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2	MAIT Journal of Science and Technology	National	Yearly	Maharaja Agrasen institute of Technology	No	No	No	Yes

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Foreword by
Dr. Nand Kishore Garg

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(Maharaja Agrasen Technical Education Society, New Delhi)

MAIT Journal of Science and Technology

FOREWORD

Dr. Nand Kishore Garg

Founder and Chief Advisor, Maharaja Agrasen Technical Education Society, Delhi
Chancellor, Maharaja Agrasen University, Baddi, H. P.



Education must be accompanied by innovative research and development to hold true value for the community, especially in our globally interconnected world where contributing to global knowledge is essential. I am pleased by the enthusiastic response from contributors and fellow educational institutions towards the inaugural volume of the 'MAIT Journal of Science and Technology' from Maharaja Agrasen Institute of Technology.

I commend the Editorial Board for their successful effort in compiling the diverse ideas and aspirations of our students and faculty into a cohesive publication. Additionally, I am delighted to see that this marks the third publication from Maharaja Agrasen Institute of Technology within just six months. Congratulations to its Office Bearers and Chief Editor for this remarkable achievement.

Dr. Nand Kishore Garg

MESSAGE



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Shri Vineet Kumar Gupta

Chairman, Maharaja Agrasen Technical Education Society, New Delhi



Nurturing creativity and sparking innovation are essential pillars of effective education, and an Institute Journal embodies this perfect blend. It captures the creative spirit of the academic community, distilling their inspired ideas in a remarkable manner.

I am delighted to announce the forthcoming publication of the 'MAIT Journal of science Technology'—an Annual Refereed Journal from Maharaja Agrasen Institute of Technology, Delhi. I extend my heartfelt congratulations to the Editorial Board for achieving this milestone as per schedule, which is truly commendable considering the dedication and effort invested. May our students continue to ascend to new heights, bringing honor to the world and their professions through the power of education!

Vineet Kumar Gupta

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About the Journal

The MAIT Journal of Science and Technology stands as a premier forum for publishing original research contributions and comprehensive technical review articles, emphasizing interdisciplinary and pioneering research across a wide range of engineering topics. The journal invites contributions from seasoned and emerging researchers, professionals, and other stakeholders to disseminate their knowledge and experiences. Published bi-annually, it spans all areas of Science, Technology, and Management, offering a rich repository of original research, comprehensive technical reviews, detailed analyses, critical evaluations, and investigations into innovative technologies, devices, systems, materials, processes, operations, performance, maintenance, and control within the engineering and management fields. As a leading peer-reviewed platform and an authoritative source of information, the journal caters to a diverse audience, including researchers, professionals, and industry stakeholders. We are thrilled to announce that Volume 2, Issue 2 of the MAIT Journal of Science and Technology will be available online in August 2024, furthering our commitment to sharing groundbreaking advancements and innovative research across multiple disciplines.



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Revolutionizing Healthcare: Enhancing Interoperability and Security in Personal Health Record Management through Solana Blockchain and Custodial Wallet Architecture

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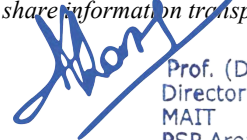
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Abstract: It has always been challenging to collaborate when managing medical records, which leads to disjointed patient records and ineffective healthcare delivery. Promising against these challenges is the Solana blockchain, which is renowned for its abundant resources and inexpensive transaction fees. The project will start with a thorough analysis of PHR interaction as it stands today, emphasizing the shortcomings of the current setup and the need for fresh approaches. Subsequently, he will comprehend the attributes and functionalities of the Solana blockchain and emphasize its appropriateness for healthcare applications. Throughout the project's duration, a PHR management model on the Solana blockchain will be developed and created. Consensus management will be implemented via smart contracts, which will also make it possible for authorized stakeholders to share information transparently and safely.

