 21.57	-	-	5 9.80	19 37.25	17 33.33	8 15.69	-	19 37.25	30 58.82	2 3.92	-	-
Khalsa College, Asr (118)	85 72.04	10 8.48	-	-	-	15 12.72	35 29.67	-	-	-	2 1.70	31 26.28	5 4.24	-	-
Hindu College, Asr (34)	1 2.95	29 85.29	4 11.77	-	-	1 2.95	1 2.95	31 91.18	1 2.95	-	24 70.59	7 20.59	3 8.83	-	-
Total (203)	89 43.84	76 37.43	15 7.39	-	-	21 10.34	55 27.09	48 23.64	9 13.33	-	45 22.16	68 33.49	8 3.94	-	-

TABLE VII: PLACE OF ACCESSING E-SHODHSINDHU (N-LIST) E-RESOURCE

Name of College	Place of Accessing E-Resources														
	Library (N / %)					Home (N / %)					Campus (N / %)				
	Always	Most of the Time	Some time	Rarely	Never	Always	Most of the Time	Some time	Rarely	Never	Always	Most of the Time	Some time	Rarely	Never
BBK DAV College, Asr (51)	3 5.88	35 68.63	8 15.69	5 9.80	-	- 	7 13.73	37 72.55	7 13.73	-	25 49.0	17 33.3	-	8 15.69	-
Khalsa College, Asr (118)	23 44.92	10 8.48	20 16.95	12 10.17	-	75 63.56	25 21.19	15 12.72	2 1.70	-	23 19.5	17 14.4	11 9.33	4 3.39	-
Hindu College, Asr (34)	1 2.94	7 20.58	26 76.47	-	-	- 	2 5.88	21 61.76	11 32.35	-	3 8.82	29 85.2	2 5.88	-	-
Total (203)	27 13.30	52 25.61	54 26.66	17 8.37	-	75 36.94	34 16.74	73 35.96	20 9.85	-	51 25.1	63 31.0	13 6.40	12 5.911	-

Table VII shows that the majority of respondents from Khalsa College (63.56%) always followed by 72.55% of BBK DAV sometimes and 61.76% of Hindu college search e-resources from home. On the other hand, 36.94% of respondents always access from home followed by the Library (13.30%) and Campus (25.12%).

Table VIII: Satisfaction Level with E-Resources

Name of the College (No. of Respondent)	Satisfaction Level with E-Resources (N/%)														
	E-Journals					E-Books					Databases				
	FS	S	MS	DS	FDs	FS	S	MS	DS	FDs	FS	S	MS	DS	FDs
BBK DAV College, Asr (51)	1 1.96	43 84.31	6 11.76	-	-	5 9.80	39 76.47	7 13.73	-	-	3 5.88	43 84.31	5 9.80	-	-
Khalsa College, Asr (118)	72 61.02	36 30.51	12 10.17	-	-	14 11.87	42 35.60%	36 30.51	-	-	46 38.99	36 30.51	17 14.41	-	-
Hindu College, Asr (34)	1 2.94	26 74.47	7 20.58	-	-	-	27 79.41	7 20.58	-	-	30 88.23	4 11.76	-	-	-
Total (180)	74 36.45	105 51.72	25 12.31-	-	-	19 9.35	108 53.20	50 24.63	-	-	79 38.91	83 40.8	22 10.83	-	--

The collected data in Table VIII reveals that the majority of respondents are satisfied with e-journals (51.72%) followed by e-books (53.20%) and databases (40.8%). While 36.45% of respondents are fully satisfied with e-journals of N-LIST e-resources, 38.91% are fully satisfied with databases and only 9.35% are fully satisfied with e-books. On the other hand, 12.31% are moderately satisfied with e-journals, 24.63% with e-books, and 10.83% with online databases.

Table IX: The N-LIST Program is Beneficial for Academics

Name of College	N-LIST Program is Beneficial for Academics (N/%)				
	Fully Agree	Agree	Neutral	Disagree	Fully Disagree
BBK DAV College, Asr (51)	11 (21.57)	40 (78.43)	-	-	-
Khalsa Collage, Asr (118)	76 (64.41)	42 (35.60)	-	-	-
Hindu College, Asr (34)	17 (50%)	17 (50%)	_	_	-
Total (180)	104 (51.23%)	99 (48.76%)	-	-	-

The data collected in the Table shows that 51.23% of respondents fully agree and 48.76% agreed with the statement that resources available through the N-LIST program are beneficial for their academics.

VII. Findings

- All the respondents (i.e., 100%) visit their college library and use e-resources to fulfill their information needs.
- 71.42% of respondents visit the library weekly followed by fortnightly (15.76%). On the other hand, only 11.33% of respondents are regular visitors to the library.
- 44.66% of respondents access e-resources weekly followed by 32.51% fortnightly and a very less numbers of respondents use daily (4.92%) and occasionally (6.40%).
- 64.40% of respondents are fully aware whereas 33.49% of respondents are partially aware of it. Surprisingly, 2.46% of respondents are not aware of it.
- 40.88% of respondents are getting awareness about e-ShodhSindhu (N-LIST) e-resources

through library staff followed by 27.09 from colleagues and only 7.38% through their library orientation program and college website (5.41%).

- 99.50% of respondents use e-resources for less than 1 hour and only 0.5% for one hour.
- 43.84% always and 37.43% most of the time use e-journals in E-ShodhSindhu (N-LIST) e-resources. Inthe case of e-books, 27.09% of respondents use them most of the time and 10.34% always. On the other hand, 33.49% of respondents most of the time use online databases and only 22.16% use them always.
- 36.94% of respondents always access from home followed by Library (13.30%) and Campus (25.12%).
- Majority of respondents are satisfied with e-journals (51.72%) followed by e-books (53.20%) and databases (40.8%).
- 51.23% of respondents fully agree and 48.76% agreed with the statement that resources available through the N-LIST program are beneficial for their academics.

VIII. Conclusion

Libraries all across the world are promoting faster, more affordable and better ways to make electronic information resources available to all types of information searchers through their current global network. The creation of the proper infrastructure for libraries that are a part of the network environment, especially academic libraries, has undergone a revolution thanks to INFLIBNET. Since 2010, the college libraries under study have made the N-LIST e-resources available to its users. The study concludes that a significant accomplishment of the college library is the awareness of NLIST resources among faculty members by library professionals. Additionally commendable are efforts made at the librarian level to increase awareness. To manage resources and give patrons better service, the library uses innovative technology. Since they know the password, the majority of them use it from their residences. College faculty members use NLIST e-books, e-journals, and online databases frequently are satisfied with the NLIST e-resources overall and use them.

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Journal of Applied Information Science
12 (1) 2024, 29-40
http://www.publishingindia.com/jais

The Use of Augmented Reality (AR) and Virtual Reality (VR) in Digital Marketing within the Indian Context

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Abstract: The integration of Augmented Reality (AR) and Virtual Reality (VR) technologies has revolutionized digital marketing strategies globally. This theoretical study specifically investigates their application within the Indian market, aiming to understand how these immersive technologies can enhance consumer engagement and brand loyalty in a culturally rich and diverse marketplace. Utilizing a comprehensive review of existing literature, the paper identifies key areas where AR and VR can create impactful marketing experiences unique to the Indian consumer. These include virtual try-ons, immersive advertisements, and interactive brand storytelling, particularly in sectors such as retail, real estate, and tourism. The study also examines the challenges faced, such as technological accessibility, digital literacy, and localization of content, proposing strategic solutions to effectively integrate AR and VR in India's digital marketing landscape. The findings suggest that, with targeted investment in technology and creative content development, AR and VR can significantly elevate the consumer experience, leading to deeper brand connections and enhanced marketing efficacy. This research contributes to the understanding of digital marketing innovations in emerging markets and proposes a roadmap for businesses aiming to implement AR and VR technologies in India.

Keywords: Augmented Reality (AR), Virtual Reality (VR), Digital marketing, Indian market, Consumer engagement, Brand loyalty, Technological accessibility, Digital literacy, Content localization, Marketing innovations.

I. Introduction

A comprehensive exposition of various elements including technological background, market specifics, cultural considerations, and current adoption rates, alongside a critical review of the potential and challenges these technologies face in transforming Indian digital marketing landscapes; here, the application of AR and VR technologies is not merely about transplanting global digital trends into the Indian marketplace but rather adapting and innovating them to fit local cultural nuances and consumer behaviors, which has been shown to potentially enhance customer engagement and retention through immersive marketing experiences [1, 15], improve brand perception through innovative advertisement formats [29, 18], and overcome significant barriers such as technological infrastructure issues, varied levels of digital literacy, and substantial regional diversity in consumer profiles [9, 24], thereby suggesting a promising avenue for growth in sectors like retail, real estate, and tourism that seek to captivate and mesmerize the Indian consumer [6, 22], and advocating for strategic investments in both AR and VR technologies to navigate and harness these emergent opportunities to their fullest potential within the Indian economic and cultural framework [11]. This unique digital convergence is rapidly transforming how Indian businesses engage with their customers by offering immersive and interactive experiences that significantly elevate consumer interaction, deepen brand engagement, and offer detailed insights into consumer behavior through innovative applications such as virtual try-ons in fashion retail,

virtual property tours in real estate, and immersive travel experiences in tourism, which are particularly pertinent in a diverse and expansive market like India where digital literacy and infrastructure are steadily advancing, thereby making technologies such as AR and VR more accessible to a wider audience and providing marketers with unprecedented tools to tailor content and experiences to a varied demographic, overcoming significant challenges like the regional diversity in language and cultural preferences, which necessitates a nuanced approach to digital content creation and marketing strategies that are culturally relevant and engaging, as evidenced by recent studies which highlight the growing acceptance of these technologies among Indian consumers and their potential to transform traditional marketing paradigms by integrating virtual elements into the real world, thus offering a seamless blend of digital and physical experiences that can dramatically enhance customer satisfaction and loyalty, as well as create distinctive competitive advantages for companies willing to invest in and adopt these cutting-edge technologies, thereby positioning India as a leading player in the adoption of AR and VR in marketing, much ahead of many other nations, reflecting its unique position as a technologically adaptive market that is ripe for digital innovations that could redefine the consumer experience and set new standards in marketing effectiveness and efficiency in sectors that are increasingly becoming digitized, aligning perfectly with India's digital India initiatives which promote the use of high technology in various economic sectors, an advancement supported by government policies that encourage digital transformations and by a burgeoning tech-savvy population that is increasingly demanding more sophisticated and engaging marketing interactions, leading to an ever-evolving marketing landscape that is being continuously reshaped by these immersive technologies as they become more refined and integrated into the fabric of daily business practices, thus making it crucial for marketers and businesses to understand the capabilities and limitations of AR and VR technologies to fully leverage their potential in crafting captivating marketing campaigns that are not only visually appealing and interactive but also culturally attuned and technologically innovative, providing a holistic and enriching experience that can captivate the imagination of the Indian consumer and engage them in ways that were previously unimaginable, thereby setting the stage for a new era in digital marketing that is built on the foundational principles of immersive technology and digital interaction, where the lines between the virtual and the real are blurred, creating a dynamic marketing environment that leverages the best of both worlds to create impactful and memorable consumer experiences that are likely to redefine the landscape of digital marketing in India for years to come [12, 15, 18].

II. Statement of the Research Problem

The research problem central to understanding the integration of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context stems from a multifaceted array of challenges and opportunities that revolve around the adoption and implementation of these immersive technologies, which are posited to radically transform the interaction dynamics between Indian businesses and consumers by enhancing user engagement through more personalized and interactive marketing experiences, yet the extent to which AR and VR can be successfully embedded into the daily operations of Indian companies is hampered by technological disparities, infrastructural limitations, and varying levels of digital literacy across different regions of India, alongside a pronounced need for creating culturally resonant and linguistically diverse content that can effectively communicate with a heterogeneous consumer base, thereby making it imperative to explore how businesses, especially in sectors such as retail, real estate, and tourism, can leverage these technologies to create impactful, innovative, and immersive marketing strategies that resonate with the Indian consumer's evolving expectations and experiences, while also addressing the critical issue of cost-effectiveness and ROI from such technologically intensive initiatives, factors which are compounded by the rapid yet uneven

technological advancement and internet penetration in the country, creating a complex landscape where the potential of AR and VR to provide compelling marketing narratives and virtual experiences faces the reality of a market characterized by significant economic and socio-cultural diversity, a scenario that calls for a nuanced investigation into the strategic deployment of these technologies in a manner that aligns with local market conditions and consumer preferences, thus highlighting the critical research gap that exists in understanding the full spectrum of possibilities and constraints that define the use of AR and VR in the digital marketing domain within the Indian context, a gap that this research aims to fill by providing comprehensive insights into how these technologies can be tailored and scaled to meet the unique demands of the Indian market, thereby contributing to the broader discourse on the future of digital marketing innovations in emerging markets [12, 15, 18].

III. Research Gap

Despite the burgeoning interest and potential transformative impact of Augmented Reality (AR) and Virtual Reality (VR) on digital marketing globally, a significant research gap exists in the specific examination of how these technologies can be tailored and effectively deployed within the Indian context, where digital marketing landscapes are rapidly evolving but face unique challenges due to diverse consumer demographics, varying levels of technological adoption across urban and rural areas, and significant cultural nuances that influence consumer behavior and expectations; this gap underscores a critical need for empirical research that delves into the effectiveness of AR and VR applications in enhancing customer engagement and satisfaction within Indian markets, particularly investigating how these technologies can bridge the digital divide and cater to the localized needs of Indian consumers across different sectors, including retail, real estate, and tourism, which stand to benefit immensely from immersive marketing experiences, yet there remains a dearth of in-depth studies that analyze the readiness of Indian consumers and businesses to adopt such advanced technologies, explore the specific obstacles that impede their wider acceptance, such as the high cost of VR equipment, the complexity of developing AR applications, and the infrastructural demands associated with delivering high-quality, real-time virtual experiences, and assess the long-term impacts of these technologies on consumer buying behavior, brand loyalty, and the overall marketing efficacy in a market that is as dynamic and varied as India, thus highlighting the urgent need for comprehensive research that not only investigates how AR and VR can enhance the digital marketing strategies but also addresses the socio-economic and technical barriers that must be overcome to fully exploit these technologies in the context of India's diverse and multi-faceted market, which could provide valuable insights for marketers, technology developers, and policymakers aiming to leverage AR and VR for creating more engaging, effective, and inclusive marketing strategies that resonate with the Indian audience and contribute significantly to the discourse on digital innovation in emerging economies [12, 15, 18].

IV. Significance of the Research Study

The significance of this research study into the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context cannot be overstated, as it promises to provide critical insights into how these cutting-edge technologies can be harnessed to revolutionize marketing strategies in one of the world's fastest-growing economies, where digital marketing faces unique challenges due to the vast diversity in language, culture, and digital readiness among the population, thus offering a detailed examination of how AR and VR can enhance customer experiences and engagement across various sectors ranging from retail and real estate to tourism and education by creating immersive, interactive, and personalized marketing campaigns that are more effective at capturing consumer attention and fostering deep, meaningful connections between brands and their audiences; moreover, this research could also explore the potential of these technologies to address

larger societal issues such as education in remote areas through virtual classrooms or health awareness through immersive informational campaigns, thereby not only increasing the scope of digital marketing but also contributing to social welfare and community development, making it an indispensable tool for marketers and strategists looking to innovate and stay competitive in a rapidly evolving market, while also providing policymakers and educators with valuable data to support the development of infrastructure and educational programs that facilitate the adoption of these technologies, thereby potentially setting a benchmark for the adoption of AR and VR in emerging markets worldwide, making this study a cornerstone for future research and implementation of immersive technologies in digital marketing, which could ultimately lead to a more informed, engaged, and satisfied consumer base, driving growth and innovation in the Indian economy and beyond [12, 15, 18].

V. Research Methodology Adopted for the Purpose of the Study

For a study focused on the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context, a comprehensive research methodology that incorporates qualitative method is considered. To establish a theoretical framework and baseline understanding of AR and VR technologies in digital marketing, emphasizing prior research conducted in various geographical and industrial contexts, with a specific focus on any available data pertaining to the Indian market. This methodology will enable a thorough exploration of the nuanced impact of AR and VR technologies in the Indian digital marketing sector, catering to the objectives laid out in the research proposal and providing actionable insights for both academics and practitioners in the field.

VI. Review of Literature

The literature on the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing, particularly within the Indian context, is rich and evolving, offering diverse perspectives and insights into how these technologies are reshaping consumer interactions and brand experiences; starting with foundational theories that describe AR and VR as immersive technologies that extend the physical world by overlaying or simulating digital information in real-time, scholars like [3] and [19] provide a theoretical framework which is crucial for understanding the potential applications and implications of these technologies in marketing, and as the discourse progresses, more recent studies by [12] explore how AR can enhance user engagement through interactive marketing practices, while [19] detail the technical aspects and challenges of AR, emphasizing its utility in creating personalized consumer experiences, a concept further expanded by [30] who investigate VR's role in creating immersive brand environments that significantly increase consumer immersion and emotional connection, a particularly pertinent aspect in the Indian market, as noted by [15], who highlight the growing penetration of digital technologies in the Indian retail sector; furthermore, research by [18] delve into how AR and VR can transform shopping experiences by providing virtual try-ons and virtual tours, applications that are gaining traction in India as the retail and real estate sectors seek innovative ways to attract and retain customers amidst a highly competitive and digitally evolving landscape, and studies focusing on the Indian market, such as those by [9] and [24], point to the specific challenges faced in this region, including issues related to digital infrastructure and diverse consumer demographics that necessitate tailored marketing strategies, emphasizing the need for market-specific research, which is currently underrepresented in global literature; additionally, the potential for AR and VR to contribute to sectors beyond traditional marketing, such as education and healthcare, which are critical in a developing country like India, is discussed by authors like [20], who suggest these technologies can democratize access to information and services, thereby contributing to broader developmental goals, an area that remains ripe for further exploration; thus, the existing literature collectively underscores the transformative potential of AR and VR in digital marketing, but also points to a critical gap in comprehensive, empirical

research that contextualizes these findings within the unique socio-economic and cultural framework of India, thereby providing a robust platform for further study and exploration into how these advanced technologies can be optimized to meet the specific needs and challenges of the Indian market, paving the way for innovative solutions that are both technologically advanced and culturally sensitive [3, 19, 12, 29, 30, 15, 18, 9, 24].

VII. Major Objectives of the Research Study

- To assess the current utilization of AR and VR technologies in digital marketing efforts across various industries in India, identifying key sectors that have adopted these technologies and the extent of their implementation.
- To investigate how Indian consumers perceive and interact with AR and VR applications in marketing contexts, including their preferences, acceptance levels, and the overall impact on their purchasing decisions.
- To evaluate the technological infrastructure available in India for supporting AR and VR technologies and to determine the readiness of Indian companies to integrate these tools into their marketing strategies.
- To study how AR and VR technologies can be customized to fit the diverse cultural and regional nuances of the Indian market, ensuring that digital marketing strategies are effectively localized to meet varied consumer needs and preferences.

VIII. Current Utilization of AR and VR Technologies in Digital Marketing Efforts Across Various Industries in India, Identifying Key Sectors That Have Adopted These Technologies and the Extent of Their Implementation

The current utilization of Augmented Reality (AR) and Virtual Reality (VR) technologies in digital marketing across various industries in India demonstrates a burgeoning trend with selective adoption, where sectors such as retail, real estate, automotive, and tourism have increasingly integrated these immersive technologies to enhance consumer experiences and interaction, exemplified by the retail sector's use of AR for virtual try-ons and interactive displays that allow consumers to visualize products in a real-world context, thus increasing engagement and potentially reducing return rates, as evidenced by the success of companies like Lenskart and Myntra, which have effectively utilized AR to offer customers a 'try before you buy' experience; similarly, the real estate sector has adopted VR to offer virtual tours of properties, providing a convenient and comprehensive viewing experience that can significantly enhance customer convenience and conversion rates, a practice that has been progressively embraced by developers such as Lodha and Prestige Group; in the automotive industry, companies like Mahindra and Maruti Suzuki are utilizing AR and VR to provide virtual showrooms and car simulations, which not only aid in marketing but also help customers make informed decisions by experiencing car features virtually before purchase; furthermore, the tourism sector in India is exploring AR and VR to create virtual travel experiences and historical tours, which can significantly enhance the tourist experience by providing rich, immersive content that adds educational and interactive elements to traditional tourism practices, with state tourism boards and companies like Incredible India leveraging these technologies to attract more visitors and provide enhanced tourist services; despite these advancements, the overall penetration of AR and VR in Indian digital marketing remains at a nascent stage, with challenges such as high costs, lack of technological infrastructure, and limited consumer awareness hindering widespread adoption, yet the potential for these technologies to transform marketing practices in India is significant, as they offer unique opportunities to engage a diverse and large consumer base, driving forward the digital transformation in marketing practices within the country [1, 15, 9].

IX. Indian Consumers Perceive and Interact with AR and VR Applications in Marketing Contexts, Including Their Preferences, Acceptance Levels, and the Overall Impact on Their Purchasing Decisions

Indian consumers' perception and interaction with Augmented Reality (AR) and Virtual Reality (VR) applications in marketing contexts reveal a complex blend of enthusiasm and caution, where the levels of acceptance and impact on purchasing decisions vary significantly across different demographics and regions, with urban consumers exhibiting a greater propensity towards engaging with these technologies due to higher exposure and familiarity, while rural consumers remain relatively hesitant due to lower digital literacy and access; this dichotomy is influenced by several factors including the novelty of the experience, the perceived utility, and the cultural relevance of the applications, where studies such as those by [15] have noted that AR applications like virtual try-ons in apparel and accessories have gained considerable popularity among younger demographics, particularly in metropolitan areas, due to their ability to enhance the shopping experience by providing a realistic and interactive way of evaluating products before purchase, thereby reducing uncertainty and potentially increasing consumer satisfaction and loyalty; similarly, VR experiences in real estate and tourism have shown promising acceptance as they offer immersive previews of properties and destinations, which is particularly appealing to middle and upper-class consumers who value detailed and experiential information prior to making high-involvement decisions; however, despite these positive trends, the overall penetration of AR and VR in the Indian market is still at an emerging stage, with a significant portion of the population yet to interact with these technologies primarily due to issues such as the cost of VR equipment, the need for high-speed internet for smooth AR experiences, and a general lack of awareness about how these technologies can be used in everyday consumer scenarios, challenges that are slowly being addressed as companies invest in more consumer-friendly applications and the government pushes for greater digital infrastructure; yet, the potential for AR and VR to influence purchasing decisions is substantial, as indicated by research from [9], who suggest that these technologies can lead to higher conversion rates and increased spending, particularly when consumers are provided with engaging and personalized marketing experiences that effectively leverage AR and VR to meet their specific needs and preferences, suggesting a future where widespread adoption of these technologies could significantly reshape consumer behavior and transform the competitive landscape of digital marketing in India [15, 9].

X. Technological Infrastructure Available in India for Supporting AR and VR Technologies and to Determine the Readiness of Indian Companies to Integrate These Tools into Their Marketing Strategies

The technological infrastructure in India, crucial for supporting Augmented Reality (AR) and Virtual Reality (VR) technologies, along with the readiness of Indian companies to integrate these advanced tools into their marketing strategies, presents a varied landscape, marked by rapid advancements in some areas while facing significant challenges in others; as major cities and tech hubs like Bengaluru, Mumbai, and Hyderabad show a robust digital infrastructure that includes widespread high-speed internet connectivity and a proliferation of mobile technology, which are essential for the effective deployment of AR and VR applications, rural areas, however, lag significantly behind due to lesser internet penetration and limited access to cutting-edge technology, a dichotomy that reflects the broader digital divide in India, and while leading corporations in sectors such as retail, automotive, real estate, and tourism are increasingly demonstrating a readiness to adopt these immersive technologies as a means to enhance consumer engagement and stand out in a competitive market, evidenced by successful implementations

of virtual showrooms and interactive marketing campaigns by companies like Tata Motors and Mahindra, smaller enterprises and traditional businesses show a hesitancy stemming from a lack of understanding of the benefits, perceived high costs of technology adoption, and concerns about the return on investment, which underscores the necessity for a strategic framework that can support and facilitate the integration of AR and VR technologies across different tiers of the business ecosystem in India; furthermore, despite these challenges, the Indian government's initiatives aimed at improving digital literacy and enhancing technological infrastructure, such as the Digital India program, are laying the groundwork for a more comprehensive adoption of these technologies, which is also being supported by the burgeoning startup ecosystem in India that is actively innovating in the AR and VR spaces, creating tailored solutions that address the unique challenges and needs of the Indian market, thus, while the potential for AR and VR to revolutionize marketing in India is immense, the actual realization of this potential is contingent upon a concerted effort by both the public and private sectors to address the infrastructural disparities, enhance accessibility, and promote the benefits of these technologies, thereby ensuring a wider acceptance and integration into marketing strategies that can lead to a transformative impact on the way Indian companies engage with their consumers [12, 15, 9].

XI. AR and VR Technologies Can Be Customized to Fit the Diverse Cultural and Regional Nuances of the Indian Market, Ensuring That Digital Marketing Strategies are Effectively Localized to Meet Varied Consumer Needs and Preferences

The customization of Augmented Reality (AR) and Virtual Reality (VR) technologies to fit the diverse cultural and regional nuances of the Indian market is a critical factor in ensuring that digital marketing strategies are effectively localized to meet varied consumer needs and preferences, a process that involves intricate adjustments and adaptations that take into consideration linguistic diversity, cultural sensibilities, regional consumer behaviors, and localized content preferences, which are essential for engaging a vast and varied audience; this is particularly important in India, where the market is not monolithic but rather a mosaic of different cultures, languages, and traditions, requiring marketers to employ AR and VR solutions that are not only technologically advanced but also culturally resonant, for instance, AR applications can be designed to offer content in multiple Indian languages, thereby increasing accessibility and user-friendliness, while VR experiences can incorporate culturally relevant themes and contexts that resonate with local traditions and values, which enhances the consumer connection and engagement; moreover, the customization also involves technological adaptations for varying levels of internet connectivity and device capabilities across different regions, ensuring that these digital experiences are smooth and accessible even in areas with lower technological infrastructure, thereby democratizing the benefits of these advanced technologies across socioeconomic strata; additionally, by incorporating local art, music, and storytelling into AR and VR experiences, companies can create deeply engaging and memorable marketing campaigns that not only entertain but also educate and inform, thereby fostering a deeper connection with the brand; this approach not only improves the effectiveness of marketing campaigns but also helps in building brand loyalty and trust, crucial components in the competitive Indian market, as research suggests that consumers are more likely to engage with and purchase from brands that reflect an understanding and respect for their culture and preferences [12, 15, 18], thus, the potential of AR and VR to transform digital marketing in India hinges not just on the technological prowess of these tools but significantly on their ability to be customized and localized, aligning technology with the rich tapestry of Indian cultural life, thereby not only enhancing consumer experiences but also contributing to a more inclusive and sensitive marketing landscape that recognizes and celebrates the diverse heritage of India [12, 15, 18].

XII. Discussion

The discussion on the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context reveals a complex interplay of technological innovation, consumer behavior, market readiness, and cultural adaptation, where these technologies are seen as transformative tools capable of revolutionizing how brands engage with consumers, offering immersive experiences that not only attract attention but also enhance understanding and retention of product information, which is particularly valuable in a diverse and competitive market like India; however, while the potential of AR and VR is immense, the actual deployment and effectiveness of these technologies in achieving marketing objectives vary significantly across different sectors and regions, reflecting a broader spectrum of challenges and opportunities—urban areas, with better technological infrastructure, show a higher adoption rate and consumer enthusiasm for AR and VR experiences, largely because these areas have a higher concentration of tech-savvy individuals and more companies willing to invest in new marketing technologies, leading to innovative applications such as virtual try-ons in fashion retail or virtual property tours in real estate, which have not only improved the consumer shopping experience but have also provided marketers with detailed data on consumer interactions and preferences; conversely, in rural areas, the adoption of AR and VR is hindered by factors such as lower internet connectivity, limited access to advanced mobile devices, and a lack of familiarity with digital technologies, which necessitates more targeted educational and engagement strategies to introduce these technologies to a wider audience; additionally, the customization of AR and VR content to align with the diverse cultural landscapes of India poses its own set of challenges, requiring marketers to not only translate content into multiple languages but also to contextualize marketing messages to resonate with different cultural and regional norms, a task that, while complex, provides a unique opportunity to deepen consumer engagement through culturally rich and personalized experiences; furthermore, the economic considerations associated with implementing AR and VR technologies, including the initial investment in software development and content creation, as well as the ongoing costs of updating and maintaining these technologies, must be carefully balanced against the expected return on investment, a calculation that many Indian companies are currently navigating; the role of the Indian government and educational institutions in promoting digital literacy and supporting technological infrastructure development also plays a crucial part in expanding the reach and impact of AR and VR in marketing, as policies and programs aimed at enhancing digital access and competence can significantly elevate the base level of consumer interaction with these technologies, ultimately leading to a more widespread acceptance and utilization of AR and VR in digital marketing strategies across the country, thus, the discussion surrounding AR and VR in Indian digital marketing is marked by a dynamic tension between the exciting possibilities these technologies offer for creating novel and engaging consumer experiences and the practical realities of market readiness, consumer accessibility, and cultural variability, challenges that must be addressed through continued innovation, strategic investment, and collaborative efforts between businesses, government, and educational entities to fully harness the potential of AR and VR in transforming the Indian digital marketing landscape [30, 31, 29].

XIII. Managerial Implications of the Research Study

The managerial implications of the research study examining the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context are profound and multifaceted, offering significant insights for business leaders and marketers aiming to leverage these technologies to enhance consumer engagement and competitive advantage; the study underscores the necessity for managers to invest in robust technological infrastructure that supports the seamless delivery of AR and VR experiences, which are crucial for captivating the increasingly tech-savvy Indian

consumer base, and it also highlights the importance of developing tailored content that resonates with the diverse cultural and regional nuances of the Indian market, thus ensuring that digital marketing strategies are not only technologically innovative but also culturally pertinent and inclusive, which can lead to greater consumer satisfaction and loyalty; additionally, the findings emphasize the need for continuous training and development programs for marketing and technical teams to keep pace with rapid technological advancements in AR and VR, ensuring that staff are capable of designing, implementing, and maintaining sophisticated AR and VR applications, and from a strategic perspective, managers are advised to adopt a phased approach to the integration of these technologies, starting with pilot projects that allow for the testing and learning of consumer responses and operational challenges before a full-scale rollout, which mitigates risk and enhances the likelihood of success; furthermore, the research advises managers to foster collaborative partnerships with technology providers, content creators, and academic institutions, which can provide access to the latest innovations and research in the field of AR and VR, thereby enhancing the capabilities of their own firms without bearing all the developmental costs alone; moreover, the study indicates that managers must closely monitor consumer trends and feedback to continually refine and optimize AR and VR experiences, ensuring they meet the evolving expectations of consumers and stay ahead of competitors in the dynamic Indian market, and considering the significant investment involved in deploying AR and VR technologies, managers must also develop comprehensive metrics to measure the return on investment (ROI) of these initiatives, including direct impacts on sales and marketing metrics as well as indirect benefits such as brand strengthening and customer data acquisition, which are integral for justifying the financial implications of these technologies; therefore, the implications for managers stemming from this research are critical in guiding strategic decisions, operational practices, and financial planning, all of which are essential for successfully integrating AR and VR into digital marketing strategies in India and achieving sustainable business growth in an increasingly digital and competitive marketplace [26, 27, 28].

XIV. Scope of the Research Study and Limitations of Further Research

The scope of the research study on the use of Augmented Reality (AR) and Virtual Reality (VR) in digital marketing within the Indian context is extensive, aiming to explore a wide array of dimensions including technological adoption rates, consumer behavior patterns, sector-specific applications, and cultural adaptation strategies, yet despite its comprehensive nature, there are inherent limitations that suggest avenues for further research; these limitations stem from the rapid pace of technological advancement in AR and VR, which might outpace the study's findings, rendering them obsolete if not continually updated, and the predominantly urban focus of existing studies, which overlooks the rural market that constitutes a significant part of India's demographic landscape and often features different consumer behavior and access to technology, thus suggesting the need for future research to include a broader geographical sample that can provide a more representative insight into the national perspective, furthermore, while current research highlights the technical and strategic implementation of AR and VR, there is a relative dearth of data on the long-term consumer engagement and retention impact of these technologies in digital marketing, indicating that longitudinal studies could provide deeper insights into the effectiveness of AR and VR over time, additionally, the economic assessments of AR and VR initiatives are often based on short-term metrics, and more comprehensive studies are required to analyze the long-term financial implications and true ROI of integrating these technologies into marketing strategies, especially in a diverse and price-sensitive market like India; moreover, the current scope of research might not fully capture the regulatory and ethical implications of AR and VR technologies in marketing, which are becoming increasingly important as these technologies become more pervasive and collect

more personal data, thus necessitating further research into consumer privacy, data protection, and the ethical use of immersive technologies in digital marketing; therefore, while the study covers considerable ground in understanding the current landscape and potential of AR and VR in Indian digital marketing, the dynamic and evolving nature of these technologies, along with the diverse and complex Indian market, requires ongoing and expanded research efforts to fully comprehend and leverage AR and VR for optimal marketing outcomes, ensuring that future strategies are not only innovative and effective but also inclusive, ethical, and sustainable [22, 23, 24, 25].

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Journal of Applied Information Science
12 (1) 2024, 41-57
http://www.publishingindia.com/jais

Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

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Abstract: Social media, such as WhatsApp, Facebook, Twitter, Instagram, Telegram, and others, have become one of the most innovative web-based means of communication in the 21st century. It has enjoyed growing acceptance and adoption among people in nearly all walks of life, including professionals and academics in diverse disciplines. In recent times, studies have shown that university teachers across the world have been adopting these tools for instructional purposes. However, research seems not to have established whether lecturers who teach Library and Information Science in government-owned universities in South-South Nigeria adopt social media for teaching task. Thus, this study examined lecturers' adoption of social media in teaching Library and Information Science (LIS) in ten South-South Nigerian public universities. It intended to identify the extent of adoption, purposes for adoption, benefits derived from adoption and challenges encountered in adoption. Employing a descriptive research approach, ninety-four LIS lecturers constituted the study population while seventy-three LIS lecturers made up the sample. A questionnaire served as a tool for data gathering, after it was validated by LIS/Measurement and Evaluation university lecturers. Ninety-four questionnaire copies were distributed but seventy-three copies were retrieved and considered amenable for analysis. This amounted to a response rate of 77.66%. Weighted mean and standard deviation were adopted to compute data. Result showed that the lecturers minimally adopted social media to teach LIS. Findings further revealed that the lecturers adopted social media to deliver lectures and to transmit course materials to students. It was also found that the lecturers' adoption of social media for teaching task enabled the lecturers to stay up-to-date; to easily communicate with and to share course materials with students; and to acquire digital skill. However, the lecturers found it difficult to apply social media for instructional activities due to unstable internet connectivity, erratic power supply and poor digital literacy.

Keywords: Adoption, Library and information science, Public universities, Social media, South-South Nigeria, Teaching.

I. Background of the Study

The need for human beings to interact and communicate at individual, organisational, institutional, corporate, societal and other levels has grown significantly over the years. Human interaction and communication provides one of the strongest backbones for the success of

activities at individual, organisational, institutional, corporate, societal and other levels. The same thing is applicable to teaching-learning activities in educational institutions. Teaching is used here to refer to the process of transmitting practical and theoretical knowledge to an individual with a view to improving his understanding of himself, of his environment, of a process and so on. In higher institutions of learning, the teaching-learning process takes place in several fields of study at preliminary, diploma, undergraduate and postgraduate levels of study. One of these fields of study is Library and Information Science (LIS).

Library and Information Science (LIS) is a field of study that involves equipping individuals with the knowledge and skills required to man a library or information centre of any type or to be an instructor in LIS in a tertiary institution of learning. Akwang [1] defined LIS as a field of study which operates with other fields of study or as a group of academic disciplines mainly intended to groom students for occupations in the information profession. It is a course of study which is meant to enable students to develop diverse library and media-service-oriented technical competences so that libraries could employ them [2]. Students acquire these skills through teaching and practical demonstrations in institutional libraries, demonstration libraries and media centres. The skills include the ability to engage in collection development, knowledge organization (cataloguing and classification), readers' services (circulation services, reference services, reserve services), serials management and many more. In recent times, students are taught how to run a digital or electronic library, helping them to gain knowledge and skills in electronic collection development, online cataloguing and classification, automated circulation services, digital reference services, digital serials management and more. As information and technological innovations evolve, higher education teachers tend to experiment with new methods of teaching to facilitate the instructional process. One of these innovations being adopted for teaching task is Social Media.

Social Media (SM), which came alongside the advent of the Internet and the World Wide Web, and is frequently used in place of Web 2.0 or social software, refers to diverse forms of networked technologies that promote the Internet as a means of communication, collaboration and creative expression [3]. Originated in 2004, "Web 2.0" represents the changes which led to the adoption of the World-Wide-Web as a forum for interaction as against its previous usage for dissemination. Its use for interaction purposes helped social media infrastructure to develop and emerge [4]. Social media originated as 'Friends United' in England in 1999, which was followed by 'Friendster' in 2002, 'MySpace' in 2003 and then by 'Facebook' in 2004, which was developed in America [5]. Over the years, several forms of social media have emerged. Spencer [6] observed that there are over sixty types of social media, the common forms of which include Facebook, WhatsApp, Telegram, YouTube, Twitter, Wikis, Wechat, Qzone, Instagram, Tumbir, Google +, Baidu, Tieba, Skype, Viber, Sina, Weibo, LINE, Snapchat and Blogs, etc. Kara *et al.* [7] noted that the popular contemporary social media platforms are Facebook, Twitter, YouTube, Wikipedia, Instagram and Snapchat. These social media forms fall into six classes: sharing sites, blogs/micro-blogging, social bookmarking sites, virtual/online communities, social networking sites (SNS), and virtual worlds [8]. Social media have been put to several uses over time.

Social media have, traditionally, been used as means of sharing informal and professional information among friends, colleagues and close relations. However, teachers in higher educational institutions seem to have found it useful for instructional purposes in recent years. Ahmed *et al.* [9] observed that social media is currently a source of attraction for professional and academic disciplines as a unique forum for easing knowledge sharing besides communication. Knowledge sharing has usually taken place among professional and academic colleagues. However, university teachers, have, recently, been exploiting social media to share or impart knowledge to students. Siakas and Georgiadou [10] acknowledged that the use of social media for pedagogy is gaining momentum, with Facebook, Whatsapp, Twitter, YouTube, Skype, Instagram and Wiki and others prominently serving that purpose [11]. Its adoption in the teaching-learning process has

helped teachers to collaborate with students better; to develop online course material; and to distribute course content to students [12].

II. Significance of the Study

The study would be beneficial to the following groups of people: Library and Information Science (LIS) lecturers in universities; researchers; students; and university management. It would benefit LIS lecturers in universities because it would acquaint them with knowledge of issues surrounding LIS lecturers' adoption of social media for pedagogy. Researchers and students also stand to gain from the study as the published paper would serve as valuable literature for future research in Library and Information Science, Lastly, the research would be beneficial to university management as it would inform them about issues involving lecturers' adoption of social media in teaching task. This knowledge would guide them in taking appropriate measures to plan for teaching and learning practices in universities.

III. Statement of the Problem

Recently, tertiary education teachers appear to have started harnessing the potentials of social media for teaching purposes. Whatsapp, Facebook, Twitter, YouTube, Skype, Instagram, blogs, telegram, Wiki and others are some forms of social media which seem to be commonly applied for these purposes. Teachers' utilization of these media for teaching purposes appears to enable them to easily and speedily transmit course-related information to students, to have better communication with students, to teach students outside classroom in their convenience and to have an intimate interaction with students. Researchers have attempted to unravel issues surrounding adoption of social media for teaching engagement in higher institutions of learning across the world. A close look at available literature suggests that several such studies, globally, have been conducted. While a few related studies have emanated from Nigeria, one of the countries of Africa, only one study has engaged Library and Information Science lecturers in public universities in South-West Nigeria [13]. The studies which have engaged university teachers in South-South Nigeria, have only explored the possibility of using social media for lecturer-student communication and for assessment and related purposes [14]-[15]. A critical literature review reveals that no study specifically provides an idea of whether or not lecturers in public universities in South-South Nigeria employ social media to teach Library and Information Science. Thus, this study investigated lecturers' adoption of social media in teaching Library and Information Science in public universities in South-South Nigeria.

IV. Purpose of the Study

The study set out to examine lecturers' adoption of social media in teaching Library and Information Science in public universities in South-South Nigeria.

V. Objectives of the Study

The specific intentions of the study were to:

- Unravel the extent of lecturers' adoption of social media in teaching Library and Information Science in public universities in South-South Nigeria;
- Discover the purposes for which lecturers adopt social media in teaching Library and Information Science in public universities in South-South Nigeria;
- Identify the benefits lecturers derive from adopting social media in teaching Library and Information Science in public universities in South-South Nigeria; and
- Unearth the challenges encountered by lecturers in adopting social media in teaching Library and Information Science in public universities in South-South Nigeria.

VI. Literature Review

This part of the paper brought into focus previous studies related to the topic of the current investigation. The review was executed under the following sub-headings: Extent of Lecturers' Adoption of Social Media in Teaching Library

and Information Science in Universities; Purposes of Lecturers' Adoption of Social Media in Teaching Library and Information Science In Universities; Benefits in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities; and Challenges in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities.

VII. Extent of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities

Over the years, research had demonstrated the degree to which university teachers adopted social media for teaching activities. Available research findings had suggested high, moderate and low extent of use of social media for instructional purposes by this category of teachers. Roebuck *et al.* [16] found that 63 percent of 201 US higher education teachers adopted social media tools in their pedagogical activities. In the same year, the rate of its instructional use by Romanian university teachers was found to be increasing [17]. A more comprehensive study revealed that 97 percent of higher education academics made same use of social media to the extent that UK academics adopted it most (37 percent), followed by academics in Australia/New Zealand (25 percent), in the US (20 percent), in continental Europe (10 percent) and in Canada (6 percent) and lastly, academics in Ireland, in the Caribbean and in Africa, in Asia and in South America [18]. This was followed by a Malaysian study, which indicated that 70 percent of 123 Universiti Utara Malaysia lecturers had begun using social media to teach students [19]. Result generated from a study which engaged a sample of thirty-two lecturers at King Abdul-Aziz University and King Saud University, Saudi Arabia, hinted that 91 percent of these university teachers harnessed social networking sites to teach students [20]. In a subsequent research, 333 social science-inclined university lecturers with predominantly-English-speaking nationality (US, UK, Australia, Canada) and others (Germany, Switzerland, Sweden, Brazil, Spain, Romania, Denmark New Zealand, Turkey, Netherlands, Israel, Ireland), were found to have actively adopted social media to impart knowledge to students [21]. Gichuhi *et al.* [22] found that 87.5 percent of twenty lecturers at the School of Education, University of Nairobi, Kenya, tapped from a diversity of social media outlets to transmit content to students. From the University of Dar es Salaam Sokoine University of Agriculture and Muhimbili University of Applied Sciences in Tanzania, a finding emerged that a sample of its seven lecturers made frequent utilization of social media for instructional endeavour [23]. A fairly-recent finding from a research, which examined the potentials of utilizing social media for lecturer-student communication after the COVID-19 period in Nigeria, also suggested high usage of the media for teacher-student communication by 15 lecturers of twelve Nigerian public universities and polytechnics in South-South, South-East and South-West Nigeria [15]. On the other hand, there were findings that suggested moderate use of social media for pedagogy by university teachers. Earlier, Okello-Obura and Ssekitto [24] found that 38 lecturers out of a sample of 68 academic staff of Makerere University, Uganda, utilised web 2.0 technologies for instructional purposes. In the following year, a moderate pedagogical application of social media was attributed to forty lecturers at the College of Education, Sudan University of Science and Technology [25]. The same year was associated with a finding from Nigeria, which showed that 56.4 percent of 227 lecturers from six public and private universities in North-Central Nigeria, made low utilisation of social media for academic activities [26]. An Australian research by Sutherland *et al.* [27] revealed that 49 percent of 53 academics in the Faculty of Arts, Business and Law and in the Faculty of Science, Health, Engineering, and Education at the University of the Sunshine Coast in Queensland, employed social media for teaching, with academics in the Faculty of Arts, Business and Law using the media more than their Faculty of Science, Health, Engineering and Education counterparts. Aside these findings, a number of empirical findings had shown that university teachers made little use of social media

for instructional task. One of these results indicated a low rate of instructional usage of social media by sixty-five lecturers in Sudanese universities [28]. In the same vein, 6,139 Italian university teachers were found to have displayed limited and restricted adoption of social media for instructional activities [12]. This was shared by a Nigerian finding which indicated marginal use of social media by 69 Business Education teachers in universities, polytechnics and colleges of education in five Nigerian states, with 33 percent of the lecturers adopting it as a means of instruction, while 56.5 percent, incorporating it into classroom activities [14]. Research also established that, though the degree to which 195 lecturers in the domains of Technology, Sciences and Veterinary at the University of Ibadan and Federal University of Agriculture, Abeokuta, South-West Nigeria, exploited social media for teaching task was low, there was seeming rise in the level of adoption [29]. It then unfolded that 11.7 percent of a sample of 128 lectures in the domain of education at the University of Port Harcourt, Nigeria, took advantage of WhatsApp for academic engagement [30].