Keywords: Healthcare, PHR, Protocol, Solana Blockchain


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1. INTRODUCTION

One of the key components that facilitates information availability in a healthcare network is the electronic health record (EHR) (Kumar et al., 2020). The process of digitizing patient health records for computer systems access by doctors, other healthcare providers, and patients is referred to as a "EHR" (Lee & Meuter, 2010). An EHR system will be very helpful to healthcare networks since it will reduce medical mistakes and enhance sickness management (Dean et al., 2009, pp. 611–638). Due to privacy concerns and insecure systems, patients are demotivated to share their health information in electronic health records (EHR) systems (Rezaeibagha et al., 2015; Zhang et al., 2022). Blockchain technology, for example, can create a secure system that better safeguards patients' privacy. Blockchain refers to distributed digital ledgers in information-sharing systems, each having its own database. It is vital to highlight that "user" refers to doctors, patients, and healthcare staff in the context of healthcare, particularly blockchain-based EHR system applications. Blockchain technology has sparked considerable interest in the healthcare industry as a potential means of upgrading existing systems.

The goal of the research is to fill gaps in electronic health record systems and make blockchain based solutions user-friendly and simpler to use in times of disaster. Patients' incapacity to manage personal health information, such as test findings and past therapies, influences their treatment options. EHR systems are vital today since they have shown to provide better medical diagnoses. However, because to their centralized and non-interoperable nature, existing EHR systems have proven unsuccessful. Also, patients' privacy and security concerns are causing them to refrain from actively sharing their health information because they are concerned about the security mechanisms in use.



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Effective patient management is critical for several reasons:

- ✓ Continuity of patient care: This ensures that all healthcare providers have access to accurate and up-to-date information about a patient's medical history, treatment and test results, enabling continuity of care and informed decision-making.
- ✓ Patient safety: Properly managed patient records reduce the risk of errors such as medication mix-ups, duplicate tests or missed diagnoses, which improves patient safety.
- ✓ Efficiency and cost-effectiveness: Simplified record management processes save time and resources reducing the elimination of the need for manuals, reducing administrative burdens and avoiding unnecessary healthcare costs.
- ✓ Data analysis and research: Well-organized patient records are valuable data sources for analyzing health trends, improving research and clinical trials. results through evidence-based practices.
- ✓ Legal and Regulatory Compliance: Privacy laws and regulations such as HIPAA compliance are important to protect patient confidentiality and avoid legal liability for unauthorized use or disclosure of medical information.

However, despite its significance, efficient medical record management faces several challenges:

- ✓ Interoperability: Incompatibilities between different electronic health record (EHR) systems make it difficult to seamlessly exchange patient data between healthcare providers, leading to fragmented care and communication gaps.
- ✓ Security and privacy concerns: Protecting sensitive patient data from unauthorized cyber threats, access or violations is a constant challenge for healthcare organizations, especially with increased reliance on digital record systems.
- ✓ Workflow integration: Integrating EHR systems into clinical workflows without disrupting provider-patient communication or causing workflow inefficiencies requires careful planning and training.
- ✓ Data overload and information overload: The medical burden generated by electronic records the large volume of information can overwhelm healthcare providers, making it difficult to effectively obtain relevant information and make informed clinical decisions.
- ✓ Standardization and quality control: Differences in documentation practices and lack of information, standardization of medical terminology hinders data accuracy, quality control and data analysis.

A blockchain-based EHR system might provide consumers with autonomy over their health data while also offering cryptographic security via blockchain technology. On a blockchain, users might share their data with anybody, at any time, making it interoperable. Solana and other public blockchain protocols may make it simple for anybody to utilize the system. In the medical business, they use established threshold settings to examine patient data and perform real-time analysis to gather transaction metadata. So, smart contracts in the healthcare industry manage real-time analysis and transaction metadata tracking for medical sensors. Because of the architectural importance of the blockchain, clinical trial data management transparency could be improved using smart contracts. Also, smart contracts enable the creative and innovative automation of complex multi-step processes or time-consuming workflows. Moreover,

blockchain protects data privacy and allows for secure data sharing (Xia et al., 2017b). Data entered by healthcare professionals into an electronic health record (EHR) is only available to medical specialists. Also, an EHR can only be accessed by one healthcare practitioner. However, individuals can use their electronic health records (ePHRs) to access health information from different sources, including patients and other healthcare professionals. Even though they have clear benefits, health consumers rarely use ePHRs.