VIII. Purposes of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities

Studies had identified the purposes for which university teachers adopted social media in teaching processes. Chen and Bryer [31] found that a sample of sixty-five Public Administration lecturers from twenty-eight American universities utilised Web 2.0 tools to relate with students; to coordinate learners' group networks; to promote their courses, etc. Three years later, research uncovered that Universiti Utara Malaysia lecturers harnessed social media for informal communication with students [19]. Result from Turkey indicated that 67 professors in the Faculty of Communication Sciences at Anadolu University primarily used Facebook to connect with students and to share information, and secondarily, to deliver information, reference books, group assignments and course sessions to students [32]. These findings surfaced in a subsequent study by Roebuck *et al.* [16] which showed that US higher education teachers and professors mostly used social media to communicate; to supply course content; to interact; and to collaborate as part of their teaching activities. Sixty-five lecturers in Sudanese universities were then found to have taken advantage of social media to urge learners to adopt technology during lectures; to aid learners' understanding of lectures by means of discussions; to enjoin learners to share information in the classroom; to answer learners' queries; to arrest learners' attention; to connect learners to lesson-based websites; and to exchange information with learners [28]. At Makere University, Uganda, lecturers adopted web 2.0 tools to develop course materials; to provide online distance instruction; to make announcements to students; and to evaluate students [24]. In the ensuing year, Manca and Ranier [12] unraveled that, while Italian university teachers mainly made use of social media to visualise resources, they often adopted same media to locate content. In the following year, a Nigerian study established that 70 percent of 69 Business Education teachers in universities, polytechnics and colleges of education in five Nigerian states were enthusiastic about their students identifying innovative uses of social media while teaching problem-solving, whereas, 66 percent displayed similar interest in having their students incorporate same media into their lesson plans [14]. An accompanying investigation divulged that a sample of 47 lecturers in five Tanzanian universities adopted Web 2.0 technologies to post; to find lecture slides and tutorials; to distribute materials and so on [33]. Similar result was also obtained in Australia where 53 academics in the Faculty of Arts, Business and Law and in the Faculty of Science, Health, Engineering, and Education at the University of the Sunshine Coast in Queensland, mainly adopted social media to distribute course-related information to students, and secondarily, to assess students and gather their views [27]. In the same year, Gichuhi *et al.* [22] brought to light that all the lecturers in the School of Education at the University of Nairobi, Kenya, adopted WhatsApp to transmit course content to learners.

IX. Benefits in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities

Studies had demonstrated that university teachers derived a number of gains from adopting social media to teach students. A good number of studies had attested to the potentials of social media in enhancing teacher-learner communication and in building groups. In the first instance, research showed that pedagogical uses of Facebook helped two third of 67 professors in the Faculty of Communication Sciences at Anadolu University in Turkey to have easy communication with students [32]. On the other hand, social media empowered American Public Administration university lecturers to extend the boundaries of course management systems; to engage in innovative and collaborative ventures; to relate theoretical knowledge to real-life issues; and to ease constructive learning [31]. In Nigeria, the instructional use of social networking tools was found to have enabled thirty-seven Library and Information Science lecturers in South-West Nigeria to deliver online lectures; to bridge teacher-student communication gulf; and to enhance their publication output [13]. It further benefited the communication process by helping teachers to integrate multimedia and multimodal texts into the teaching process; to speedily and effortlessly distribute these teaching materials; and to build a team-learning environment [34]. Subsequent findings by Roebuck *et al.* [16] also confirmed its benefit for communication and revealed other advantages, including enabling 201 US higher education teachers and professors to share information with students; to obtain students' feedback from multiple sources; to produce more participating students; to have better students' team task, discussion opportunities, enhanced creativity and preparation for instructional activities; and to build a stronger classroom community. In the same country, allied findings were obtained in a study by An *et al.* [35] which demonstrated that instructional application of Web 2.0 technologies by 14 US university teachers offered them opportunities to interact; to communicate; to work together; to create knowledge; to develop writing and digital competence; and to handle instructional technology easily and flexibly. The potential of using social media in creating communities also surfaced in another US study, which suggested that adopting social media for teaching task helped eight American Public Administration lecturers in building communities and in fostering team activities [32]. In a broad survey, social media pedagogical usage benefits which accrued to higher education academics in the UK, Australia/New Zealand, US, continental Europe and Canada, Ireland, the Caribbean and Africa, Asia and in South America included being opportune to network with other academics and with people or groups outside universities; helping to promote openness and to share information; to publicize and develop research and to give and receive support [18]. Ahmed *et al.* [25] reported that lecturers in the College of Education, Sudan University of Science and Technology, viewed pedagogical use of social media as vital because it helped them to locate and share educational materials with students; to promote knowledge distribution; to ease information exchange and responses with learners; to support innovative instructional strategies, etc. In Africa, the application of web 2.0 technologies for teaching assignment was reported to have empowered five Tanzanian university teachers to bring order to documents and academic materials; to link to relevant materials; to be more responsible, and to think and argue critically [34].

X. Challenges in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Universities

Research had established that university teachers encountered some barriers in their attempt to utilize social media to instruct students. Roebuck *et al.* [16] found that 201 US higher education teachers and professors encountered difficulty in using social media for instructional purposes owing to issues surrounding monitoring, accountability, obligation to maintain institutional culture, information explosion and the fact that its usage is time-demanding. However, in a subsequent study, it was the task of monitoring students' social media handles while conducting online assessment that presented a challenge for University of Maryland University

College online course teachers [36]. An *et al.* [36] made known that discomfort with openness, technical problems and lack of time hindered fourteen US university instructors from adopting social media for pedagogy. In a broad survey, higher education academics in the UK, Australia/New Zealand, US, continental Europe and Canada and Ireland, the Caribbean and Africa, Asia and in South America had difficulty in putting social media to teaching uses because of privacy and plagiarism concerns; the unclear line between personal and professional use of social media; the risk of endangering their career by unwise social media usage; lack of repute; the posted content quality; time demands; mandatory use of social media; use of social media as a means of harm; excessive self-publicity by others; potential plagiarism of teachers' ideas and content commercialization [18]. As for lecturers in Sudanese universities, the primary obstacle was lack of high-speed Internet, followed by lack of smart phones that enabled fast access; absence of teacher's confidence; narrow screen coverage; technical issues; and lack of teacher development programs [28]. In another study, pedagogical use of web 2.0 technologies by Makerere University lecturers was found to have been hampered by costly Internet subscriptions or low Internet band width; lectures' technophobia; rising cybercrime cases; poor training in ICT applications; shortage of time to apply the technologies; shortage of ICT facilities for students' use; low staff strength and absence of inspiration of lecturers by the university [24]. In the year that followed, Manca and Ranier [12] revealed that a sample of 6,139 Italian university teachers were not much willing to adopt social media to teach students owing to cultural resistance; instructional issues or institutional problems; displacement of teachers' conventional roles; the management of their relations with learners; threats to their privacy; lecturers' conservatism; lack of technical facilities and support; and lecturers' perceptions of social media usage as being harmful. This year came with another research by Ahmed *et al.* [25] which discovered that the major barriers encountered by lecturers in the College of Education, Sudan University of Science and Technology in using Social Media for instructional task, included absence of courses to train them on pedagogical application of the media; learners' reluctance to partake owing to their discomfort with the openness with which the media were adopted; the piling amount of administration and teaching work; and lack of a plan to create and adopt Web 2.0 for instructional functions. From a broad survey involving university teachers from majorly English-speaking nations, including UK, US, Australia and others, 62 percent of a sample of 333 of these lecturers were primarily hindered by worries about cultural and social beliefs; about safeguarding their reputation on the Internet; and about protecting their privacy [21]. An Australian research then discovered that privacy, bullying and lack of time prevented 53 academics in the Faculty of Arts, Business and Law and in the Faculty of Science, Health, Engineering, and Education at the University of the Sunshine Coast in Queensland from adopting social media for teaching purposes [27]. Likewise, a Malaysian study identified the hindrances to pedagogical applications of social media by Universiti Utara Malaysia lecturers to include lecturers' fears of invasion of their privacy; perceptions of social media as a source of distraction, lecturers' lack of social media operational skill and its perceived potential danger for students [19]. Two years later, a Nigerian investigation unraveled that 69 Business Education lecturers in five Nigerian states were hesitant about using social media for pedagogy because of lecturers' fears of students' abusive use of social media; lack of expertise and ignorance of accessible teaching software and absence of tools for using social media [14]. With respect to lecturers in the educational area at the University of Port Harcourt, Nigeria, the challenge experienced with adopting WhatsApp for teaching purposes was lack of skill [31]. In the same country and in the same year, Shadrach and Abugu [37] uncovered that older teachers' low level of media literacy, security threat from the Internet, poor network, likelihood of distractions and addictions constituted critical social media instructional application barriers to lecturers in Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. In a relatively-current study, lecturers in government-owned universities in Rivers State, Nigeria, who adopted social media for pedagogy, were found to have been hampered by poor Internet services, inadequacy of support

tools, social media users' diverse social-cultural backgrounds, the non-suitability of social media for all kinds of work engagements and the potential adoption of social media to modify proposed syllabus [38].

XI. Research Methodology

The study adopted descriptive research design. The choice of this design was premised on the fact that the study was meant to collect and interpret lecturers' opinions on issues bordering on their adoption of social media in teaching Library and Information Science (LIS) in public universities. This is consistent with the observation that the purpose of a survey research design is to glean and systematically describe information and facts about a given population [39]. The study population was ninety-four Library and Information Science lecturers in ten public universities in South-South Nigeria. The research made use of total enumeration sampling technique to engage a sample of seventy-three LIS lecturers. This sampling method was adopted because the population was manageable. A close-ended questionnaire was used to source for research data.

The instrument had two sections: A and B. Section A elicited information on the personal details of the study respondents, while Section B had four clusters: A, B, C and D. Cluster A dealt with "Extent of Lecturers' Adoption of Social Media in Teaching Library and Information Science"; Cluster B with "Purposes of Lecturers' Adoption of Social Media in Teaching Library and Information Science", Cluster C covered "Lecturers' Benefits in Adoption of Social Media in Teaching Library and Information Science and Cluster D covered "Challenges in Lecturers' Adoption of Social Media in Teaching Library and Information Science". Cluster A, which had fourteen items, was weighted on a four-point rating scale of "Very Great Extent (4)", "Great Extent (3)", "Low Extent (2)" and "Very Low Extent (1). Cluster B, which contained four items, was weighted on a two-point rating scale of Agree (2) and Disagree (1). On the other hand, Cluster C and D with five and seven items respectively, were both weighted on a four-point rating scale of "Strongly Agree (4), "Agree (3)", "Disagree (2)" and "Strongly Disagree (1)".

Two senior Library and Information Science lecturers and a senior Measurement and Evaluation lecturer at Niger Delta University, Bayelsa State, Nigeria, attested to the validity of the instrument. However, the instrument was not pilot tested based on the position that a valid instrument tends to be reliable [39]. Ninety-four copies of the questionnaire were administered to the LIS lecturers. However, only seventy-three copies were retrieved and found amenable for data analysis, amounting to a response rate of 77.66%. Data collection spanned from 7th January, 2024 to 28th February, 2024. The data gathered were analysed by means of weighted mean and standard deviation.

Cut-off points of 2.50 for Cluster A, C and D and 1.50 for Cluster B were set for the study. It was decided that Cluster A items whose weighted means were less than 2.50 would be considered as "Low Extent" while those with means equal to or greater than 2.50 would be considered as "Great Extent". Specifically, items with means which fell within the boundaries of "3.50-4.49", 2.50-3.49, 1.50-2.49 and "0.50-1.49" would be regarded as "Very Great Extent", "Great Extent", "Low Extent" and "Very Low Extent" respectively. The aggregate mean for this cluster was also interpreted in the same way. With respect to Cluster B, items with means less than 1.50 would be viewed as "Disagreed", whereas, items with means equivalent to or greater than 1.50 would be regarded as "Agreed". For Cluster C and D, items with weighted means less than 2.50 would be considered as "Disagreed", whereas, those with means equal to or greater than 2.50 would be viewed as "Agreed". Specifically, items in cluster C whose weighted means fell into the ranges of "3.50-4.49", 2.50-3.49, 1.50-2.49 and "0.50-1.49" would be considered as "Strongly Agree, "Agree", "Disagree" and "Strongly Disagree" respectively. This decision rule was also applicable to Cluster D.

XII. Data Analysis

This part of the research paper provided a tabular layout of the findings based on the research questions raised to provide guidance for the study.

XIII. Extent of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Here, respondents were asked to indicate the extent to which they adopted social media to teach Library and Information Science on a scale of Very Great Extent, Great Extent, Low Extent and Very Low Extent. Result reveals that Library and Information Science lecturers in public universities in South-South Nigeria adopt WhatsApp to a great extent; Telegram, YouTube and Google + to a low extent, while they adopt Facebook, Twitter, Wikis, Wechat, Instagram, Skype, Snapchat, blogs, Ozone and Tumbir to a very low extent. On the whole, the cluster mean of 1.36 falls within the range of "0.50-1.49", which was earlier set as "Very Low Extent". Hence, Library and Information Science lecturers in public universities in South-South Nigeria adopt social media for teaching processes to a very low extent. The responses are displayed in Table I.

Table I: Mean Ratings of Responses on Extent of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Sr. No.	Items	Mean	Standard Deviation	Remark
1.	Facebook	1.13	0.11	VLE
2.	WhatsApp	2.56	0.26	GE
3.	Telegram	2.33	0.23	LE
4.	YouTube	2.15	0.22	LE
5.	Twitter	1.45	0.15	VLE
6.	Wikis	0.57	0.06	VLE
7.	Wechat	1.43	0.14	VLE
8.	Instagram	1.16	0.12	VLE
9.	Skype	0.58	0.06	VLE
10.	Snapchat	1.15	0.12	VLE
11.	Blogs	1.10	0.11	VLE
12.	Qzone	0.50	0.05	VLE
13.	Tumbir	0.51	0.05	VLE
14.	Google +	2.44	0.24	LE
	Grand Mean and Standard Deviation	1.36	0.14	VLE

Key: VGE: Very Great Extent; GE=Great Extent; LE=Low Extent; VLE: Very Low Extent

XIV. Purposes of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Respondents were asked to state the purposes for which they adopted social media in the instructional process using a scale of Agree and Disagree. Finding indicates that, while Library and Information Science lecturers in public universities in South-South Nigeria apply social media to teach students in such areas as delivering lectures to students and disitibuting course content to students, they do not adopt same media to develop course content and to assess students. Responses are shown in Table II.

Table II: Mean Ratings of Responses on Purposes for Which Lecturers Adopt Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Sr. No.	Items	Mean	Standard Deviation	Remark
1.	I use social media to develop course content.	1.15	0.12	Disagree
2.	I utilise social media to deliver lectures to students.	2.01	0.20	Agree
3.	I adopt social media to distribute course content to students.	2.23	0.22	Agree
4.	I adopt social media to assess students.	1.44	0.14	Disagree
	Mean and Standard Deviation	1.73	0.17	Agree

XV. Lecturers' Benefits in Adopting Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

On a scale of Strongly Agree, Agree, Disagree and Strongly Disagree, respondents were asked to specify the gains they derived from adopting social media to teach Library and Information Science. Out come indicates that adopting social media to teach students helps Library and Information Science lecturers in public universities in South-South Nigeria to stay current, to disseminate course content to students, to exchange information with students with ease and to acquire digital skills. However, the lecturers' adoption of social media for teaching processes does not make them resourceful in teaching. This is shown in Table III.

Table III: Mean Ratings of Responses on Lecturers' Benefits in Adopting Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Sr. No.	Items	Mean	Standard Deviation	Remark
1	Social media usage for teaching activities enables me to have access to the latest information.	3.46	0.37	Agree
2.	Social media utilization for instruction helps me to distribute course content to students easily.	4.32	0.43	Agree
3.	Social media adoption for teaching activities facilitates my communication with students.	4.35	0.44	Agree
4.	Social media usage for instruction helps me to become a resourceful teacher.	2.47	0.25	Disagree
5.	Social media adoption for instruction enables me to acquire digital skills.	2.56	0.26	Agree
	Grand Mean and Standard Deviation	3.43	0.34	Agree

XVI. Lecturers' Challenges in Adopting Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

On a scale of Strongly Agree, Agree, Disagree and Strongly Disagree, respondents were asked to indicate the obstacles they encountered in adopting social media to teach Library and Information Science. It was discovered that Library and Information Science lecturers in public universities in South-South Nigeria have problems in applying social media for teaching engagement owing to unstable Internet connectivity and electricity supply and poor digital literacy. Whereas, shortage of ICT facilities, absence of supporting policy framework, ignorance of social media and inadequate fund/ poor funding do not militate against the lecturer's utilization of social media for pedagogical uses. This is conveyed in Table IV.

Table IV: Mean Ratings of Responses on Lecturers' Challenges in Adopting Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Sr. No.	Items	Mean	Standard Deviation	Remark
1.	Inadequate ICT facilities	2.48	0.25	Disagree
2.	Lack of supporting policy framework	1.43	0.14	Disagree
3.	Lack of awareness of social media	2.46	0.25	Disagree
4.	Unstable internet connectivity	3.34	0.33	Agree
5.	Insufficient fund/poor funding	2.47	0.25	Disagree
6.	Unstable power supply	3.45	0.35	Agree
7.	Poor digital literacy	2.57	0.26	Agree
	Mean and Standard Deviation	2.60	0.26	Agree

XVII. Discussion

The study made an attempt to ascertain issues bordering on lecturers' adoption of social media for teaching Library and Information Science in public universities in South-South Nigeria. This attempt uncovered that the lecturers made very low use of social media for teaching endeavor. This result aligns with studies linking Italian university teachers with very limited pedagogical adoption of social media [12]; and Business Education teachers in tertiary educational institutions in five Nigerian states with marginal utilsation of same media for same purpose [14]. On the contrary, it disagrees with studies ascribing pedagogical applications of social media to 63 percent of 201 US higher education teachers [16] and to 70 percent of 123 Universiti Utara Malaysia lecturers [19]. It further disagrees with research associating South-South, South-East and South-West Nigerian public university and polytechnic lecturers with a high degree of utilization of same media for communication with students [15]. The very low utilisation of social media for teaching activities by the lecturers may be due to the seeming interest in using same media for knowledge and information sharing among lecturers, rather than for pedagogy.

This study also showed that the while the lecturers applied social media to impart knowledge to students in areas including delivering lectures to students and in disseminating course content to students, they did not utilise same media to develop course content and to evaluate students. The outcome is in agreement with previous studies connecting Universiti Utara Malaysia lecturers with pedagogical uses of social media for informal communication with students [19]; Turkish Anadolu University Communication Science professors with adopting same media for disseminating information, reference books, group assignments and for holding course sessions [32]; and US higher education teachers and professors with utilsing same for communication and supply of course material [16]. Although the finding concurs with the result from the Ugandian study that Makerere University lecturers adopted web 2.0 tools to make announcements to students, it disagrees with the part of the result which indicates that the lecturers also used the technologies to create course content and to assess students [24]. While the present result is also in line with the finding that academics in Arts, Business and Law and Science, Health, Engineering and Education faculties at the University of the Sunshine Coast in Queensland principally utilized social media to distribute course-related information to students, it disagrees with the part of the result that the lecturers also adopted same media to evaluate students [27]. There seems to a growing interest among the lecturers in utilizing social media to share knowledge, and this may explain why the LIS lecturers adopt social media to deliver lecturers and to distribute course content to students.

The research further revealed that, in using social media to instruct students, the lecturers were able to stay aware of the latest information, to share course material to students easily, to easily communicate with students and to acquire digital skills. However, pedagogical use of same media does not enable the lecturers to become resourceful teachers. The current outcome is in line with research claiming

that instructional use of Facebook enabled Anadolu University Communication Science professors to have easy communication with their students [32]. Although the result agrees with finding by Roebuck *et al.* [16] that social media application for teaching task helped 201 US higher education teachers and professors to share information with students, it disagrees with the same finding that its instructional use improves teachers' creativity. It also bears semblance to result suggesting that Web 2.0 technology application for teaching purposes helped US university teachers to acquire digital skills [35]. Moreover, it is consistent with finding suggesting that applying social networking tools for instructional processes helped thirty-seven South-West Nigerian universities' Library and Information Science lecturers to have online classes with students and to narrow their communication gap with learners [13]. There appears to be widespread use of social media for knowledge sharing among lecturers in public universities in the study area. This could be accountable for the current result.

The study also established that the lecturers found it difficult to put social media to teaching uses because of unstable internet connectivity, irregular electricity supply and lack of digital competence, while shortage of ICT tools, lack of supporting policy framework, ignorance of social media and inadequate fund/poor funding did not hamper the lecturers' utilization of same media for pedagogy. This corresponds with findings that technical obstacles and lecturers' lack of social media operational competence posed obstacles to pedagogical utlisation of social media by US university instructors and Universiti Utara Malaysia lecturers respectively [35]; [19]. It is also in accord with the finding that Makerere University lecturers find it difficult to utilized web 2.0 tools to teach students due to low internet bandwidth and little training in ICT usage [24]. Although the result is in tune with research attributing poor inclination towards social media pedagogical usage by 6, 139 Italian university teachers to lack of technical support, it disagrees with the part of the result suggesting that lack of technical facilities also posed a challenge [12]. Lack of competence to operate social media for teaching activities poses an obstacle to the lecturers probably because a good number of these lecturers tend to be lukewarm towards acquiring digital skills.

XVIII. Conclusion

The study made an incursion into lecturers' adoption of social media for teaching Library and Information Science in government-owned universities in South-South Nigeria. The investigation made bare that the lecturers minimally adopted social media to instruct students in Library and Information Science. In making use of social media for instructional activities, the lecturers applied social media to deliver lectures to students and to transmit course materials to same. This process was beneficial in enabling the lecturers to become acquainted with the most current information; to transmit course materials to students with ease; to have easy communication with students; and to acquire digital aptitude. However, the lecturers had difficulty in adopting the technologies to impart knowledge to students due to unstable internet connectivity, irregular power supply and lack of skill to operate social media for instructional task.

XIX. Recommendations of the Study

In the light of the outcome of the research, it was suggested that:

- Nigerian government should take steps to improve power supply in the country. Solar systems could be installed in the country to boost electricity supply.
- Public universities should install Wide Area Networks to strengthen Internet connectivity on campuses. University management could collaborate with Internet Service Providers such as MTN, GLO, Airtel and others to have a strong network and Internet connectivity.
- Library and Information Science lecturers in public universities in South-South Nigeria should undergo training in digital literacy and in innovative instructional techniques. They could undertake regular digital pedagogical training to develop or enhance their skill to effectively adopt social media for instructional activities.

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Appendix A: Questionnaire on Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Section A: Demographic Data of Respondents

Institutional Affiliation: The table below reflects the probable public universities in South-South Nigeria in which you teach Library and Information Science. Please use a tick (√) to indicate your university in the table:

Sr. No.	Name of Institution	Response
1.	University of Port Harcourt	
2.	University of Benin	
3.	University of Calabar	
4.	University of Uyo	
5.	Niger Delta University	
6.	Cross Rivers State University of Science and Technology	
7.	Ambrose Ali University	
8.	Rivers State University	
9.	Delta State University, Abraka	
10.	University of Agbor, Delta State	

Section B: Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

Cluster A: Extent of Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

The four-point rating scale in the following table, symbolized by VGE, GE, LE and VLE, which stand for Very Great Extent (4), Great Extent (3), Low Extent (2) and Very Low Extent (1) respectively, indicates the extent to which you might have adopted the itemized social media in teaching Library and Information Science. Kindly use a tick (√) to rate the extent to which you have adopted each of these media using the scale.

Sr. No.	Items	VGE	GE	LE	VLE
1.	Facebook				
2.	WhatsApp				
3.	Telegram				
4.	YouTube				
5.	Twitter				
6.	Wikis				
7.	Wechat				
8	Instagram				
9.	Skype				
10.	Snapchat				
11.	Blogs				
12.	Qzone				
13.	Tumbir				
14.	Google +				

Cluster B: Purposes of Lecturers' Adoption of Collaborative Technologies in Teaching Library and Information Science in Public Universities in South-South Nigeria

The two-point rating scale of Agree (2) and Disagree (1) in the table underneath shows the purposes for which you have possibly adopted and not adopted collaborative technologies in teaching Library and Information Science. Please use a tick (√) to indicate the purposes for which you have adopted and not adopted these technologies using the scale.