Personal Health Record (PHR) systems, while offering benefits in terms of patient engagement and access to health information, still face several issues that impact healthcare delivery:

- ✓ **Interoperability Issues:** PHR systems often lack interoperability with the electronic health record (EHR) systems used by healthcare providers. This lack of integration leads to the fragmentation of health information and prevents the smooth exchange of information between patients and health care providers. As a result, incomplete or unavailable patient data can compromise healthcare.
- ✓ **Security and privacy risks:** PHR systems store sensitive health information, making them an attractive target for cyberattacks and data breaches. Inadequate security measures can compromise patient privacy and confidentiality and undermine trust in the healthcare system. Breaches of PHR systems can lead to identity theft, medical fraud and other harmful outcomes for patients.
- ✓ **Accuracy and Reliability of Patient Information:** Patients are often responsible for updating and maintaining their PHR information, which can lead to inconsistencies and inaccuracies in the information. Inaccurate or incomplete information to health care providers can lead to misdiagnosis, inappropriate treatment, or medical errors that compromise patient safety and outcomes.
- ✓ **Limited adoption and availability:** Despite efforts to promote PHR adoption, many patients still do not actively do access or use these systems. Limited access to technology, barriers to digital literacy, and privacy and security concerns can hinder PHR adoption, especially among vulnerable populations. This limited adoption limits the potential benefit of PHRs in improving health care and patient outcomes.
- ✓ **User experience varies.** PHR systems can lack user-friendly interfaces and intuitive design, resulting in a disjointed patient experience. Confusing navigation, complex terminology and technical glitches can frustrate patients and prevent them from actively using their health information. A fragmented user experience prevents effective communication between patients and healthcare providers and makes collaborative care and shared decision-making difficult.
- ✓ **Lack of standardization and integration:** PHR systems often lack standardized formats and data structures, which leads to inconsistencies in data storage, health information, and is displayed. The lack of a standard makes it difficult to share and exchange information between different PHR systems and healthcare providers, which hinders interoperability and coordination of care.

Making blockchain-based solutions accessible to a bigger audience with various backgrounds is the most challenging problem. To address these concerns, the system will employ a custodial wallet architecture, eliminating the need for users to managing wallets and other assets. Furthermore, the system will pay all transaction costs for the user. In the future, these charges will be added to the hospital bill as convenience fees. Patients would just input their phone numbers, which would be validated by the ABHA ID.

With move from specialized facilities to community-based healthcare settings in the growing medical situation, it will serve as a medium for organized administration of users' health data. We developed a blockchain protocol to

demonstrate the system's feasibility and superiority over traditional EHR systems. Our proof-of-concept gives control over health information as well as interoperability the ability to share medical records safely and freely with anyone. It is feasible to achieve five major goals by using our model: (1) Users have access to their medical records. (2) Users may quickly and securely share their medical records with anybody. (3) Users own personal health records, which are not held by a centralized institution such as a network of hospitals or laboratories. (4) Create an immutable system for tracking all user and medical record activity to protect stakeholders legally. (5) a decentralized blockchain-based system that everyone may use without needing to maintain blockchain assets.

2. BLOCKCHAIN FRAMEWORK

2.1 Introduction

Blockchain is a distributed, decentralized, and public ledger. It works with a distributed database. Several distributed, connected nodes are used to achieve decentralized data storage. They collaborate to administer the network and jointly control the blockchain network. These nodes collaborate to manage data using a unique approach that employs cryptographic algorithms to ensure security and availability. These nodes employ consensus mechanisms to validate and add a user's transaction to the ledger. Throughout this process, data is also stored in blockchain components called as accounts. The major advantage of distributed and decentralized networks is that data is available and tamper-proof to all network members. Cryptographic algorithms help to protect identity and trackability. Processes to ensure blockchain to work:

- ✓ **Data Replication:** All nodes have the same data, so data needs to be sent every node after each transaction. In this way, data is copied or consistent in network.
- ✓ **Data Duplication:** Every blockchain member has access to the whole ledger and the status of the blockchain. This also aids with transaction verification and node consensus utilizing their data. As a result, data is accessible and secure.

Blockchain components include:

- ✓ **Node:** single node in the network.
- ✓ **Transaction:** The event changes the state of blockchain
- ✓ **Block:** A single piece, like a ledger page, that has many transactions grouped together.
- ✓ **Hash:** A variable string of a fixed length made by cryptographic hashing method.



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The Solana Blockchain is being used to construct this protocol. It is a relatively recent blockchain that allows you to trigger computer instructions (smart contract) in addition to sending money. It is an open, public, decentralized blockchain that allows anybody to design protocols, utilize the blockchain, and join the network. It employs the Proof of History consensus process, which aids in the formation of new blocks. Blocks are used to store transactions and relate to a hash. The current block is constantly connected to the preceding block hash, producing a chain of blocks known as a ledger. A hash function is used to create the hash from an arbitrary text and other needed inputs. Hashes are irreversible, which means that we cannot track an arbitrary text or inputs through a hash. Finding the input from output strings is impossible. Solana use the SHA256 hashing algorithm. All medical data, as well as a history of data access and data authority, is encrypted and maintained on blockchain.

Smart contracts are self-executing contracts with the terms of the agreement directly written into code. In the context of Personal Health Records (PHRs) or healthcare in general, smart contracts can offer various functionalities to enhance data management, patient care, and regulatory compliance. Here are some key smart contract functionalities in healthcare:

- ✓ **Access Control:** Smart contracts have the ability to regulate access to PHR data, making sure that only people with permission—such as healthcare professionals or approved family members—are able to read or alter particular data. Granular control over data access can be enforced through the encoding of access rights in the smart contract.
- ✓ **Consent Management:** Patients can designate which parties are allowed access to their health information and under what circumstances by using smart contracts, which can streamline consent management

procedures. Through interactions with the smart contract, patients can alter or revoke their consent preferences, giving them control over data sharing and transparency.

Regarding compliance with healthcare regulations, smart contracts must adhere to relevant laws and standards to ensure the protection of patient data and compliance with privacy regulations such as HIPAA (Health Insurance Portability and Accountability Act) in the United States or GDPR (General Data Protection Regulation) in the European Union.

- ✓ **HIPAA Compliance:** HIPAA laws, which include strict standards for data security, privacy, and confidentiality, must be complied with by smart contracts handling PHR data. To protect patient data and stop illegal access or disclosure, smart contract developers must put strong security measures in place, such as encryption, access controls, and audit trails.
- ✓ **GDPR Compliance:** In order to function in regions where the GDPR is applicable, smart contracts must abide by its tenets, which include the rightful handling of personal data, accountability, and data subject rights. In compliance with GDPR regulations, smart contracts should have procedures for gaining and handling user consent in addition to supporting requests for data portability, erasure, and rectification.

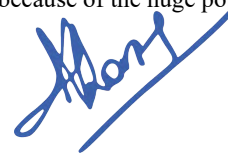
2.2 Why Solana?

Solana is a blockchain that is both scalable and quick. It can run programs to accomplish complicated transactions like Ethereum, but it has many greater capabilities that are appropriate for the PHR Protocol. Solana has an extremely scalable design and can manage a big number of transactions. As a result, it will be capable of handling transactions for a big population.