Sr. No.	Items	Agree	Disagree
1.	I use social media to develop course content.		
2.	I utilise social media to deliver lectures to students.		
3.	I adopt social media to distribute course content to students.		
4.	I adopt social media to assess students.		

Cluster C: Benefits in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

The four-point rating scale in the table underneath, SA, A, D and SD, which represent Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1), indicates your agreement with the listed benefits you derive from using social media for instructional activities. Please use a tick (√) to show the benefit (s) peculiar to you.

Sr. No.	Items	SA	A	D	SD
1.	Social media usage for teaching activities enables me to have access to the latest information.				
2.	Social media utilization for instruction helps me to distribute course content to students easily.				
3.	Social media adoption for teaching activities facilitates my communication with students.				
4.	Social media usage for instruction helps me to become a resourceful teacher.				
5.	Social media adoption for instruction enables me to acquire digital skills.				

Cluster D: Challenges in Lecturers' Adoption of Social Media in Teaching Library and Information Science in Public Universities in South-South Nigeria

The four-point rating scale in the following table, abbreviated as SA, A, D and SD, which stands for Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1) respectively, reveals the potential obstacles you have faced in utlising social media to teach Library and Information Science. Please use a tick (√) to express your challenges by means of the four-point rating scale.

Sr. No.	Items	SA	A	D	SD
1.	Inadequate ICT facilities.				
2.	Lack of supporting policy framework.				
3.	Lack of awareness of social media.				
4.	Unstable internet connectivity.				
5.	Insufficient fund/poor funding.				
7.	Unstable power supply.				
8.	Poor digital literacy.				

Appendix B: Distribution of Respondents of the Study

Sr. No.	Names of Universities	Number of Respondents	Percentage of Respondents
1.	University of Port Harcourt	7	9.589%
2.	University of Benin	7	9.589%
3.	University of Calabar	8	10.959%
4.	University of Uyo	6	8.219%
5.	Niger Delta University	8	10.959%
6.	Cross Rivers State University of Science and Technology	9	12.329%
7.	Ambrose Ali University	8	10.959%
8.	Rivers State University	7	9.589%
9.	Delta State University, Abraka	7	9.589%
10.	University of Agbor	6	8.219%
	Total	73	100%

Journal of Applied Information Science
13 (1) 2025, 01-09
www.publishingindia.com/jais

E-Learning Platform: Developing Software Solutions to Enhance Educational Infrastructure and Connectivity in Rural Areas

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Abstract: This research presents the development of a web application Edurl, designed to enhance specific skill or knowledge area. Leveraging the MERN stack (MongoDB, Express.js, React.js, Node.js) and Progressive Web App (PWA) technologies, Edurl aims to provide an accessible and engaging learning experience. By incorporating features such as login, registration, educational path selection and learning, quizzes, and feedback, accessible interactive tutorials, quizzes, personalized learning paths, the application seeks to address the specific learning need or challenge faced by the rural students. The effectiveness of Edurl will be evaluated through a combination of user testing and quantitative analysis of user engagement metrics by offering an innovative and easily accessible educational solution. This research highlights the connection between e-learning and rural development, advocating for tailored strategies to meet the unique needs of these regions. By providing a cutting-edge and user-friendly educational solution, Edurl promotes regional economic development. In conclusion, this research aspires to contribute to a more inclusive and equitable education system in rural India by leveraging technology to empower learners and support sustainable development.

Keywords: Educational development, E-Learning website, MERN stack, Rural education.

I. Introduction

E-Learning applications are becoming increasingly important in the world of education and training, including for Micro, Small, and Medium Enterprises (MSMEs). However, there are still many obstacles and limitations in the implementation of E-Learning among MSMEs, especially in integration with MERN technology which has not been widely implemented [1, 2]. This study will discuss the opportunities and challenges faced by MSMEs in integrating E-Learning applications with MERN technology, providing useful insights for the development of MSMEs in the field of E-Learning. The Edurl application that we created has the potential to increase knowledge about product branding for entrepreneurs or MSMEs [2], with the increasing quality of MSME product branding in Indonesia, it is hoped that it can also increase the level of marketing and the local economy in Indonesia. This application will continue to be updated in the future with related content to support MSMEs in Indonesia [2]. With a website-based application, users can open the application anywhere and anytime without having to require certain device specifications.

II. Research Methods

A. Research Flow

According to Saravanos and Curinga (2023), the Waterfall model is a sequential software development process where progress flows downwards through phases like a waterfall. Each phase must be completed before the next one begins, and it includes phases such as requirements, design, implementation, verification, and maintenance [3].

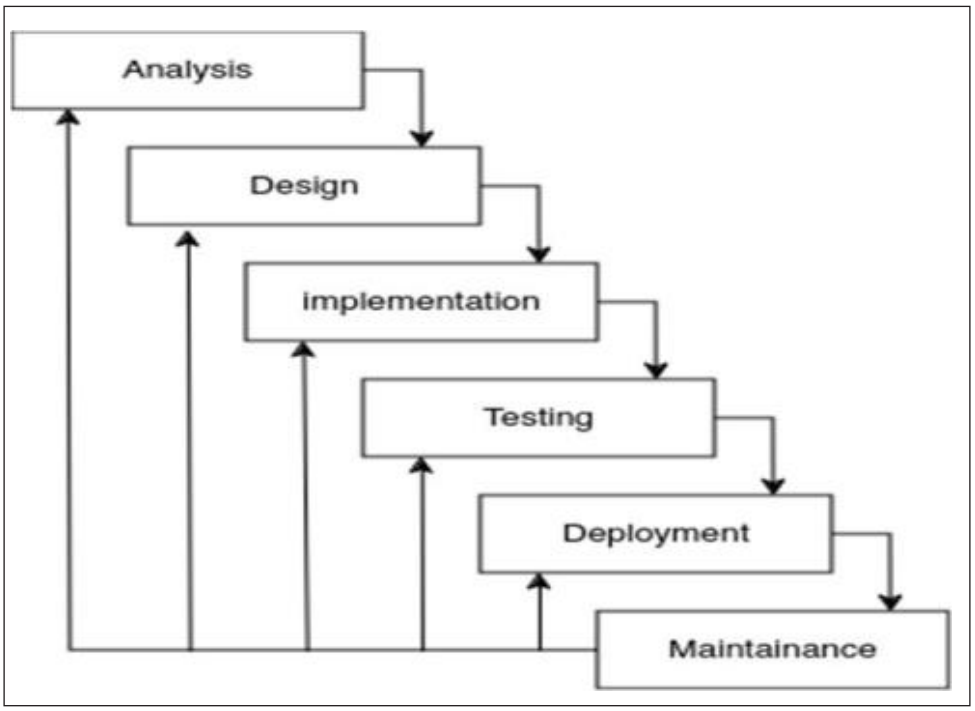

Fig. 1: Research Flow [3]

- *System Requirements Analysis:* This stage involves identifying and documenting user and system needs in detail through observation, interviews and literature studies.
- *Design (Software Design):* After the needs are defined, the developer designs the software architecture to be built. This includes system design, user interface design, and technical planning.
- *Development (Implementation/Development):* This stage turns the design into program code that can run. Developers work to create small parts of the program based on predetermined specifications.
- *Testing:* After the software is developed, the testing phase is carried out to ensure that the software functions according to predetermined needs and standards. Testing includes functionality testing, integration testing, and performance testing.
- *Deployment:* After passing the testing phase, the software is implemented and used by end users. This process involves user training, software installation, and ongoing system maintenance.
- *Maintenance:* This maintenance stage involves bug fixes, feature enhancements, and technical support tensure that the software continues to run smoothly in the long term.

B. E-Learning System

The process of learning through electronic media and technology is known as electronic learning, or e-learning. E-learning is usually done online,

allowing students to access their course materials at any time and from any location. Online courses, online degree programs, and other online learning initiatives are common forms of e-learning.

E-learning has many advantages over traditional learning methods, including the flexibility to choose your own learning environment and pace, as well as cost efficiency because it eliminates the geographic barriers often associated with traditional classrooms [4].

C. Website

Website is a collection of web pages and related content that is identified by a common domain name and published on at least one web server. Websites are a fundamental aspect of the internet, providing a platform for information sharing, communication, and commerce, among other functions [5].

D. React

React is a JavaScript library created by Facebook for building dynamic user interfaces, open to community contributions, and continuously developed to improve functionality and reliability. React's success lies in its ability to simplify the creation of interactive and complex UIs, making it the primary choice for developers for large and popular projects in today's web development world [6].

E. Node.js

Node.js is a software system specifically designed to facilitate the development of web applications. With Node.js, developers can use the JavaScript language to build applications on both the client and server sides. Node.js enables the development of web applications by combining various components in one platform using NPM (Node Package Manager). In addition, Node.js also functions as a runtime and scripting environment, which means it can run and implement the main functions of the programming language [7].

F. Framework of Thought

Website design is one of the crucial factors in determining the dissemination of information and the appeal to users on an E-Learning website. Designing a good website design for the Edurl website is expected to help facilitate and be an attraction for MSMEs as a means of learning [8].

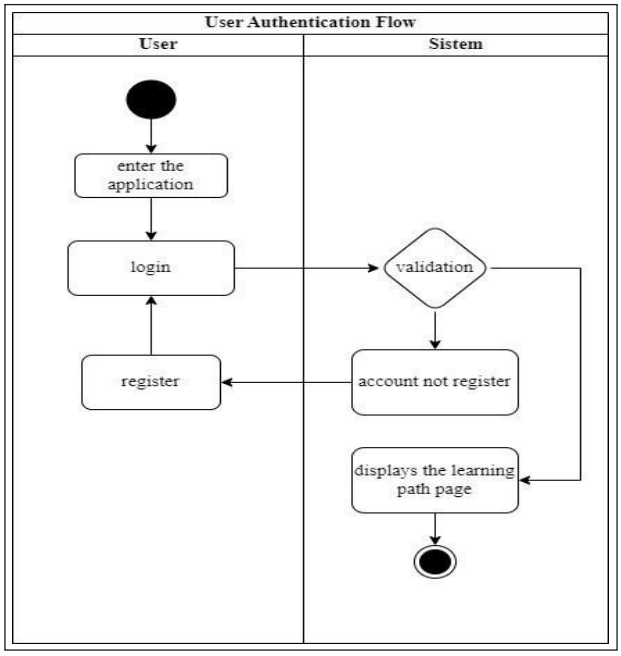

Fig. 2: Framework of Thought

G. Registration and Authentication Flow

In the Registration and Authentication flow of the user account, the user must first log in, but before that, make sure that the user already has an account on the Edurl application. If the user does not have an account on the Edurl application, the user can create an account first on the Registration page. If the user successfully logs in, the user will immediately enter the Edurl Learning Path Dashboard page. On this page there are various Learning Path options.

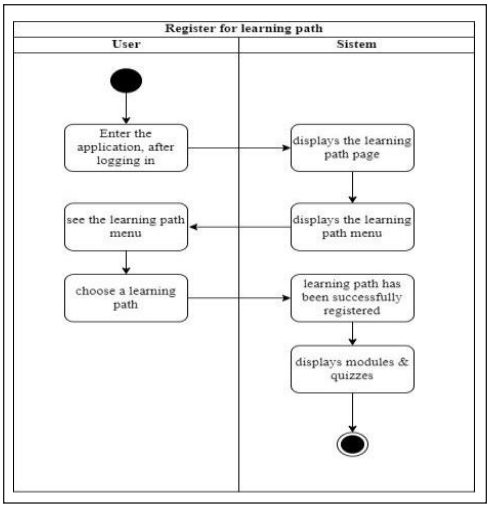

Fig. 3: Registration and Authentication Flow

H. Learning Path Management Process Flow

In the Learning Path Management process flow, the admin can create, edit and delete Learning Paths. In the Learning Path Management Process Flow above, it is explained how the admin creates a Learning Path where in the Learning Path there is material in the form of text or video and also quizzes.

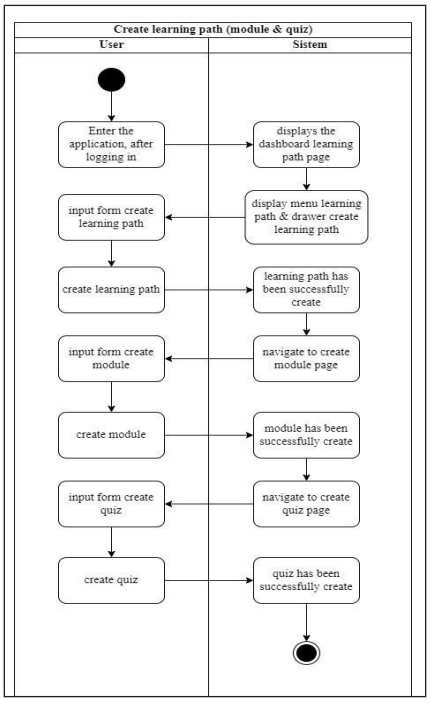

Fig. 4: Learning Path Management Process Flow

III. Results and Analysis

A. User Interface

The Edurl website user interface looks like, the home page will appear on the home page there is a main menu of insight, e-learning, about, login and registration. If the user has logged in, the user will be redirected to the Learning Path page.

The interface is optimized for responsiveness and accessibility, ensuring that users can easily navigate the platform on various devices, including smartphones, tablets, and desktops. The overall design focuses on reducing complexity, making it easy for users to find what they need quickly and efficiently. Through these thoughtful design choices, Edurl ensures that its users have a smooth and engaging experience, helping them stay motivated and focused on their educational goals.

Fig. 5: Home Page

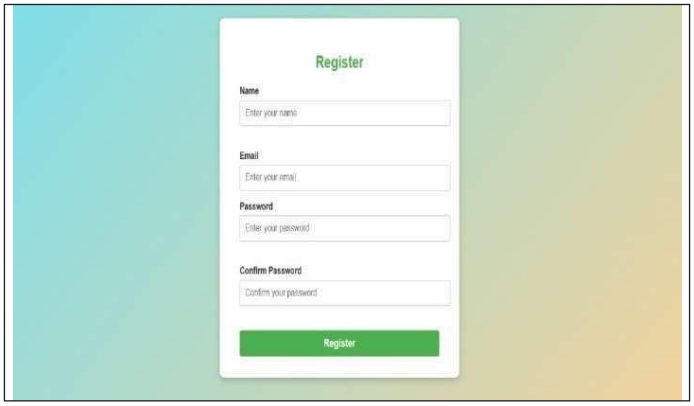

Fig. 6: Registration Page

The registration page is used if the user does not have an account; there is a registration button on the register option. On the Register page, users can register an account via a Gmail account, or want to fill it in manually.

The next page is the about page which contains information about the application creator and a description of the application.

Fig. 7: About Page

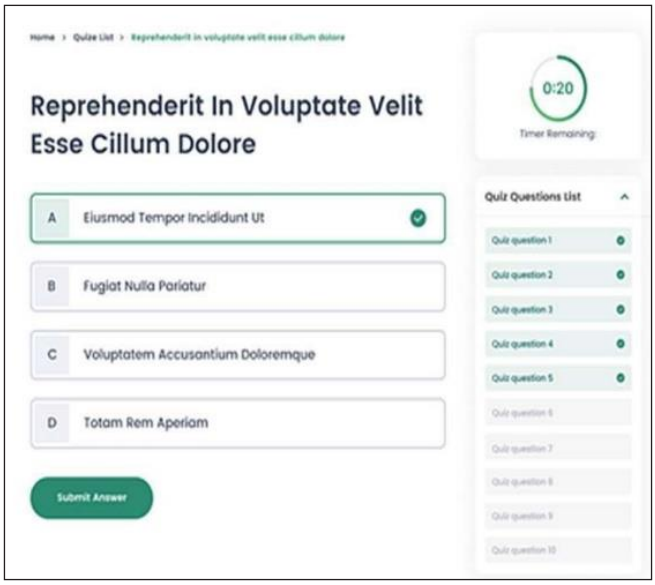

Fig. 8: Quiz Page

Users can choose various Learning Paths regarding business and branding of MSME products. To select a Learning Path, the user can press one of the available learning paths, and then the user will be redirected to the module page.

Fig. 9: Learning Paths

The user has selected a learning path; the user will be redirected to the module page. On this module page, the user can start learning the material from Our Services sliding blocks.

IV. Future Scope

In the future, we will continue to evolve by integrating several advanced features aimed at enhancing the learning experience for rural students. Planned additions include multi-language support, offline learning capabilities and gamified assessments. The platform will also expand its educational content to include hands-on training, localized subjects and community support features. Additionally, the user interface will be further optimized for accessibility, while data analytics will offer deeper insights into student progress. These upgrades will ensure that Edurl remains a dynamic, inclusive, and comprehensive educational solution for rural communities.

A. Quizzes

Future updates could include personalized quizzes based on the learner's progress, difficulty level, and performance. These quizzes could adapt to the learner's needs, offering more challenging content or revisiting areas where they need improvement.

A more advanced quiz system could provide instant feedback, including hints for wrong answers and explanations for correct ones. This system could also track quiz history and performance over time, helping both students and educators focus on areas that require more attention.

B. Community and Support Features

Parent/Teacher Engagement: Building features to keep parents and teachers informed about the progress and need of the students can help create a more cohesive learning environment. This could include regular progress updates, meeting schedules, and notifications for important events or assessments.

C. User Interface

We will enhance its user interface to offer a more intuitive, engaging, and visually appealing experience. By this platform will feature a clean, modern design optimized for mobile devices, ensuring accessibility for rural students. Personalized dashboards will track learning progress, while multilingual support will cater to regional languages. Accessibility features like dark mode, font adjustments, and screen reader compatibility will ensure inclusivity. Interactive elements, such as progress indicators and

achievements, will further motivate learners. These updates will make Edurl more user-friendly, visually attractive, and accessible for all students.

D. Multi-Language Support

We will introduce multilingual support to make learning easier for students who speak different languages, starting with Hindi and English. The platform will offer content in both of these languages, allowing students to choose and learn in their preferred language. This feature will help break language barriers, making the lessons more accessible and ensuring that all students can understand and engage with the material more effectively. By offering a bilingual learning experience, Edurl will provide students with the confidence to learn at their own pace and improve their understanding of the content.

V. Methods of Online Education Model and Their Benefits

There are the ways of E-learning which benefits both Instructor and learner are as follows [9, 10]:

- *Collaboration:* Students can share resources more easily because to technology. Students have the opportunity to collaborate on projects [11, 12], speak effectively both in and out of the classroom, and share their work online.
- *Automation:* Years ago, Instructor has spent hours after school and on weekends grading papers. There are plenty of E-learning tools [13] that can save time and automatic grading and making measuring student advancement simple.
- *Information Collection:* E-Learning can greatly simplify the process of tracking student progress over time. Numerous tools have the ability to automatically provide instructors with student data, quickly and easily displaying the abilities [14] that pupils have learnt and those that require improvement.
- *Turn the Classroom Around:* E-Learning is one potential medium for the flipped classroom, where students watch lectures or read books at home before working on projects or having class discussions. The field of education is exploding with this novel approach to teaching and learning.
- *Originality:* Learners can engage in creative activity with the help of an e-learning kit. Students can showcase platforms by producing digital art and online presentations.
- *Learn to Write Code:* The ability to program computers is becoming more and more in-demand. Even in primary school, there are numerous resources available to educate pupils how to code.
- *Free Resources:* Teachers are no longer required to forfeit workbooks. Busy teachers can create lesson plans in a matter of minutes with the support of a wealth of free resources available online.
- *Customise Education:* Teachers can differentiate instruction with the aid of e-learning. Each student can concentrate on their own areas of weakness while working independently on a different aspect of their particular strategy.
- *Cleaning Up:* Numerous resources are available to assist students with remediation through e-learning. E-learning resources can help students who are falling behind in their studies catch up.
- *Offer a Boost in Speed:* E-Learning can be used to increase velocity; however, it is not for remediation. When students become disinterested in the content, they do extra assignments and use e-learning to speed up their learning.

VI. Conclusion

This research initiative aims to tackle the ongoing digital divide in rural areas, which limits equitable access to quality education. The project focuses on developing innovative software solutions [15, 16] to enhance educational infrastructure and connectivity. Utilizing rigorous research methods and user-centered design principles, the study seeks to create a sustainable and impactful approach to meeting the unique needs and challenges of rural communities. The software developed will empower learners

and educators, fostering inclusive and equitable educational access. Ultimately, this research aims to contribute to closing the digital divide, ensuring that every learner, regardless of geographic location, has the opportunity to thrive in the digital era.

The Edurl E-Learning application [17] can be used and has good usability so that it can be utilized by rural students and the general public.

Initial evaluation of the Edurl web application identifies areas for improvement. To enhance the overall user experience, we aim to optimize system flows and feature functionality, particularly in areas such as navigation, search functionality, content organization, and user interaction.

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Journal of Applied Information Science
13 (1) 2025, 10-17
www.publishingindia.com/jais

Rakshika: A Systematic Review of Artificial Intelligence and Internet of Things Solutions for Women's Safety

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Abstract: The increasing global awareness of gender-based violence and harassment has led to the emergence of innovative technologies focused on improving women's safety. This review paper looks at the evolution, design, and societal impact of various safety devices and solutions tailored to empower women in diverse environments. These technologies incorporate wearables, mobile applications, and stand-alone devices with advanced GPS tracking and emergency alert system capabilities in place to facilitate response in high-risk situations within real time. Emerging technologies of the IoT, AI, and ML have transformed and are evolving these solutions that allow predictive analytics, intelligent detection, and proactive responses. It includes critical challenges such as privacy, security of data, accessibility for underprivileged groups, and the requirement of more inclusive and intuitive designs along with technological advancements. Other issues that it also presents include usability validation and how the adoption of these devices may be promoted by governments and organizations. This paper, through the analysis of key innovations and their real-world applications, demonstrates how technology can empower women and make public and private spaces safer, thus contributing to gender equality and societal progress.

Keywords: Artificial intelligence, Convolutional neural network, Crowd monitoring, GPS tracking, IoT (Internet of Things), Wearables, Women security.

I. Introduction

The safety of women has become a global concern, especially with the rising cases of harassment, assault, and violence against them. Whether at home or in public, women face constant threats that endanger both their physical and mental well-being. The 2012 Nirbhaya case deeply shocked the nation and triggered widespread protests, calling for stricter laws, safer environments, and swifter justice for women in India.

This led to a series of legislative reforms throughout the country, including the Criminal Law (Amendment) Act of 2013 [1]. However, despite these changes, women in India continue to face the threat of sexual violence. Alarming cases like the gang rape and murder of a Dalit woman in Hathras, India, in 2020. This case not only threw a beam of light on systemic failures in how such crimes are dealt with but also cast very wide-ranging questions on justice and law enforcement accountability as well as on issues of caste-based violence [2]. Another one is the most recent brutal rape and murder of a young, promising and ambitious doctor within the premises of the RG Kar Medical College in Kolkata has sent shockwaves throughout the medical community and the whole country concerns about the safety of women, even in spaces where they should feel secure [3]. These cases reflect a global issue that transcends geographical and cultural boundaries, necessitating immediate action through both social reforms and technological solutions and highlight that the problem of women's safety is far from resolved.

Despite government efforts and legal frameworks designed to reduce such violence, the reality is that women remain vulnerable to harassment and assault in everyday situations. There is a clear need for practical, real-time solutions that can protect women and enable rapid responses during dangerous situations. Women's safety devices have become indispensable in combating gender-based violence. These tools range from basic personal alarms to advanced wearables and mobile apps with features like GPS tracking, emergency alerts, and real-time monitoring, offering quick assistance when needed most.

This review paper examines the development and effectiveness of these devices, focusing on their design, functionality, and practical use, especially in response to rising incidents. It also explores how technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML) can enhance personal safety. The paper emphasizes how technology empowers women, creating safer environments both publicly and privately.

In addition, it addresses challenges like privacy concerns, accessibility, and user adoption, while identifying opportunities for innovation to further improve women's safety. The paper will assess available technologies, highlight key innovations, and evaluate their ability to reduce risks in vulnerable situations. It will also explore the difficulties these devices face, such as privacy issues, limited access, and inconsistent adoption rates. Finally, the paper will consider future directions for advancing women's safety technology, with a focus on AI, ML, and IoT to create more personalized and predictive solutions.

Even though no panacea will likely completely eliminate the risk of sexual violence, a perfect combination of legal reforms, change in attitude from society, and technology-based safety measures will definitely reduce the levels at which women have to suffer. It is all about creating an atmosphere where women feel safe enough and are empowered to walk freely in public places, at home, or online.

II. Literature Survey

A literature survey is a critical component of research that involves reviewing and synthesizing existing scholarly work on a particular topic. A literature survey provides a strong foundation for the research being conducted, allowing the researcher to build upon existing knowledge and demonstrate their familiarity with the field.

The issue of women's safety in India has been at the top of societal concern and academic research for some time now, especially with major cases of sexual violence surfacing. The 2012 Nirbhaya case - in which a young woman was brutalized, gang raped, and murdered in Delhi - marked a turning point and

sparked widespread protests for tighter laws, safer environments, and swifter justice. Public outbursts even spurred some legislation: such as the Criminal Law Amendment Act 2013, aimed to harden the laws against sexual crimes. Still, sexual assault remains a significant issue facing Indian women [1].

The gang rape and murder of a Dalit woman in Hathras in 2020 exposed not only systemic failures in handling such crimes but also underscored issues of caste-based violence and raised serious questions about justice, law enforcement accountability, and systemic bias [2]. More recently, the brutal rape and killing of a young doctor in the premises of RG Kar Medical College in Kolkata shocked the medical community and raised alarms about women's safety within spaces presumed to be safe. These incidents underscore the urgent need for robust safety measures and comprehensive reforms to ensure the safety and dignity of women in both public and private domains [3].

The existing literature on women's safety technologies highlights the development of mobile applications and wearable devices designed to improve personal security. Several mobile apps and wearable equipped with SOS features and GPS tracking have proven effective in assisting women in distress. Research has shown a notable decrease in response times and high user satisfaction with these applications [4]. For example, systems that employ sensors and data processing to alert authorities have proven effective in protecting women during emergencies. These systems can be seamlessly integrated into live surveillance setups for ongoing monitoring. In the future, we can expect the Internet of Things (IoT) technologies to broaden their applications to fields like healthcare and military operations [5].

One particular system uses GPS tracking to find victims and sends security alerts to nearby police stations, as well as notifications to pre-saved contacts via a GSM module. It also features a buzzer system with a sound range of 80-110 dB, which can be heard from up to 50 feet away [6]. An emergency application built with Dc-RFO-IoT technology aids women by providing essential critical thinking tools in crisis situations. When the emergency button is pressed, notifications are dispatched to registered contacts, women's helpline, and authorities, complete with GPS coordinates to pinpoint the victim's location [7].

Additionally, ongoing research in AI-driven wearable technology aims to identify potential attackers in public areas, using advanced deep learning models like Mirasys VMS to spot women who may be in distress or at risk [8]. Other systems utilize hardware components like Raspberry Pi, GPS, GSM, and force sensors to detect threats. These devices send real-time location data to authorities or emergency contacts [9]. However, while some of these systems provide significant protection, they are often costly and impractical for everyday use. Research continues into making these solutions more affordable and accessible to all women [10].

Created an AI-integrated safety band that predicts hazardous situations based on user trends, and learns above insights with time [11]. A smart surveillance system that included real time video analytics AI and IoT to observe surroundings and automatically identify potential safety hazards was introduced [12]. Investigated the use of artificial intelligence to find advanced digital forensics to protect women's online presence and deter cyber bullying by raising alerts in advance as well as providing protective measures [13].

Leveraging mobile apps that offer self-defense lesson and SOS services, enabling women to enjoy physical and cyber security tools at any given time [14]. Provided a summary of mobile applications that improve safety using GPS based location tracking and SOS systems to avert cases of violence between individuals [15]. In the course of the project EmpowerHer, we have created a guardian wrist band which has vibrating alerts for the unsafe zone in addition to the panic button for emergency alerts through the mobile application [16].

Launched a women's safety gadget for real-time tracking and location sharing, aimed at preventing sexual violence and introducing the GPS-GSM capabilities in it [17]. Conducted an assessment of the SAATHI device, an Internet of Things enabled adaptive safety system which enables ongoing supervision and mechanical notification to the trusted

contacts in case of detection of any threat or unusual behavior [18].

A wore panic button and Internet of Things based monitoring systems review was conducted which emphasizes the real time response capabilities found in the systems [19]. Analyzed mobile applications designed to assist victims of domestic violence in self-prevention along with their features such as anonymity, geo-tracking and integration of emergency contacts for high-risk women [20]. Presented a concept where real time health monitoring combined with health environmental detection is used to activate alarms. The idea is based on the internet of things wearable devices for women's safety [21]. Investigated the contribution of artificial intelligence and the internet of things in delivering predictive analysis in identifying dangerous scenarios for women and sending alerts to authorities or emergency contacts [22].

AI language models like BERT, GPT-3, and RoBERTa can enhance women's safety by enabling real-time threat detection, sentiment analysis, and natural language understanding in safety apps [23]. Palm recognition offers a secure, biometric method to authenticate and access safety devices. It ensures that only authorized users can activate emergency features, such as panic alarms or real-time location sharing, and provides discreet, seamless activation of safety protocols in high-risk situations, safeguarding both personal data and physical security [24]. Face recognition technology using Convolutional Neural Network can be used to automatically identify and track people in real-time. This helps monitor public spaces and detect known threats, sending alerts if a woman is near someone suspicious or in an unsafe area, improving safety and awareness [25-27]. Detecting diabetic retinopathy early allows for proactive monitoring of women's health. By scanning the retina for initial signs, it facilitates timely medical intervention and helps lower health risks [28, 29].

Table I shows the comparison of different techniques used for women's safety.

Table I: Comparison of Innovative Solutions for Women's Safety

Sr. No.	Publishing Year	Paper Title	Author Name	Technology
[1]	2024	Ensuring Women's Safety using Wearable Technology (AI and IoT): AI Tools and Applications for Women's Safety.	Manjula, Devarakonda Venkata, Madhu Palli, and Tejasri Boddu	*Techniques:* YOLOv6, a deep learning algorithm, deep learning model Mirasys VMS. *Features:* SOS button acts as an instant lifeline, Safe-Guard's voice-activated assistance, Ability to capture both audio and video.
[2]	2024	Transforming Women Safety with Information Technology: A Mobile Real-Time Intelligence Framework.	P. Gupta, K. Singh, and B. K. Sidhu	Introduces a mobile framework for real-time intelligence, including GPS tracking, emergency alert systems, and incident reporting. Uses mobile devices to ensure the safety of women in real-time, based on real-time monitoring.
[3]	2024	V-Safe-Anywhere: Empowering Women's Safety with Wearable AI and IoT Technology.	V. R. Bora, and B. Nagpure	Focuses on wearable AI and IoT technologies for women's safety, featuring location tracking, real-time alerts, and geo-fencing. The system aims to ensure safety through real-time data collection and analysis.
[4]	2024	Empowering Safety: Designing of an IoT-Based Women Protective System using Artificial Intelligence-enabled Smart Sensors.	R. Sonia, T. R. Kumar, G. Naresh, S. D. Devi, and N. Juliet	Proposes a system combining IoT and AI-based smart sensors for real time monitoring and alerting, focusing on wearable devices. Uses AI for activity and movement detection and provides real-time notifications.

Sr. No.	Publishing Year	Paper Title	Author Name	Technology
[5]	2023	Automatic Prediction and Identification of Smart Women Safety Wearable Device using Dc- RFO-IoT.	K. Srinivas Rao, D. V. Divakara Rao, I. Patel, K. Saikumar, and D. Vijendra Babu	*Techniques:* MLSTF categorization concept based on emotive elements. *Sensors:* Body Position. Identification Sensor, Accidents Recognition Sensor, GPS sensor. *IoT Components:* IoT Wi-Fi Module with ESP8266 inbuilt Microcontroller, OLED Display, Emergency Button, Pin Hole Camera with Mic, Relay Unit, Alert Buzzer.
[6]	2023	Maximizing Women's Safety with an Effective System.	B. Amruta, and Mohammed Taheer	*Protocols Used:* Short Message Peer to Peer Protocol (SMPP), Wireless Application Protocol (WAP), Geofencing API.
[7]	2023	IoT Based Smart Wearable Device for Women Safety.	Sunita Malaj	*IoT Components:* EPS32 SOC, UBLOX NEO6M GPS Modem, push button, OV2460 Camera Module, OLED Display, Buzzer, LIPO Battery.
[8]	2023	Android-Based Woman Safety App.	P. Sarma, D. Ahmed, and P. Bezbaruah	*Tools:* Android studio, Google map engine modules. *Libraries:* Manifests, Context, Intent, Package manager, Location, Firebase, Button, IBinder.
[9]	2023	WSA: A Navigation App for Women Safety	R. Jayabhaduri, S. Saineha, M. Madhumithaa, and A. Roshini	*Tools Used:* Google Directions Service API for map interface, Kotlin for user verification, WSA dataset, Android Studio IDE, Optical character recognition (OCR).
[10]	2020	IoT Based Women Security: A Contemplation.	Deepinder Kaur, Ravita Chahar, and Jatinder Ashta	The paper presents a wearable IoT device for women that send alerts with the location to emergency contacts in real-time.

III. Conclusion

The conclusion of the paper underscores the urgent need for effective safety solutions in response to the increasing instances of gender-based violence. It highlights the significance of wearable safety devices as essential tools for enhancing women's safety by providing immediate assistance in emergencies. While it acknowledges challenges such as privacy concerns and accessibility, it also points to the potential of future technological advancements—particularly through artificial intelligence and the Internet of Things—to improve these devices. Ultimately, it advocates for continued innovation and awareness to empower women, helping them navigate their lives with greater confidence and security.

Furthermore, the conclusion calls for a collaborative effort among technologists, policymakers, and communities to raise awareness and educate the public about these safety devices. This holistic approach will not only foster greater acceptance and usage but also contribute to creating safer environments where women can confidently engage in their daily activities. By persisting in innovation and advocacy, society can work towards a future where women's safety is a top priority, supported by effective technological solutions.

IV. Future Scope

The future of women safety devices looks bright, fueled by technological advancements and an increasing awareness of gender-based violence. There are several key areas that offer opportunities for further research and development.

- *Integration of Advanced Technologies:* AI and ML integration can significantly further

the predictive capabilities of safety devices, allowing them to assess possible threats based on a user's behavior and environmental conditions. This would lead to proactive safety measures whereby a user is warned before a hazardous situation occurs.

- *Better Connectivity:* Future devices could use the Internet of Things to create a network of interlinked safety solutions. This would ensure seamless interoperability between wearables, mobile applications, and emergency services, guaranteeing faster responses and better situational awareness.
- *User-Centric Design:* Ongoing research into user experience will be essential for ensuring safety devices are not only highly effective but also user-friendly and easy to integrate into everyday life. Future designs should focus on the devices' aesthetic appeal, ease of wear, and adaptability to various lifestyles and personal preferences.
- *Wider Access:* For safety devices to make a real difference, they must be accessible to women from different economic backgrounds. Further studies should focus on finding affordable solutions, community-based programs, and partnership opportunities to distribute these devices to those in need.
- *Education and Awareness Programs:* With new devices still in development, educational programs will be a key in helping users learn how to work with these technologies. Future efforts should include extensive awareness campaigns demonstrating the benefits of wearable safety devices and their usability.
- *Longitudinal Studies:* Long-term studies are urgently needed to accurately assess the real-world effectiveness and impact of wearable safety devices on women's safety and well-being. This research will provide insights for future improvements and best practices in designing and implementing these technologies.

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Journal of Applied Information Science
13 (1) 2025, 18-25
www.publishingindia.com/jais

Consumer Awareness in Energy Efficiency for Nigerian Student Residents in India

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Abstract: Energy has a major role in boosting employment prospects and economic competitiveness, especially in nations that are seeing rapid economic expansion. Today's educational institutions around the world use more energy to run their daily operations. The study aimed to assess the awareness of energy efficiency among Nigerian international students residing in India. A survey was conducted to measure their awareness of energy-efficient practices in using electrical appliances and their willingness to contribute to energy conservation efforts within institutions and hostels. The survey, conducted via questionnaires distributed to Nigerian international students in India, discloses an estimable level of awareness regarding energy efficiency in appliance usage. Evaluations showed that students understand the importance of energy efficiency at a high level. Moreover, a significant number of international students from Nigeria commented that they were willing to help energy conservation efforts by gradually changing their habits to use less energy.

Keywords: Awareness, Energy conservation, Energy efficiency, Energy saving, Nigerian students.

I. Introduction

There is a lot of pressure on educational institutions' budgets due to the high level of electricity usage in these facilities and the resulting rise in energy bills. Gross energy waste from improper electricity use is one reason for the high amount of electricity used in educational institutions. Waste accounts for a sizable portion of the electrical energy utilized in educational facilities [1]. As an illustration, while a classroom is empty, it is typical to find fans running and lamps turned on. Moreover, air conditioners are left on while offices are unoccupied. Therefore, it is necessary to create and put into action strategies to lower electricity use and, consequently, educational institutions' electricity costs. Efficient demand side management (DSM) techniques can lead to a decrease in energy usage [2]. Implementing rules and procedures to regulate, impact, and typically lower the demand for electricity is known as demand-side management (DSM) [3]. In order to implement effective demand-side management in educational institutions, building operations must be managed, equipment must be upgraded, energy management devices must be installed, and faculty, staff, and students must be made aware of the need for change. The first two strategies are behavior-

based, complement one another, and may be put into practice without the need for capital funding. While the second avenue is more explicitly concerned with changing understanding among facilities and custodial workers who control building operations, the first route focuses on changing behavior among all facility users.

II. Literature Review

Recent emphasis has been placed on energy conservation, with existing research examining the awareness of Malaysian households on this issue. However, there remains a lack of concrete understanding regarding energy awareness among students and staff at Malaysian universities. The current level of awareness regarding high energy consumption is insufficiently developed, hindering the development of effective energy conservation programs within university settings [4]. Three main areas were the focus of Syed Hussein's study on energy awareness among University Utara Malaysia (UUM) students: knowledge, attitudes, and behaviors. The results showed that UUM students generally had inadequate awareness of energy conservation, which put a heavy financial burden on the institution because of high electricity costs. Hussein said that putting more extensive programs into place could raise awareness and motivate UUM students to adopt energy-saving behaviors. [5]. Results of a survey intended to assess students' knowledge of energy-saving techniques about the use of electrical devices and their readiness to assist in reducing energy waste in educational settings. In order to conduct the survey, 970 resident students at Kwame Nkrumah University of Science and Technology in Kumasi were given questionnaires. The results show significant awareness of energy saving when using various consumer appliances. Additionally, a sizable percentage of students indicated that they were willing to take part in programs designed to reduce energy waste [6]. Nigeria's rapidly growing population has led to a shift in the energy consumption patterns of the educational institution buildings sector. This notable expansion is mostly due to population growth and the demand for enhanced academic functionality; as a result, it requires a lot more energy than other economic sectors. Energy is essential to this business for several reasons, such as the provision of lab equipment, lighting, heating, and air conditioning, as well as instructional materials. Equipment needed for teaching, research, practical demonstrations, and other support services is also powered by it [7]. Research suggests that behavioral factors such as individual and social norms, emotions, attitudes, trust, and competence significantly influence the decision-making process when it comes to energy regulations on a global scale [8]. It has been proposed that the interplay between material culture, energy practices, and norms is a crucial determinant that shapes and reinforces the energy-related behaviors of occupants [9]. The substantial electricity consumption observed in academic settings can be partly attributed to considerable energy wastage resulting from ineffective use of electricity. This inefficiency is evident in a notable percentage of electrical energy being wasted within educational settings [10]. Carried out in Nigeria, a study focused on exploring the factors impacting energy efficiency within selected housing samples. The results uncovered a strong connection between attitudes and behaviors concerning energy efficiency in residential dwellings. Furthermore, the identical investigators conducted a social survey addressing comparable issues, but with a particular emphasis on the implications of implementing energy efficiency measures in Bauchi town, Nigeria [11]. A proposal from Kuwait University is that all higher education institutions launch continuous environmental education campaigns to raise awareness of energy-saving practices and encourage a culture of energy conservation. This plan seeks to guarantee a consistent and ongoing endeavor to raise awareness of the significance of energy resource conservation [12]. Several American institutions have launched a variety of initiatives to support education in sustainability and self-management. The participants' efforts to save energy have increased noticeably as a result of these campaigns. There is a clear discrepancy between the students' initial proficiency and consumption and their subsequent consumption following seminars and training sessions [13]. In a few African nations, Okwanya and Abah conducted research to assess the

relationship between energy use and the decrease of poverty. Based on the availability of data, they selected twelve African countries and used a panel structure to analyze them. Through the use of the fully adjusted approach of ordinary least squares, the researchers determine that differences in energy consumption had the least effect on reducing poverty in any of the African nations they assessed [14]. They integrate energy simulation into their investigation of house energy request in Nigeria. Their study involves gathering a dataset consisting of 40 data points spanning from 1971 to 2011, specifically examining energy demand patterns in Nigeria and subjecting it to Analysis of logistic regression. Furthermore, they utilize a questionnaire with some structure to interview 501 houses in Ibadan between 2014 and 2015, providing additional evidence to reinforce their main conclusions [15]. Data from the International Energy Agency aids in analyzing business-as-usual (BAU), exploratory, and normative scenarios. These scenarios are designed to suggest potential paths for the global energy transition and pinpoint the factors that impact their effectiveness. These factors include investments in money, uncertainties surrounding industrial progress, governmental scheme, and the impact of behavioral interventions [16]. with support from the Indian government, the Green Terre Foundation launched the U75 initiative, which aims to convert 75 yards into net-zero entities. The initiative sets a goal for all university campuses in India to achieve net-zero status by 2030. Positioned as leaders in the country, these campuses can have a crucial impact on advancing research and development (R&D) endeavors and molding future leaders. Ultimately, this initiative is expected to greatly contribute to India's efforts to achieve its net-zero targets [17]. Study assessing the impact various retrofitting techniques to improve buildings' energy efficiency was carried out, with particular emphasis on an educational facility at Kazakh–German University. The findings showed that implementing small-scale retrofitting modifications resulted in savings of up to 36.9 kWh/m^2 on electricity. With major retrofitting measures, the savings rose to 77.76 kWh/m^2, leading to an impressive 82% reduction in CO_2 emissions [18]. Energy plays a pivotal role as a primary physical infrastructure necessary for the advancement and progress of various sectors. Particularly in developing economies, the use of energy serves as a vital driver for stimulating macroeconomic activities. It is apparent that every sector of the economy heavily depends on energy for efficient operation [19].

III. Objectives

The primary goal of the current investigation is as follows:

- To evaluate the awareness of energy conservation among the Nigerian international student residents in India.
- To evaluate the behavior on energy consumption within the Nigerian international student residents in India.
- To ascertain the connection between the Energy consumption and consciousness behavior among the Nigerian student residents in India.

IV. Methodology

The study examined Nigerian international students enrolled in different universities across India to explore the connection between their awareness of energy conservation and their behaviors within their respective accommodations. The sample was drawn from a population of Nigerian international students studying in India.

A. Research Instrument

The primary tool utilized for gathering data in this study was a questionnaire developed through Google Forms. This questionnaire encompassed sections for demographic details, the extent of awareness regarding energy conservation, and the energy-efficient behaviors exhibited by students, all rated on a 5-point scale. a comprehensive analysis of the body of current literature was conducted beforehand to ensure the questions' reliability and effectiveness in establishing the correlation between behavior and awareness.

B. Data Collection

Data collection is carried out via an online platform with a target of 90 respondents. However, 90 individuals have completed the survey questionnaires. Following data analysis, each questionnaire has been classified based on gender, age, and the name of the institute.

C. Data Analysis

Standard deviation and mean were two examples of descriptive statistics that were used to analyze the results, aiming to explore the correlation between awareness and behavior among Nigerian international students.

$$mean = \frac{\sum fx}{\sum f} \quad (1)$$

$$Standard\ deviation = \sqrt{\frac{\sum F(x-\bar{x})^2}{\sum F}} \quad (2)$$

V. Results and Discussion

The study received a total of 90 responses during the data collection period. Among these respondents, 60 were male and 30 were female. Additionally, participants belonged to various age categories. Fig. 1 illustrates the demographic distribution of the respondents.