On a standard gigabit network, Solana may theoretically accomplish up to 710,000 TPS, which is exceptionally as compared to Ethereum's 30 TPS (Transactions Per Second). It replicates itself using Optimistic Concurrency Control without sacrificing transaction speed. Through the Solana design, transactions may be completed in parallel. Parallel processing of transactions and fast transaction speed are suitable for PHR, because of the huge population and rate of increase in patients.

Solana advantages for healthcare includes:

- ✓ **High performance:** Solana can process thousands of transactions per second, making it suitable for daily processing of large amounts of health data. This high performance ensures timely access to patient data and other critical data and improves the efficiency of healthcare.
- ✓ **Low transaction costs:** Solana's powerful consensus mechanism and low transaction fees make it cost-effective for health services. This affordability is especially important for healthcare organizations operating on tight budgets, as it lowers the financial barriers to adopting blockchain technology.
- ✓ **Scalability:** Solana's scalable architecture allows it to support growing numbers of users and applications without compromising performance. This scalability is important for the growing needs of the healthcare industry, such as the integration of mobile devices, telemedicine platforms and IoT devices.
- ✓ **Security and Privacy:** Solana's strong security features combined with privacy features make it suitable for storage and maintenance, sharing sensitive health data. Solana ensures the confidentiality and integrity of



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patient data using encryption technologies and authorized access rights, while complying with data protection regulations.

Some relevant use cases of Solana demonstrating its strengths include:

- ✓ **Decentralized Finance (DeFi):** Solana's high throughput and low latency make it well-suited for DeFi applications such as decentralized exchanges (DEXs), liquidity pools, lending protocols, and stablecoin issuance platforms. Projects like Serum, Raydium, and Mango Markets leverage Solana's capabilities to provide fast and cost-effective financial services.
- ✓ **Non-Fungible Tokens (NFTs):** Solana's scalability and fast confirmation times make it ideal for NFT marketplaces, digital art platforms, and gaming ecosystems. Projects like Solsea, Solible, and Solanart enable creators and collectors to mint, trade, and showcase NFTs on the Solana blockchain.
- ✓ **Healthcare Data Management:** Solana's high throughput and security features make it suitable for managing healthcare data, including electronic health records (EHRs), patient information, and medical research data. Solana's ability to handle large volumes of data efficiently and securely can improve data interoperability, patient privacy, and healthcare outcomes.
- ✓ **Supply Chain Management:** Solana's fast confirmation times and low transaction costs benefit supply chain applications, including product tracking, inventory management, and logistics optimization. Projects like Stardust, Mercurial, and Everlasting leverage Solana's capabilities to create transparent, efficient, and resilient supply chain solutions.

Solana generates a block in 400ms, indicating that it has an extremely short block duration. Solana's transaction processing is lightning quick. It employs the Proof of History approach, in which the node's leader generates a new cryptographic proof of blocks whenever some time has passed since the last proof. Because of the low block duration, transaction confirmation time in Solana will be extremely fast. Because medicine is such a delicate subject, and milliseconds can mean the difference between life and death, doctors must have quick access to medical information. As a result, it's best blockchain for constructing our system.



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2.3 Custodial Wallet Architecture

Custodial wallets are services that store and maintain users' private keys in a centralized manner. They are simple to use, recover, and access, making them user-friendly. Coinbase and Binance are two instances of custodial wallet software. We employ the custodial wallets design to make it easier for users of various backgrounds to manage the system's crypto assets and avoid the hurdles of joining the blockchain. It also aids in the administration of user identities. In the event of a medical emergency, the user may be unable to manage their own crypto wallet for transaction fees and account rent.