A. Age and Gender

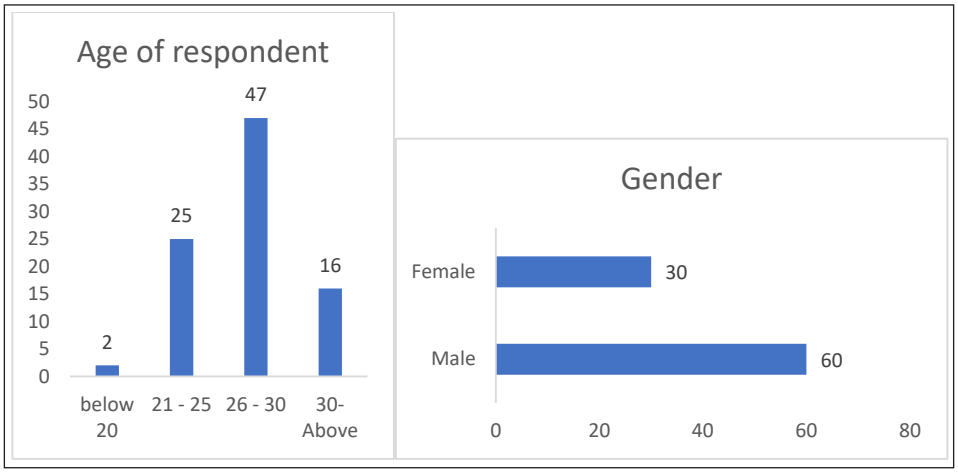

Fig. 1: Background of Respondent for Age and Gender

B.Awareness Assessment

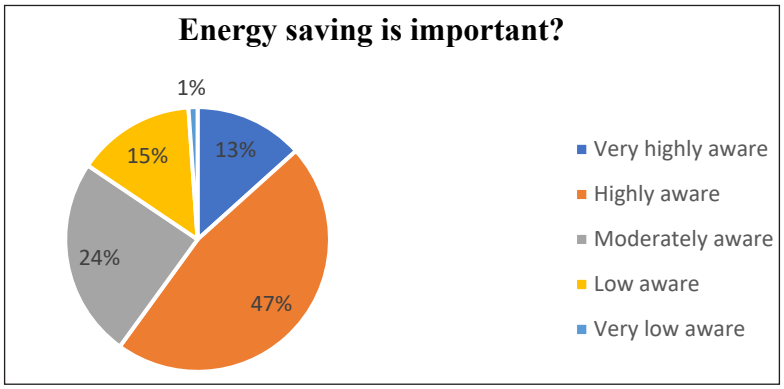

Fig. 2: Energy Saving is Important

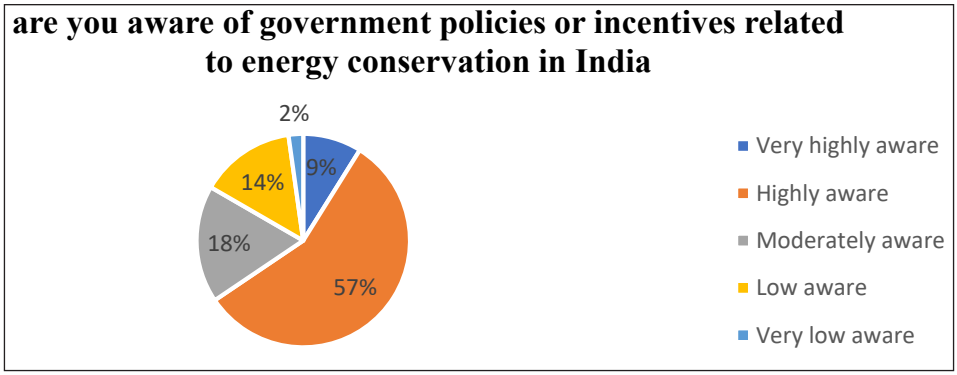

Fig. 3: Are You Aware of Government Policies or Incentives Related to Energy Conservation in India

Table I: Result of Awareness Assessment

Sr. No.	Question	5	4	3	2	1	Mean
1.	Are you aware of the important of energy efficiency?	12	42	22	13	1	3.5667
2.	Are your electrical appliances energy efficient?	12	45	19	14	0	3.6111
3.	Are you aware that Energy efficiency practice reduce overall bill expenses?	10	49	18	12	1	3.6111
4.	Are you aware of government policies or incentives related to energy conservation in India?	8	51	16	13	2	3.5555
5.	Are you aware of the concept of energy efficiency?	9	50	17	12	2	3.5777
6.	Are you aware A few of our behavior can aid in the world's energy efficiency?	13	42	20	15	0	3.5888
7.	Are you aware Equipment have different energy consumption depending on power rating?	11	45	19	14	1	3.5667
8.	Are you aware of renewable energy can be saved by using energy efficient appliances?	7	48	21	13	1	3.5222

Table II: Result Interpretation of Likert-Scale

Mean Range	Descriptive Interpretation
4.51 – 5.00	Very highly aware
3.51 – 4.50	Highly aware
2.51 – 3.50	Moderately aware
1.51 – 2.50	Low aware
1.00 – 1.50	Very low aware

The initial phase of the inspection involves gauging respondents' awareness levels regarding energy saving. They are asked to provide their responses to 8 Likert-scale questions, ranging from 1 to 5, where 5 indicates the highest awareness level and 1 the lowest. Subsequently, mean values are calculated for each question as well as an overall mean for all 8 items. This data is then used to interpret the degree of consciousness for each assertion as well as the collective recognition towards energy efficiency, categorized according to the mean ranges, as outlined in Table II.

On the whole, the average mean for all items stands at 3.5750, signifying a noteworthy level of awareness among Nigerian international students regarding energy efficiency. This suggests that a majority of respondents understand the significance of energy efficiency, with an average mean of 3.5667 falling within the high awareness range. Additionally, respondents demonstrate a general awareness regarding the energy efficiency of their electrical appliances, the cost-saving benefits of energy-efficient practices, and governmental policies aimed at energy conservation in Nigeria. Moreover, the data indicates that respondents acknowledge their individual behaviors' potential impact on global energy efficiency. The collective awareness regarding energy efficiency significantly

influences the overall high level of awareness, with mean scores of 3.6111, 3.5555, and 3.5888 recorded for understanding the importance of energy efficiency, awareness of the energy consumption rates of various equipment, and familiarity with the concept of energy efficiency, respectively. Following closely are awareness levels related to understanding different energy consumption rates (mean = 3.5667), grasping the concept of energy efficiency (mean = 3.5777), and knowing methods for conserving energy (mean = 3.5222). The lowest recorded mean of 3.5222 is attributed to awareness of how renewable energy can be conserved by using energy-efficient appliances.

The standard deviation of the averages of the 8 unit is 0.0276, indicating significant deviation of each unit mean from the overall average mean of 3.5750.

$$\frac{0.0276}{3.5750} \times 100\% = 0.7370\% \quad (3)$$

Put differently, the level of awareness among Nigerian international students varies across the statements presented in Table I. While some students may be well-informed about certain aspects of energy conservation, they may lack knowledge in other areas.

C. Usage Assessment

The respondent's behavior toward energy saving was accessed and evaluated as presented in the table below.

Table III: Outcome of Energy Use Behavior Evaluation

Sr. No.	Question	Yes	Yes	No	No	Mean
1.	Are you switching off your light at day time?	62	69%	28	31%	0.6889
2.	Are you practice energy saving at hostel?	58	64%	32	36%	0.6444
3.	Do you turning off the electrical appliances after used?	61	68%	29	32%	0.6778
4.	Do not leave laptop charging overnight?	52	58%	38	42%	0.5778
5.	Do you attended any workshops or seminars related to energy efficiency?	55	61%	35	39%	0.6111
6.	Do you actively use energy efficient appliances?	56	62%	34	38%	0.6222
7.	Do you use any smartphone apps to monitor energy consumption?	54	60%	36	40%	0.6000
8.	Before you leave the classroom, make sure the lights and air conditioner are off.	64	70%	26	30%	0.7111

Examining respondents' general behavior regarding energy usage reveals an overall mean of 0.6417 out of 1.0, indicating that the real actions taken to conserve energy are not particularly admirable. Translating this value to fit the scale provided in Table II yields 3.2085, categorizing it within the moderate behavioral level. Factors contributing to the lower mean value include leaving laptops charging overnight (42%), not utilizing smartphone apps to monitor energy consumption (40%), lack of participation in workshops or seminars related to energy efficiency (39%), failure to actively use energy-efficient appliances (38%), neglecting energy-saving practices in hostels (36%), failure to turn off electrical appliances after use (32%), and not switching off lights during daytime (31%). These actions are relatively simple and can be implemented quickly. However, it is encouraging to note that respondents ensure both air conditioners and lights are switched off before leaving the classroom, with a notable percentage of 70%. It's puzzling that activities scoring both extremely low and high marks don't significantly differ in the time required or the effort needed to perform them to save your energy.

The overall aggregate mean's standard deviation is 0.0440.

$$\frac{0.0440}{0.6417} \times 100\% = 6.86\% \quad (4)$$

This indicates a notable inconsistency in the behavior of the respondents. There isn't a clear pattern explaining why they don't consistently engage in similar actions to reduce energy consumption. For instance, while a significant majority (70%) ensure to switch off the air conditioner and lights before leaving the classroom, this behavior doesn't seem to extend uniformly across other energy-saving practices.

Table IV: Evaluation on Respondents' Readiness to Engage in Energy Conservation Efforts

Sr. No.	Question	Yes	Yes	No	No
1.	Changing habit for energy efficiency.	83	92%	7	8%
2.	Spending time learning about energy efficiency.	80	89%	10	11%

The strong correlation observed between the high awareness level of energy efficiency and the proactive behavior towards energy conservation among Nigerian international students suggests that while they possess ample knowledge and understanding of energy conservation, their actions in practicing energy efficiency lag. The greater energy consumption standard deviation value behavior (6.86%) in contrast to that of energy efficiency perception (0.7370%) indicates that respondents are selective in their energy conservation efforts despite their extensive knowledge of the subject. Table IV illustrates those responders in general inclined to take measures toward energy efficiency by altering habits or investing time to learn more about energy conservation.

VI. Conclusion

In summary, this research evaluates the awareness level and energy usage behavior and discusses the relationship between the two. Overall, the data shows that international students from Nigeria are highly conscious of the need to save energy. Yet, these same respondents only exhibit a modest level of conduct when using electricity generally. The respondents exhibit strong enthusiasm and desire to start energy-saving practices, even if there is no direct linear relationship between awareness level and behavior in this area. Perhaps as a result, international students from Nigeria are more conscious of the need to conserve electricity in both their dorms and schools. They can start by making lifestyle and habit changes as part of energy-saving activities.

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Journal of Applied Information Science
13 (1) 2025, 26-41
www.publishingindia.com/jais

A Technology Transfer Model to Enhance University-Industry Collaboration

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Abstract: There is no gainsaying the fact that intellectual property leverages the economic growth of a region. Further it cannot also be gainsaid that academic institutions have come up with renewed interests in developing new ideas and innovations to find solutions to emerging problems. Teaching and learning being the first two missions of any educational institute, the academic institutions have now evolved to fulfil the demands of their third mission focussing on research and technology transfer. It is not possible for companies alone to overcome the complexities of today's markets. Therefore a synergistic collaboration between industry and academia based on a suitable Technology Transfer Model which fosters transfer of technology is inevitable in today's knowledge economy in order to gain new knowledge and utilise innovation to provide solutions to emerging problems. However, this collaboration is easier said than done as it is usually fraught with barriers owing to the lack of a suitable model for universities, which impede the success of linkages between academia and industry. It becomes very important to understand the best practices incorporated in TT models that are being used by firms and use them in creating a suitable model for universities. This paper endeavours to discover best practices in TT by understanding various TT Models and drawing a comparative insight from the jurisdictions that are leading in the university-industry collaboration viz. China and Singapore. Finally the paper based on the survey of TT Models and comparative insight proposes a suitable technology transfer model that plays a significant role in industry-academia collaborations. It is believed that the study will help improve industry-academia collaboration's success and will provide a foundational conceptual framework in order to come up with sound policy decisions in the said domain. Furthermore, the model can serve as a foundation for future research in the setup of industry-academia collaboration.

Keywords: Intellectual property, Knowledge transfer, Technology transfer model, University-industry collaboration.

I. Introduction

"Overnight, organisations and academic institutions across the world became hotbeds of innovation, as entrepreneurial professors took their inventions and students off campus to set up companies of their own. A goose that lays such golden eggs needs nurturing, protection and even cloning".

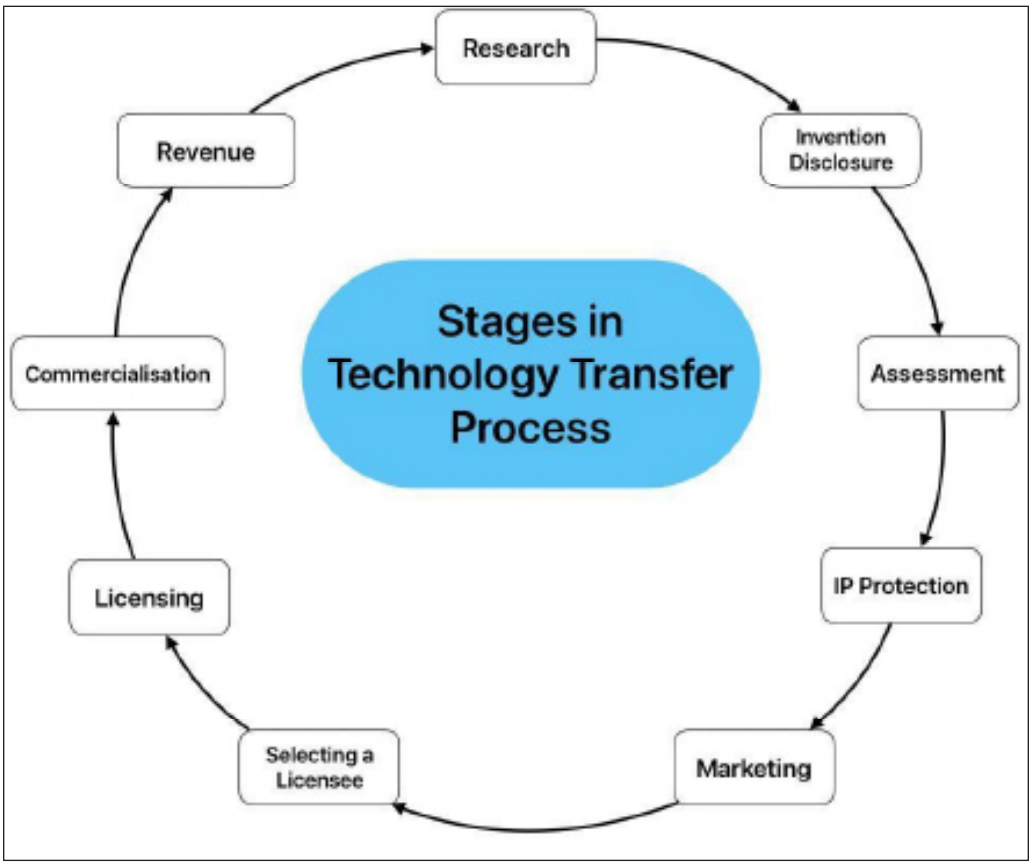
-The Economist.

Groundbreaking inventions generated by research organisations, research centres, academic institutions and hospitals not only save our lives but also improve the way we live. These organisations are haven for inventions that alter the way in which we live. Inventions like Google, vitamin D-fortified milk, Gatorade, life-saving vaccinations etc. are only some of the thousands of inventions that are making this world a better place to live in. It all starts with an idea that culminates into a revolutionary invention which in turn contributes in changing the economic landscape of a nation. However, having an idea is not sufficient and it has to be manifested to see if the

idea has the real potential which it pitches initially. For such cogent manifestation of an idea the research organisations and academic institutions need support to grow and advance these ideas to make an impact socially. Increase in the demand for enhanced efficacy and productivity in innovation and research and development has overladen the organisations with overwhelming burden to meet the expectations. Additionally the need for application of technology to counteract pressing social and economic problems has also posed significant challenges to the organisations. Consequently a reinforced and renewed interest in technology transfer and research has been emanated from such scenarios faced by the organisations. Though there is an absence of clear cut definition of the term technology transfer however, a common thread that runs through all the definitions that have been suggested so far is that technology transfer covers getting the knowledge out of the research labs or literature and moved into the hands of the users. The following paragraphs will try to enlighten the reader more about the concept of technology transfer.

II. The Concept of Technology Transfer

Technology Transfer (TT) is an elaborate and complex process however the following figure (Fig. 1) may be useful to provide a preliminary understanding of the concept. To better understand the concept especially with reference to academic institutions some simple examples can be resorted to. During the 1980s researchers at Ohio University genetically modified a mouse growth hormone. The said hormone was transplanted in an embryo which was further transplanted in mother mice. The offspring exhibited superior qualities and better characteristics as they grew up. After a couple of years the researchers applied for a patent and started a company based on the technology that helped to genetically modify the said gene. The company involved researchers from the lab and young entrepreneurs.



Source: Developed by Author.

Fig. 1: Stages in Technology Transfer

The purpose behind starting the company was to produce a drug for a disorder called acromegaly which leads to abnormal production of growth hormone in adults leading to gigantism. After a couple of years the said company was purchased by a pharmaceutical company which started clinical trials on the drug being developed. The said drug was approved in 2003 by the FDA and the drug started to be produced, marketed and is currently the most common medication for acromegaly. This is technology transfer who involves taking research methods or results from laboratories, developing it, protecting it, moving it into a company and bringing it into a marketplace for the benefit of the public at large.

Another important example can be taken of University of Arizona where researchers studied an important branch in medicine called medication management. The research included immense study of data and literature on medicines to find out the principles governing drug interaction. A software program was developed based on the research and the principles that were formulated after the said research. The said software technology was commercialised and licensed to a company which was in turn purchased by a public company at the juncture when the company employed more than 300 people and managed drug interaction for more than 50 million people.

There are innumerable examples to show how technology transfer is making the world more safe and liveable. It can be noted that in all such acquisitions the technology developed plays the central role. The methods for transfer of technologies employed, aid in the acquisitions.

III. The Process of Technology Transfer

The importance of technology is paramount in the process of technology transfer. Every year governments fund the institutes to support them in research and development of important technologies. Faculties at the institutes apply by submitting their proposals which are strictly reviewed and only about a small percentage of all the submitted proposals get approved. The approved proposals are funded and a grant is sanctioned to the research centre to research. The said grant is the bedrock on which the technologies anchor.

Argument to support the grants is fourfold. First is the creation of immense literature in the form of articles published in technical, scientific and medical journals published by faculty. This vast amount of knowledge expands the body of knowledge which can be accessed by the common folk through the internet. Second argument concerns the graduates. The students and research assistants after toiling hard in laboratories move out in the world and join the workforce as knowledge workers of advanced technology industries. Third argument concerns intellectual property. Countries around the world have legislations in place that provide for owning by the universities and research organisations, the inventions created by them with the support of public funds. Fourth argument concerns licensing of the technology. There are two types of companies that receive technologies from the research organisations: first type are the companies that are already in place and are in search of promising technologies to gain a competitive advantage; second type are the startup companies. There are thousands of startup companies that are being created by academic institutions every year that are working in developing the research ideas into viable products and services. The first type of companies take in the technology which usually is at a nascent stage and develop them further into products for the benefit of society at large which usually takes more than five years.

The most important phase in technology transfer is the embryonic stage of the invention where the invention is at development phase. An invention at the fairly embryonic stage requires careful analysis based on two important elements. First element is whether the technology as evident in the research is patentable, is there a possibility of developing commercially valid claims from the technology; and the second element focuses on the need and demand of the technology in the marketplace. The said needs and demands don’t mean the needs and demands of the marketplace today but those of the near future.

The technologies take around seven to eight years to get into markets as products after licensing. These crucial elements demand the congruence of *the needs of the marketplace in future* and *the technology being developed*. When such congruence is achieved it results into a valuable asset. Moreover if there is not a significant congruence the science behind the technology goes into the body of knowledge. All that is now needed after the congruence is achieved is to find a suitable home for this commercially valuable asset in a company. This culminates into a licence agreement between the university or research organisation and companies. The agreement authorises the company to develop upon the technology and manufacture products based on the technology transferred from the university to the company.

The company provides a small percentage of the sales to the universities as royalty. The universities across the globe have fairly consistent policies that govern these aspects of the technology transfer. The largest share that is kept aside for the university often goes to the inventor. Other stakeholders and support teams also get adequate shares. A small percentage of share is also granted to the technology transfer office (TTO) of the university. However, it has been observed that the shares reaching the TTOs are abysmally low and generally it is not sufficient to run a TTO. Technology transfer is not a happenstance and it is not a matter of luck. It requires a sheer amount of hardwork and cogent strategies to get there and do what is needed.

Technology transfer methods come handy to lend the required support. The field of Technology Transfer helps to transfer results of a research to the market place which is a step in continuity to the research. TT helps to bring these ideas from the labs to the market. Technology transfer is the process of transferring skills, knowledge, technologies, and methods of manufacturing from one unit to another.

Such transfers ensure that the scientific and technological developments are available to a wide range of users and are further developed. It also promotes development of the said shared knowledge into new products, processes and applications. Scholars also define it as *transmission of knowledge in a continuous, frequent and systematic manner*. The said episteme is thereafter utilised for research in various sectors capable of generating further knowledge like in universities, laboratories, government agencies and others.

Technology transfer professionals play a significant role in transfer, protection and commercialising the ideas. The professionals work in close association with technology transfer offices of the universities and research organisations and other units like industries. The professionals help in evaluating the inventions, protecting intellectual property through patents and copyrights, marketing ideas, negotiating and licensing inventions to companies interested, creating and nurturing startups, leading corporate engagements, supporting economic development. In other words the professionals offer their expertise in seven most fundamental areas of TT: Invention disclosure and assessment, Intellectual Property Management, Marketing, Licensing, Startups, Operations and Leadership.

TT is concerned with transforming ideas into opportunities. David Allen argues that in order to have more social impact of technology transfer there is a pressing need to change the conversation. The focus of the conversation shall not be on the best practices and efficiency of research at the universities but the conversation shall focus on what is necessary to create an environment suitable to transfer all the research into the marketplace. No doubt at research institutes the research in itself is preeminent but if the real benefit of the research is to be harnessed the research has to be transferred into the marketplace for the sake of benefit. Only after that comes the discussion on efficiency.

IV. Technology Transfer and Academic Institutions

In the context of academic institutions, technology transfer refers to the process by virtue of which novel inventions and other innovations developed by the said institutions are converted into products and are

commercialised. Generally there are two ways of doing this: through licensing patented intellectual property to the corporations or by itself creating startup companies which consequently licence the IP created by faculty. Universities play a pivotal role in the contemporary world by imparting education and skills to a large population. They are the strongholds of generating new ideas and knowledge which carry immense potential to drive economies. It has been seen that recently universities have started to act upon what scholars call 'the third mission' which incorporates fostering links with knowledge users and facilitating technology transfer.

The advantages of university-industry linkages are not confined to making money but also includes generation of new business and innovative opportunities. Generally the process of technology transfer involves licensing of the results of research conducted by the university to industry. In turn the industry develops products or services on the basis of the said results by investing in the shared knowledge thereby generating huge profits. Thus technology transfer is beneficial for academic and research institutes, industries and the society as a whole.

The author endeavours to do a detailed comparative study of technology transfer processes followed in India, China and Singapore thereby suggesting a suitable framework (conceptual model) for the mechanism of technology transfer and related issues in India. Considering the knowledge economy in which the present day world finds itself grappling with a host of issues, this study becomes immensely important for the pioneers of the said economy including researchers, students, university leaders, university administrators, investors and people in business and executive roles. Further this study becomes imperative with the recognition of technology and innovations as an important discipline by the recent National Education Policy which seeks to promote interdisciplinary research and innovation. Another aspect which favours the study stems from the sustainable development goals set up by the United Nations which identifies technology transfer as a means to promote sustainability. Technology transfer has been proven to play a vital role in economic and social development of countries thereby enhancing sustainability.

V. Research Objective

- To understand the concept of technology transfer.
- To understand the technology transfer processes by studying prominent TT models and best practices employed in the universities of China and Singapore.
- To develop a TT model suitable for technology transfer processes (Industry Academic Collaboration) in the light of insights received after studying different models and comparative studies.

VI. Research Questions

- What is understood by the term Technology Transfer?
- How is Technology Transfer understood in the Academic and Industry collaboration?
- What are the prominent models and best practices for technology transfer processes?

VII. Research Methodology

The researcher plans to relook and re-examine the technology transfer framework within India in light of the experiences drawn from Singapore and Chinese jurisdictions and by studying prominent TT models that have been followed thus far. Generally the research will be conducted by incorporating a Qualitative Doctrinal approach. The background for the research is made by perusal of books, articles, research papers, news articles and official websites. Analysis through perusal of policy documents including draft legislations, if any, state bills and legislations, impact reports in form of annual reports. This analysis also seeks to determine the factors that create an environment conducive for

implementation of innovative ideas and ascertain steps that are needed in the positive direction for India to capitalise on immense potential breeding in the research organisations and academic institutions of our country.

The researcher will retrieve data from published literature in the form of country reports, university public databases and government websites. Data will be retrieved from public databases in India, China and Singapore. Data will also be taken from the databases of international organisations such as WIPO, WTO etc. Further the researcher will proceed with a qualitative comparison of

- Technology transfer models followed in the countries.
- Other factors leading to successful tech transfer between organizations.

The researcher will be looking at the primary materials such as national reports, international conventions, statutes, University reports, WIPO reports on tech transfer, WTO Reports, rules, regulations, bylaws, government notifications to gather knowledge about the working dynamics of the tech transfer processes in India and other jurisdictions. The researcher will also be consulting secondary source materials such as commentaries, articles, treatise etc to understand the historical, theoretical and doctrinal backdrop of the process.

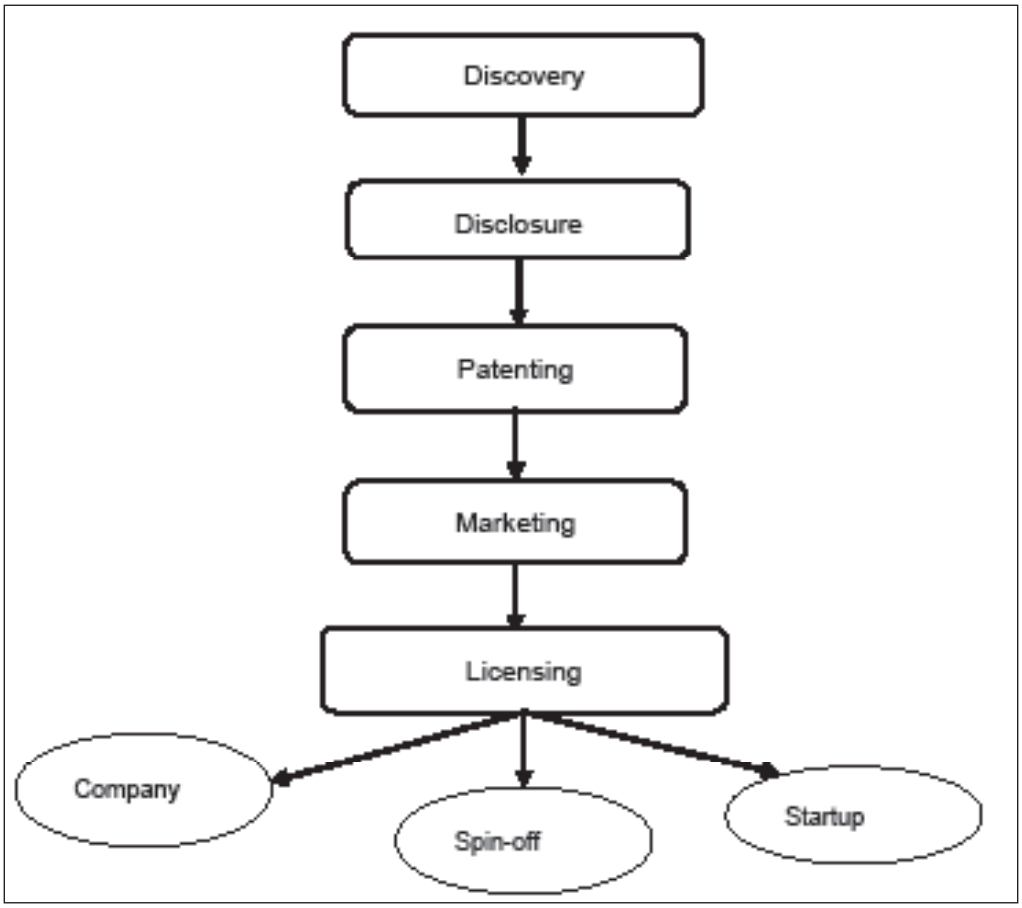
In order to fulfil the objectives of this research the author conducted a thorough search on relevant databases in two phases: Information Retrieval Phase and Refining Phase. In the first phase the author searched for relevant and prominent technology transfer models on SCOPUS Database. The keywords used were technology transfer model and Industry University Collaboration. The search was further refined and confined to prominent journals that exclusively deal with technology transfer namely The Journal of Technology Transfer, Research Policy, International Journal of Technology Management and Technovation. This phase included selection of the information source, selection of the relevant keywords, defining the search fields, selection of any filters or restrictions to be used to refine the research, performing and storing the search results. Thereafter in the second phase the author further refined the search and finally the results were interpreted, analysed and categorised according to the requirements of the objective to be achieved in this study.

Finally, the author finalised a total of 44 Models, 3 Case Studies from China, 2 Case Studies from Singapore (see Table I) to be made part of the present study. The models, strategies, case studies and best practices were thoroughly studied and the relevant insights from the study were consolidated in a tabular form (see Table I). The table was efficiently studied and was used to build a conceptual framework for proposing the required TT model as shown in Section.

VIII. Technology Transfer Models

A collection of interconnected steps through which scholarly inventions that result from research carried by universities or research organisations constitute a TT model. The models consist of various processes that are followed in a series with effective and important roles played by various actors. The actors include inventors, university leaders, TTO managers, representatives from industry and governments. The research surrounding the aspects of the TT model in a technology transfer process has gained ground only during the last decade. Earlier the research majorly focussed on TTOs, issues related to TTOs, obtaining patents and licences.

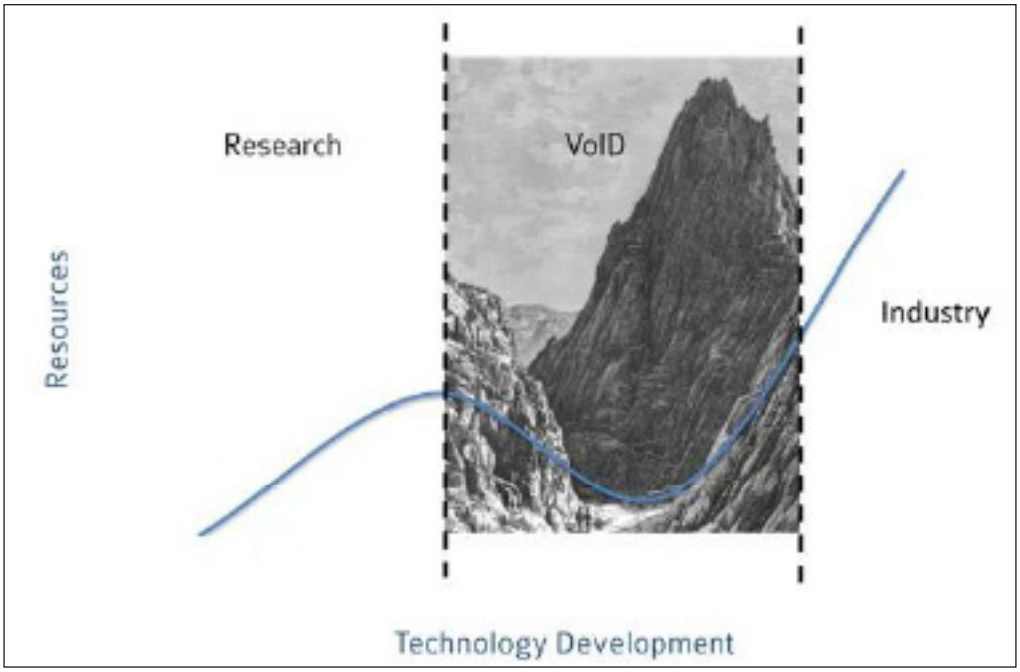
It has also been noted that the TT models do not conform to the “one size fits all” policy. Thus it can be said that there isn’t a model which can be described as being ideal to carry out the TT process universally. More often the models are based on the domestic laws prevalent in the nation carrying out research. On this premise it becomes crucial to look at some of the existing models followed across the world.



Source: Author.

Fig. 2: Traditional Technology Transfer Model

Scholars have studied the Traditional model as an organisation-centric model. The organisation centric model amalgamates the triple helix model [1] and the concept of multiversity. The triple helix model encompasses the relationship between university, industry and government. The model involves a symbiotic kind of relationship among the three institutions in which each endeavours to strengthen the position of the other two. Further the concept of multiversity as given by Prof. Clark Kerr provides for a modern institution focusing on institutions with multiple activities and organisations. A multiversity includes research laboratories, science parks and other organisations in accordance with the requirements of faculty, students and the regional milieu. The traditional model has been proved to be efficient for some of the technologies however it has various limitations. The traditional model does not consider complex practical nuances that are implicated in the process of technology transfer. The traditional model appears to be more unrealistic and falls short of accurately capturing the intricacies of TT in practice. The conventional model tries to provide a one size fit all models which evidently does not represent variations in TT process over all the disciplines. Each discipline as well as academic arena is independent and requires a model that respects the subtle nuances that are exclusive to the research area of the field. If all the inventions are forced to undergo the disclosure mechanism as depicted in the traditional linear model it will lead to unsuccessful commercialization and failure of inventions. Kirsten Leute, technology transfer professional at Stanford University calls it the valley of innovation death [2] (VoID).



Source: (Leute 2017).

Fig. 3: The Valley of Innovation Death (VoID)

Inventions are created and reach a certain level of basic research. But as they attempt to transition to the big time, outside of fundamental research, they falter. Industry is not ready to take on these very nascent inventions, yet they are often beyond the scope of an academic lab. However, it's not just resources or cash that inhibits these inventions from making it out of the VoID.

IX. Why is a Model Necessary for Indian Universities

The model discussed so far in the preceding chapters fall short of being comprehensive and all-inclusive. However an analysis of the model has led to identification of important factors that are needed to be incorporated in the present study of developing a conceptual framework for technology transfer. The table below presents some crucial aspects including similarities, differences, utility, merits and demerits of the models discussed earlier.

Technology transfer is cited by academic institutes as evidence of the growing economic impact of research centres and academic institutes (faster technological diffusion to the public and enhancing local/regional economic development) and is acknowledged as a potential source of university revenue, particularly in the current economic climate of reduced support for universities. The enhancement of curricula and use of technology transfer as a marketing strategy to draw in staff, students, and more funding for industry research are a few additional advantages for academic institutions. The study of the models suggests that there is an impending need to develop a new model for India which addresses the shortcomings of the models studied. The new model suggested shall include novel and macro points emanating from the comparative insight of the models studied so far. Another fact that justifies development of a new model is that the earlier models were predominantly linear and did not involve a network which might include and regard contribution from all stakeholders involved in the process of technology transfer. Further it has been observed that Indian laboratories are occupied with numerous technologies developed therein which are yet to be explored and commercialised, technology remain unnoticed and not captured by industries, a very meagre percentage of total patents granted have been commercialised [3]. A study which analysed more than 125 tech transfer and commercialization projects confirmed that only 60 percent of the

projects were commercialised successfully and the rest of the projects were a complete failure. These factors lead to the conclusion that a network kind of tech transfer model which combines essential factors across the tech transfer process is essentially required which reflects the importance of all the actors/stakeholders involved and assures successful transfer of technology.

TABLE I

Sr. No.	Model/Best Practices	Merits/Advantageous Factors	Factors Relevant for the Conceptual Model
1	Gibson and Smilor Model [4] [1991]	Technology transferor and receiver perspective; non-linear model	Incentivisation
2	Lee *et al.* Model [5] [1994]	Experience of TT and TC of USA	
3	Goldsmith Model [6] [1995]	Fusion of technical, market and commercial factors	Testing prototype before launch, hasslefree accessible finance
4	The UNIDO Model [1996]	Comprehensive practical model, provides a checklist	Negotiation and effective communication
5	Jain and Chifos Model [7] [1997]	Evaluation of potential of the technology on commercial aspects	Market study and survey
6	Narayana Ramani Model [8] [1997]	Comprehensive model	Step by step process and relevant stages
7	Jagathesan *et al.* Model [9][1997]	Focus on supplier and receiver	Mechanisms of transfer, Efficient statutes and laws
8	Joseph Lane Model [10] [1999]	Simple and step based comprehensive model	Skillful Management, Financially sound, Quality and Price, hasslefree accessible finance
9	Frair and Balachandran Model [11] [1999]	Technology and market based strategy	Market size and opportunity, hasslefree accessible finance
10	Sundararajan *et al.* Model [12] [1999]	Indian model comprising different stakeholders	Testing prototype before launch, exclusive licence, protection from competition, strengthened financial schemes
11	Bozeman Model [13] [2000]	Comprehensive and taking into account all stakeholders	Enhanced protection of IPRs, exclusive licence
12	Sung and Gibson's Model [14] [2000]	Covers the entire chain of the process. Doesn't include receiver, market, govt. factors	Demonstration, training, transfer of know-how, effective communication, dispute resolution. Skillful Management, Incentivisation
13	Heslop *et al.* Model [15] [2001]	Model to evaluate readiness of TT	Enhanced protection of IPRs, testing prototype before launch, novelty, inventiveness and utility, skillful team
14	Malik Model [16] [2002]	Pertinent factors identified	Demonstration, training, transfer of know-how, effective communication, dispute resolution. Skillful Management, easy repayment of loans
15	Cummings *et al.* Model [17] [2003]	Key variables identified	Skillful Management, hasslefree accessible finance
16	Siegal *et al.* Model [18] [2004]	Comprehensive model, factors identified	Enhanced protection of IPRs
17	Functional Model [19] [2006]	Comprehensive model	Marketing Skills, Quality and Price
18	Tony Model [20] [2006]	Detailed analysis of industry-academia linkage	Theoretical framework
19	Waroona Kum and Stewart Model [21] [2008]	Many factors identified	Business experience, Efficient statutes and laws

Sr. No.	Model/Best Practices	Merits/Advantageous Factors	Factors Relevant for the Conceptual Model
20	Rothwell and Ziegfeld Model [22] [2008]	Actors in the process and their interrelationship identified	Theoretical framework
21	The UniQuest Process Model [23] [2008]	Step by step model (8 stages)	Testing prototype before launch, making the tech perfect
22	Coopers Model [24] [2008]	Simple and excessively used model in new product market	Market size and model, Meeting demands and needs, Quality and Price
23	Sazali *et al.* Model [25] [2009]	Based on international technology transfer	Domain knowledge
24	Jin-Fu Model [26] [2010]	Comprehensive model	New product in market, hasslefree accessible finance, Incentivisation
25	Farhad *et al.* Model [27] [2011]	Comprehensive model for industry academia linkage	Business experience
26	Heather Model [28] [2011]	Comprehensive model comprising all stages	Theoretical framework
27	Nazanin Jalili *et al.* Model [29] [2011]	Various factors identified	Meeting demands and needs, hasslefree accessible finance, efficient statutes and laws [30]
28	China strategy 1 [31]	Five pronged approach	1. Transfer of technology from abroad, 2. Massive use of technology, 3. Disseminating knowledge internally, 4. Accessing foreign knowledge through FDI and trade, 5. Boosting domestic R&D.
29	China strategy 2 [32]	Laws and Regulations	Chinese Bayh-Dole Act, University Regulations, Establishing TTOs and TLOs, Promotion of Technology Transfer Act 1996, Science and Technology Advancement Law, Science and Technology Discoveries Conversion Law 1998, Incentivisation schemes for researchers, Initiative 2002 to strengthen universities in S&T, National TT centres at institutions, permitting academic institutions to operate for-profit firms, encouraging private enterprises to support innovative projects, Strong IP Protection Laws
30	China Startup Model 1 [33]	Model for establishing startups	Tech demand, Report, Assessment, Feasibility, Negotiation, Contract and Execution, Commercialization
31	China Startup Model 2 [30]	Model for establishing startups	Supply and Demand Factors, Enabling and driving Factors
32	Heqiang Teng Model (2010) [34]	Comprehensive and simple model for TT from university to industry	Important phases involved, conceptual framework on analysis of factors, life cycle management, TT chain in phased manner, market pull, development phase, search for the technology (U-I linkages), implementation, life cycle management
33	Liu and Jiang Model (2001) [30]	Theoretical framework for TT in China	Economic system, government policy, restrictions, impetus

Sr. No.	Model/Best Practices	Merits/Advantageous Factors	Factors Relevant for the Conceptual Model
34	Case study 1 [32]	Tsinghua University China	High quality research staff, research conditions, U-I cooperation, colab with local govts, local govts as medium of transfer, enhanced communication, establishing risk mitigating foundations, TT bases with govts., Land and Policy by local govts., Online query system
35	Case study 2 [32]	IC related study in China, HSIP Model	Regional innovation and local industry growth, Industrial Park, dispatching RSEs, Information exchanges, circulation of skilled workers, firms acquired, training
36	Case study 3 [35]	Study related to button manufacturing	Confluence of information between residents, governments, entrepreneurs and markets, channels to create easy info exchanges, industrial zones, university linkages for training, testing, design, R&D, initiatives by local govts.
37	Singapore strategy 1 [36]	Industry Academic Institutions Collaboration	Industry and Technology Relations Office (INTRO), Innovation and Technology Transfer Office (ITTO), Venture Assistance, Multidisciplinary Research, resource pooling, cross-pollination, Specialized Agency (A*STAR), Programmes such as GET-Up, Assistance Programmes, Operational and Technological Roadmapping, Technology for Enterprise Building (T-Up), Technical Advisor Scheme, National IP Platform [37] [38]
38	Entrepreneurial Model of Singapore	Additional Roles of universities for Knowledge commercialization, Enhanced Triple Helix Nexus	Primary focus on university-industry relationship [39] [40]
39	KRDL Model Singapore [41]	Comprehensive phased manner model for academic Institutions	Market pull strategy, mechanisms for tech transfer, Two way and one way mechanism of technology flow
40	Barriers in TT (India) [42]	Micro and Macro Barriers	Institutional, Technological, Economic, Informational, Financial, Cultural, Legal, Participation, Cultural, VoID, Market Orientation, Entrepreneurial Mindset, TT Documentation, Red TApism & Bureaucracy, Lack of Incentivisation, Efficient Pre and Post TT Services, Competency of Industry Partner, Technology Adoption Capabilities, Risk Taking Attitude, Measures to determine success of TT

Sr. No.	Model/Best Practices	Merits/Advantageous Factors	Factors Relevant for the Conceptual Model
41	Raghavan and Purushotham Model (1992) [43]	Timeline based comprehensive model	Phases of development, preparation, assistance, training, demonstration
42	Mohan and Rao Model (2003) [44]	To improve technology transfer capabilities	Database search tools, Identification Phase, Assessment phase, Analysis and Planning Phase
44	Coopers Model [2008] [45], Joseph Lane Model [1999], Jin-Fu Model [2010], Heslop *et al.* Model [2001], Waroonkum and Stewart Model [2008], Bozeman Model [2000], Nazanin Jalili *et al.* Model [2011], Functional Model [2006]	Factors to check the success of technology transferred	Embarking on the production, launching the product, returns, socio-economic development

X. Developing the Conceptual Framework

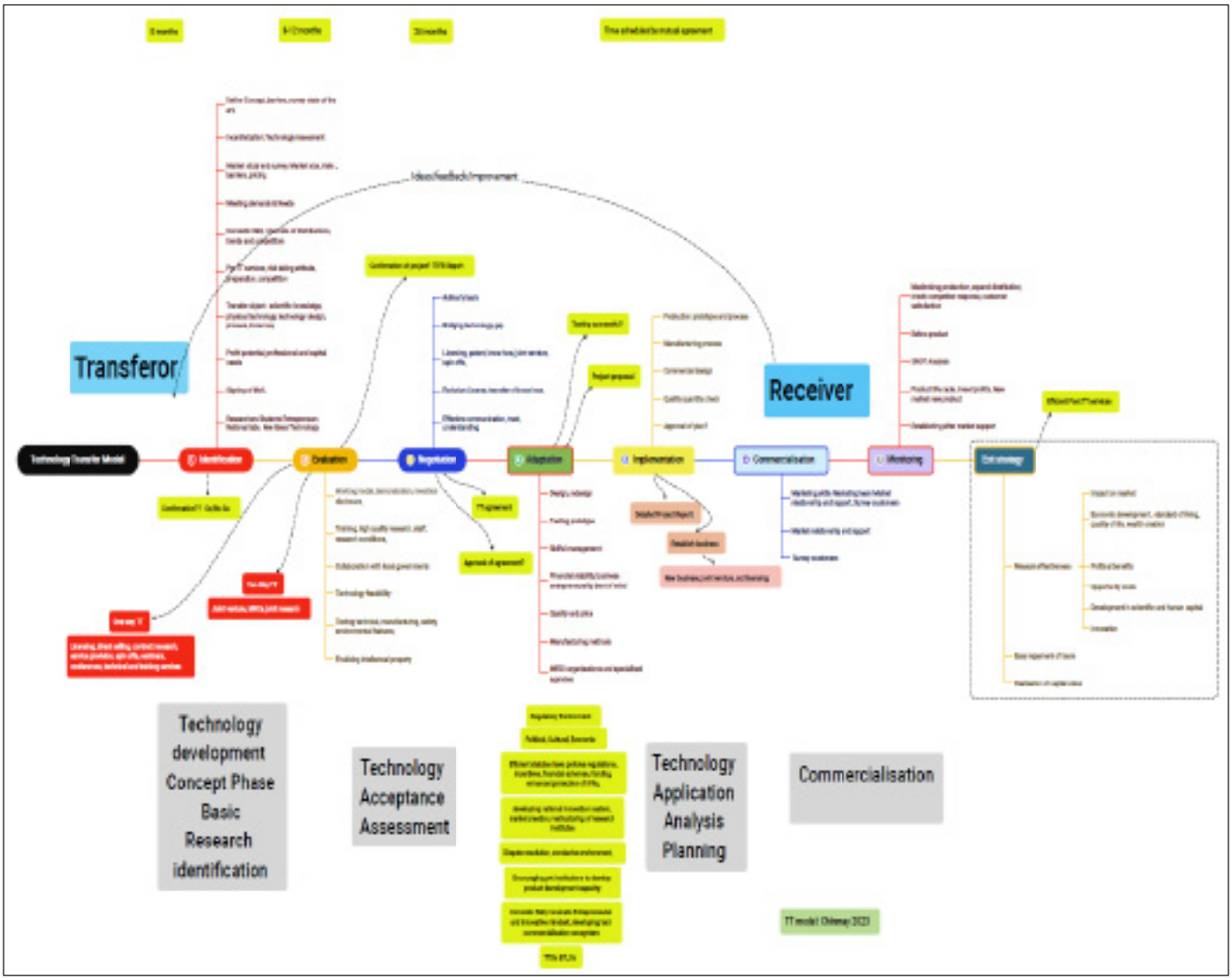
The analysis above shows that the process of technology transfer plays a crucial role in technical and economic advancement. It was also seen that a typical technology transfer process predominantly involves three key elements around which the process revolves namely technology transferor factors, receiver factors and environmental factors. Earlier models do not emphasise much on the factors related to the environment and other ancillary factors. The analysis shows that the process of technology transfer involves several stages, which can vary depending on the specific context and goals of the transfer. Some of the common stages in technology transfer noted are:

- *Identification of Technology:* This stage involves identifying a technology that has the potential to be transferred to another entity or organisation. This could involve identifying a technology that is not yet commercially available, or finding a technology that has been developed for one application but could be adapted for another use.
- *Evaluation of Technology:* In this stage, the technology is evaluated to determine its potential for transfer. This might involve assessing its technical feasibility, its potential market demand, and the costs and benefits of the transfer.
- *Negotiation and Agreement:* Once the technology has been identified and evaluated, the parties involved negotiate the terms of the transfer. This might include agreements around intellectual property rights, licensing, and royalties.
- *Adaptation and Customization:* After the transfer has been agreed upon, the technology may need to be adapted or customised to meet the needs of the recipient organisation. This might involve modifying the technology to work with local infrastructure, or adapting it to meet local regulations.
- *Implementation and Testing:* The technology is then implemented and tested in the recipient organisation. This might involve training personnel on how to use the technology, and conducting pilot tests to ensure that it is working as expected.
- *Scaling and Commercialization:* Once the technology has been successfully implemented and tested, it can be scaled up for wider use. This might involve commercialising the technology for sale to other organisations or consumers.
- *Monitoring and Evaluation:* Finally, the technology transfer process is monitored and evaluated to determine its success. This might

involve tracking the adoption and impact of the technology, and assessing whether it has achieved the goals set out in the transfer agreement. Based on these stages and mapping them with the factors emanating from the comparative insight (as shown in the Table I) a conceptual model is developed as shown in Fig. 4.

XI. Technology Transfer Model Proposed

A higher resolution pdf/image of the model can be accessed through this link https://drive.google.com/drive/folders/1y-34gIOFLD5qvmt4BT8RM0jBQi7T5nZR?usp=sharing



Source: Proposed and Developed by Author.

Fig. 4: Technology Transfer Model

XII. Conclusion

The paper introduced the concept of technology transfer and its evolution over the years and also threw light upon some relevant nuances related to the concept. We learnt about various actors and subject matter involved in the process of technology transfer. We also learnt about various types of technology transfer processes classified on the basis of level of involvement of various actors in the process.

Thereafter the chapter discusses the traditional model of tech transfer, valley of innovation death and the limitations of the traditional based model. The chapter thereafter proceeds with an in-depth analysis of important technological transfer models, implemented within the process of technology transfer after 1990. The chapter analysed around 28 technology transfer models which will be used to develop a conceptual framework for the current study. Finally in order to successfully fulfil and justify the requirements of the first objective the chapter ends with discussing important strategies generally undertaken in a process of technology transfer and also discusses some important factors that influence the process of technology transfer.

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Journal of Applied Information Science
13 (1) 2025, 42-51
www.publishingindia.com/jais

Optimizing Analytics Deployment in Banking – Building Strategic Capabilities

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Abstract: Data analytics capability is the holistic approach towards capturing, processing and analyzing the various dimensions of data. Being the new frontier of innovation in banking space, analytics aids banks in producing data-driven financial insights. Every time a customer transact, banks can generate insights on each of the transactions. Leveraging data to create value from deploying analytics is the potential challenge for banks and hence building strong analytics capabilities has become imperative for banks. At the global level, leaders and agencies are emphasising on practices that promote sustainable development goals and banks are therefore focusing on sustainable initiatives. The present research aims at investigating analytics capabilities and challenges faced by banks in building these capabilities. Literature on analytics capabilities is drawn by researcher by using key-word strategy. A structured questionnaire was built to collect responses from bank staffs and data was further analysed by using SPSS (Statistical Package for Social Sciences). Researchers have employed TOE model (Technology-Organization-Environment) to gain insights on adoption of analytics and factors influencing for building capabilities in banking. The findings indicated that technical know-how of handling analytics and investments on analytics deployment are foundational requirements to build analytics capability in banks. Data integration and security and compliance are found to be quite challenging for banks while developing analytics capabilities. The research concludes with suitable measures to be adopted by banks for smooth deployment of analytics initiatives.

Keywords: Analytics capabilities, Banking analytics, Data analytics, Data integration, Sustainable banking.

I. Introduction

Business decisions are currently driven by data at larger scale and this is leading to increased importance of adopting analytics. Banking industry is at the front-run to adopt analytics much prior to any of the other industries. In the era of data, there has been an exponential growth in the data generation and this has led to an exponential investment into building analytics capabilities to create value from data. With the accelerated deployment of analytics, banks are currently focusing on achieving competitive advantage. Earlier, banks were just involved in recording and storing customer data but currently, capturing and then creating value out of the data is gaining importance. To create value, banks are deploying tools of analytics to generate insights and leverage the data. Large volume of customer data can help the banks to enhance their understanding about customers and accordingly strategize business operations to achieve profitability. The interesting challenge in creating value out of any data is the format of data as it can be either structured or unstructured or semi-structured or both. As per the term, structured data is more organized and

standardised. Unstructured data is unorganized and difficult for banks to connect the dots, whereas semi-structured data will be partially organized and partially un-organized. Analytics helps banks to convert organized, unorganized and semi-organized data into meaningful insights [1]. Technologies such as business analytics are transforming business strategies [2]. For instance, analytics has the ability to influence firms to enter into new markets by leveraging customer data [3].

Banks across the globe are committed to provide long term value creation to all stakeholders. Banks are acting as change agents by responding positively on sustainable actions and demonstrating the commitment towards achieving these goals. Traditional banking system operated tremendously on paper based whereas, modern day banks are driving their business activities by reducing carbon footprints. Focusing on adopting analytics, funding to socially responsive business ideas, reducing paper consumption, customer data privacy and value creation are some of the good sustainable practices being adopted by banks.

Banks used to generate paper printed reports which affect the green initiative of the banks. Analytics can be treated as an alternate way of generating reports by reducing the dependence of paper, waste and leading to prioritizing sustainability. Research suggests that analytics aids banks in achieving financial performance and sustainability [4]. Banks are integrating business strategies with the sustainable strategies as they have understood the importance of incorporating sustainable business practices. These strategies aim at creating an environment that supports the growth of banking business without causing environmental and societal factors.

Innovation is one of the sustainable development goals to transform the globe and analytics can be fostered as innovation in banking space by increasing internal performance and sustainability. It is evident that investing into such sustainable business practices shall mitigate several risks to which banks can be exposed. Hence, banks can assess the initiatives of borrowing company towards environmental and societal consideration and then decide on lending. In this regard, several banks are appointing special officers to monitor the sustainable practices of the bank and exclusive reports are constituted in the annual reports of the banks.

II. Analytics as a New Frontier of Innovation in Banking

In the fast-changing world of modern banking, analytics has emerged as a key driver of innovation and redefining the industry's future trajectory. Banking no longer relies simply on old techniques and intuition; instead, data-driven insights are transforming every element of financial services, from client interaction to risk management and operational efficiency.

At its foundation, banking analytics uses data to find important patterns, trends, and correlations, allowing organizations to make more educated decisions. This revolutionary power not only improves the customer experience by providing individualized services, but it also allows banks to optimize internal operations for increased efficiency and profitability. Analytics is driving innovation in product creation and service offerings in the banking sector. Banks can use data analytics insights to predict new market trends, anticipate client demands, and provide innovative solutions like digital wallets, AI-powered chatbots for customer support, and personalized investment advising services. These innovations not only address changing consumer tastes, but also position banks as leaders in a competitive environment driven by technological breakthroughs.

Technology such as analytics can be used to broaden the reach to under-served customers of the banks. Innovative practices help banks to attract new customers and retain existing customers [5]. Banking industry has always been at the front run to experiment any newer technologies to enable customers to experience convenient and secured banking. At the inception stage, banks could just make profits if customers visited the branch and involved in basic transactions. Over the years, banking industry has seen massive transformation due to the velocity of market competition both at the domestic and global level. Banks with more customer base would naturally enhance bank's profitability level

as deposits tend to increases. With an objective to increase the widespread of customer base, banks are focusing on initiating digital convergence strategies. Adopting analytics is one such diverse strategy that provides technical solutions by integrating data and technology at various levels. Digital transformation can streamline the customer journey by leveraging technology to create dynamic consumer engagements and information-based revenue streams [6]. Today, banks are able to use advanced analytics to explore data set of customers such as demographic features and product held details like credit card statements, point of sale data, online fund transfers and credit bureau data [7].

Increased quantity of data and every year and low price of data storage and computing has made adopting analytics as desirable to gain competitive advantage. Banks are in position to generate huge volume of data from both internal and external sources. Through opening of different accounts, credit scoring, withdrawals, deposits and availing various banking services, banks can generate data of any customer. Banks are therefore deploying technologies such as analytics to improve data capturing, data processing, storage and undertaking real-time decisions [8]. Due to exponential growth in data generation, banks find it difficult to generate insights as data is complex and competitive. Many financial services firms such as banks are using the 'customer journey' through websites, ATM stations, physical visit to banks and presence in other social media channels to understand the approach of customers towards the bank, how a particular path may lead to customer attrition and whether a particular product is likely to be bought by customers [9].

III. Analytics Capabilities and Implementation Challenges

In order to gain competitive advantage, banks are now investing on staff, process and technologies to enhance deeper understanding of customers and all other stakeholders. Investments alone cannot create competitive advantage; firms need to focus on creating capabilities that distinct the firm from others in the market [10]. Data analytics capability is the ability of a firm to capture and draw insights from data by deploying necessary resources [11]. Identifying resources needed to build a capability model and configurating these resources with the banking operations is the greatest challenge. Hence, it is significant for banks to design a framework that aids bank to align analytics capabilities to attain the value. Picking the ideal blend of resources is critical as single alone resource is insufficient to develop analytics capability model. Which combination of resource capabilities lead to generate value is to be determined by banks as it is subject to one bank to another bank.

Banks can deploy analytics to translate data into actionable insights and increase bank performance. Though banks are able to realize the potential usage of data, there are challenges while implementing analytics capabilities models in the banks. Therefore, prior implementing analytics, banks should take inputs from all stakeholders [12].

- *Integration Challenge*

The result of implementing analytics in banks relies primarily on the presence of technology. Hence, there is a need to integrate analytical techniques to support the linkages between internal and external aspect of the banks such as market, product, service and technology [13]. The integration challenge is significant as banks should also ensure that regulatory compliance and data privacy is well considered. Banks should create a checklist to ensure its preparedness to implement analytics before actually integrate existing technology with new analytics tools. The preparedness of the bank should reflect in availability of existing technology to integrate with other functional and operational activities of the bank.

- *Training Challenge*

In order to undertake smooth implementation of analytics in bank, it may require data scientists or any professionals with expertise in analytics. Otherwise, analytics initiatives cannot be dealt by regular bank staff. It is important to note that not all data is useful for drawing insights. Banks should provide adequate training to create skills for the staff so that correct

data set is identified and correct insight is drawn [14]. The success of integrating analytics into banking eco-system depends on the overall execution. It is significant that banks should train the employees on analytics tools so that execution is made possible. Due to increased integration of analytics into banking, newer job titles can be expected in banks [15].

- *Data Governance and Compliance*

Banks can deploy analytics initiatives if strong data governance practices are put into place. Banks should have proper Standard Operating Procedures [SOP] to define bank data, data ownership, data access, data usage, data control, data management, etc. because traditional data governance models focused primarily on structured data formats. On the similar line, it is another challenge for banks to ensure that data collected is used to run analytics initiatives and it is fair, transparent and not misused by banks. Banks need to commit themselves for data monitoring to achieve operational efficiency and sustainability goals [4].

- *Cultural Resistance*

Another important challenge for banks could understand the adoption rate or response rate of bank staff if analytics initiatives are deployed in the bank. Any technological disruptions may create fear among the staffs and may resist adopting the new change.

- *Investments*

Deploying analytics in banks will definitely costs to banks as it requires investing heavily on building strong data infrastructure, investing on promoting data-driven culture, investing on staff training and investing on integrating the whole eco-system.

IV. Research Methodology

Researchers have relied on both primary data sources and secondary data sources. A structured questionnaire was built and shared with the respondents. In the current research, respondents included bank officials of selected banks operating in Bangalore region. Five-point Likert scale was instrumented in the questionnaire to obtain responses. The questionnaire consisted of questions on analytics capabilities and implementation challenges. Literature survey was undertaken to gain more insights on analytics capabilities in banking space. TOE model (Technology-Organization-Environment) was instrumented in the questionnaire and further data was analysed using SPSS.

- *Data Sources*

To identify key trends, challenges and best practices in leveraging analytics for strategic capabilities, a comprehensive review of existing literature on analytics deployment was deployed. To gather data from bank officials, questionnaire using 5-pointLikert scale was administered. Along with this, informal conversation with the bank executives also supported the researcher to extract insights. Thus, the study adopted mixed-method approach, combining surveys, informal discussions and secondary data sources.

- *Sample*

The study focused on the 34 banking executives of selected banks operating in Bengaluru region of Karnataka, India.

- *Research Objectives*
  - To identify analytics capabilities required to be built in banks.
  - To discover the challenges encountered while implementing analytics in banking.
  - To propose measures for effective and smooth implementation of analytics in banking.

V. Data Analysis

The researcher adopted descriptive statistics to summarize the data with all items using SPSS. Missing values turned out to be zero with 34 valid items. In order to understand the degree and direction of the skew, test of skewness was performed which turned out to be 1.261, indicating that the distribution is positively skewed for Q1.2, whereas, the result indicated negative skewness for Q1.3. A kurtosis

value of 8.366 suggests that the distribution has fatter tails and a more peaked central peak compared to a normal distribution, indicating a leptokurtic distribution with a potential presence of outliers or extreme values. The mean of the dataset of technology context 1.9118 indicate that the average values in the dataset clusters around 1.998. A standard deviation of 0.51450 is a relatively moderate value. It indicates that, on average, the data points deviate from the mean by approximately 0.51450 units.

- *Test of Reliability*

The internal consistency was checked using Cronbach alpha measure which indicated that all items are acceptable with reliability of 0.728.

Table I: Reliability Statistics

Cronbach's Alpha	N of Items
.728	25

Table II: Descriptive Statistics – Technology Context

		Basic Resources are Must for Implementing Analytics in Banking	Data Security is Critical While Implementing Analytics in Banking	Banks Should Ensure Existing Technology is Compatible with New Tools of Analytics
N	Valid	34	34	34
	Missing	0	0	0
Mean		1.0000	1.9118	1.9118
Std. Error of Mean		.00000	.08824	.08824
Median		1.0000	2.0000	2.0000
Mode		1.00	2.00	2.00
Std. Deviation		.00000	.51450	.51450
Variance		.000	.265	.265
Std. Error of Skewness		.403	.403	.403
Std. Error of Kurtosis		.788	.788	.788
Range		.00	3.00	2.00
Minimum		1.00	1.00	1.00
Maximum		1.00	4.00	3.00
Sum		34.00	65.00	65.00
Skewness			1.261	-.157
Kurtosis			8.366	1.041

Source: Author Calculation.

Table III: Descriptive Statistics – Organization Context

		Stakeholder Support is Crucial in Implementation of Analytics in Banking	Bank Staff Should Have Sound and Sufficient Knowledge About Usage of Analytics in Banking	Banks Should Invest Considerably in Building Analytics Capabilities
N	Valid	34	34	34
	Missing	0	0	0
Mean		1.8529	1.6471	1.6471
Median		2.0000	2.0000	2.0000
Mode		2.00	2.00	2.00
Std. Deviation		.55772	.48507	.48507
Variance		.311	.235	.235
Skewness		-.067	-.644	-.644
Std. Error of Skewness		.403	.403	.403
Kurtosis		.253	-1.688	-1.688
Std. Error of Kurtosis		.788	.788	.788
Range		2.00	1.00	1.00
Sum		63.00	56.00	56.00

Source: Author Calculation.

In this case, the values in dataset, on average, deviate from the mean by approximately 0.55772 units. The mode with the value 2 represents the frequency in the dataset with more occurring. A variance of 0.311 implies that, on average, the squared differences between individual data points and the mean is 0.311, which is relatively closer to the mean or less variability in the dataset.

Table IV: Descriptive Statistics – Environment Context

		Government Regulations Do Impact the Operation of Analytics in Banks	External Data Sources Such as Economic Data or Market Trends Affect Your Bank's Analytics Initiatives	Environment Sustainability Factors (ESG) Should Be Considered While Deploying Analytics Capabilities
N	Valid	34	34	34
	Missing	0	0	0
Mean		2.2353	1.7353	1.8824
Median		2.0000	1.5000	2.0000
Mode		2.00	1.00	1.00
Std. Deviation		.74096	.96323	1.03762
Variance		.549	.928	1.077
Skewness		1.485	1.439	1.112
Std. Error of Skewness		.403	.403	.403
Kurtosis		2.039	1.363	.194
Std. Error of Kurtosis		.788	.788	.788
Range		3.00	3.00	3.00
Minimum		1.00	1.00	1.00
Maximum		4.00	4.00	4.00
Sum		76.00	59.00	64.00

Source: Author Calculation.

From the table given below, it is evident that banks are considering environment sustainability factors while deploying analytics capabilities in banking. 44% of bank officials have strongly agreed that ESG should be considering while deploying analytics.

Table V: ESG Should be Considered While Deploying Analytics Capabilities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agree	15	44.1	44.1	44.1
	Agree	13	38.2	38.2	82.4
	Neutral	1	2.9	2.9	85.3
	Disagree	5	14.7	14.7	100
	Total	34	100.0	100.0	

Source: Author Calculation.

- *Correlation*

To measure the relationship between bank size and having an exclusive analytics department, Pearson correlation was checked, which resulted to 0.328, indicating a moderate positive relationship between bank size and exclusive analytics department.

Table VI: Correlations

		Bank Size	Exclusive Analytics Department
Bank size	Pearson Correlation	1	.328*
	Sig. (1-tailed)		.029
	N	34	34
Exclusive Analytics Department	Pearson Correlation	.328*	1
	Sig. (1-tailed)	.029	
	N	34	34
*. Correlation is significant at the 0.05 level (1-tailed).			

The absolute value of the correlation coefficient (0.500) is less than 1, suggesting a moderate negative linear relationship between bank size and reporting and communication.

Table VII: Correlations

		Bank Size	Reporting & Communication
Bank size	Pearson Correlation	1	-.500**
	Sig. (1-tailed)		.001
	N	34	34
Reporting & Communication	Pearson Correlation	-.500**	1
	Sig. (1-tailed)	.001	
	N	34	34
**. Correlation is significant at the 0.01 level (1-tailed).			

- *Regression*

R value of 0.274 suggests a moderate positive correlation between the dependent and independent variables. A positive "r" value indicates a positive linear relationship, meaning that as one variable increases, the other tends to increase as well.

R-squared value of 0.75 suggests that your model explains the best proportion of the variability in the dependent variable. R^2 value depicts the best fit of the model and accuracy in predictions.

A higher adjusted R^2 indicate better fit of the model. In the present case, it is 0.46 which is balanced and lower than the R^2. A standard error of the estimate of 0.81471 suggests that, on average, the observed values deviate from the regression line by approximately 0.81471 units.

Table VIII: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.274[a]	.075	.046	.81471
a. Predictors: (Constant), Bank size.				

VI. Results and Discussion

The study on optimizing analytics deployment in banking focused on analytics initiatives at selected commercial banks. The research employed a mixed-methods approach, combining surveys, informal discussions and secondary data analysis to gather insights into strategies, challenges, and outcomes related to analytics deployment.

- The study demonstrated that basic resources are critical for the successful application of analytics in banks. These resources include a

strong IT infrastructure, significant data storage capacity, and skilled individuals who understand data analytics methodologies.

- The study emphasized the vital necessity of data security issues in the deployment of analytics in banks. To protect sensitive client information, critical considerations were ensuring effective data encryption, access restrictions, and regulatory framework compliance.
- Banks should ensure that new technology such as analytics tools should be able to compatible with existing technology.
- The findings emphasized the need of bank employees having strong knowledge and expertise in analytics utilization. Investing in ongoing training programs and upskilling activities was highlighted as critical to maximising the efficacy of analytics tools and driving organisational success.
- Significant investments in analytics skills were discovered to be critical, particularly when aligned with Environmental, Social, and Governance (ESG) criteria. This strategic alignment improves operational efficiency while also reinforcing banks' commitment to sustainability and responsible banking practices.
- Banks should also consider changing government regulations while adopting analytics.
- A large number of respondents strongly agreed that external data sources, such as economic indicators and market movements, have a significant impact on banks' analytics operations. Incorporating external insights improves the accuracy and relevance of analytics-driven decision-making processes.
- The study discovered that the establishment of dedicated analytics departments varies greatly depending on the size and operational scale of banks. Larger organizations often invest in specialist analytics teams to focus on specialized data analytics duties and strategy development.
- The degree of reporting and communication processes differed significantly between banks of various sizes. Larger banks often use more extensive and organized reporting methods than smaller institutions, reflecting differences in organizational capacity and resources.
- Data integration, security, and regulatory compliance issues were highlighted as significant barriers to the implementation of analytics in banks. Overcoming these difficulties necessitates strong governance structures, innovative data management tactics, and strict compliance requirements.

The findings underscore the critical importance of strategic planning and organizational readiness in optimizing analytics deployment within the banking sector. Effective deployment hinges on aligning analytics initiatives with overarching business objectives and ensuring robust technological foundations.

VII. Conclusion

The research on optimizing analytics deployment in banking has provided valuable insights into the multifaceted challenges and strategic considerations essential for successful implementation. Key findings underscore the critical role of basic resources, data security, compatibility with existing technology, staff expertise, and substantial investments in building analytics capabilities aligned with ESG factors.

Analytics is the new frontier of innovation in banking space. The significance of adopting analytics in banking activities is explored through present research. The results of TOE model depicted that the banks should invest tremendously on implementing analytics in banking. Having an exclusive analytics department is always recommended as execution, monitoring and assessing of analytics initiatives becomes easier. Analytics can promote sustainable practices in bigger way and can be leveraged to greater extent. Analytics can help improve risk management, fraud detection, operational efficiency, consumer insights, compliance, supply chain management, and community impact in banking. Banks may contribute to both environmental and social sustainability while retaining financial viability by appropriately exploiting data and analytics. The findings underscore the multifaceted considerations

and challenges associated with optimizing analytics deployment in banking. By addressing these key areas, banks can enhance their analytical capabilities, strengthen operational resilience, and foster sustainable growth in a competitive financial landscape. In conclusion, optimizing analytics deployment in banking requires a comprehensive approach that integrates technological readiness, robust data governance, strategic investments, and continuous organizational adaptation to regulatory changes. By addressing these key considerations, banks can position themselves competitively, enhance customer experiences, and drive sustainable growth in an increasingly digital and data-driven financial landscape.

VIII. Limitations and Future Research

The current research focuses primarily on identifying capabilities required to implement analytics in banks. Future research can be extended on identifying those capabilities which affect the performance of bank. Addressing issues such as data silos and personnel shortages is critical for banks looking to maximise the benefits of analytics adoption. Future research could look into how emerging technologies such as AI and machine learning can be used to improve analytics skills while also managing changing regulatory environments.

To summarize, improving analytics adoption in banking necessitates a comprehensive approach that combines strategic planning, strong technological infrastructure, and good data governance. Banks can use the findings of this study to strengthen their deployment plans, improve operational agility, and achieve long-term growth in an increasingly competitive market.

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