3. SYSTEM DESIGN

3.1 Identifying the Issue:

As Digital India and global digitization advance, more hospitals are developing and maintaining their own EHR systems. However, because these systems are incompatible, a hospital cannot access data from other hospitals' systems. Patients who wish to see a new doctor or a doctor from another hospital find it difficult to transfer their information as a result. Because the patient does not have the data, hospitals can destroy it at any moment, and the

patient may lose vital health information. Another drawback with these systems is their lack of security. Because hospitals typically hold data on unprotected file systems, there is a risk of sensitive user data leaking. We developed the "Interoperability Personal Health Records Protocol" to address this issue. It is a global health stack identity and document management protocol. The user can save their own health records on a non-changeable file storage system and share them with other system users. The user has complete ownership over their health data on blockchain systems, which cannot be altered, and may share it with anybody, at any time. Because it is built on top of a Public Blockchain, Solana, and anybody with permission may view the health data, it eliminates the problem of not being able to work with other systems. Furthermore, the data is stored on a blockchain system that cannot be altered, ensuring that the user will never lose their data.

3.2 ABHA ID

14-digit ABHA ID would provide each participant in India's digital healthcare ecosystem with a distinct and trustworthy identification. This identification will be recognized by medical specialists across the country. With this number, you may easily join PHR (Personal Health Records) programs that share health data, such as the ABDM ABHA app. Avoid standing in large lines at medical institutions. Simple PHR Enrolment: Join PHR (Personal Health Records) programs that make it simple to share health information, such as the ABDM effort. In this project, each user will be assigned a unique Abha ID, used for authentication. ABHA provides OTP (one-time password) based verification that use the registered phones number of the users for verification.

3.3 Structure of Accounts:

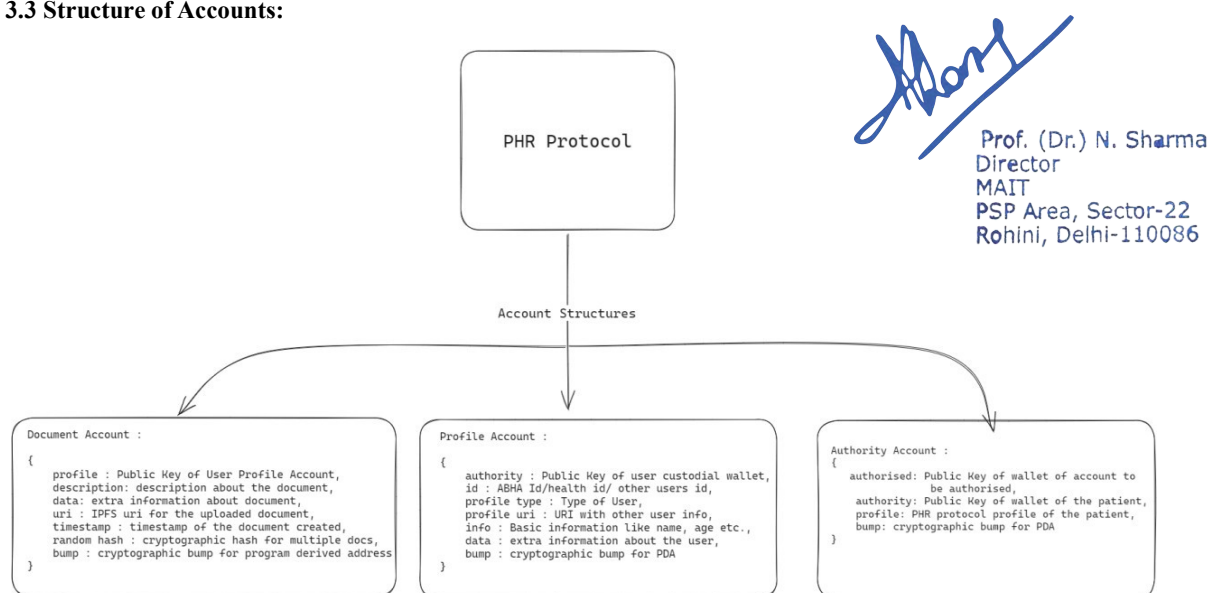


Figure 1: Various Account Structures

3.4 Information Flow:

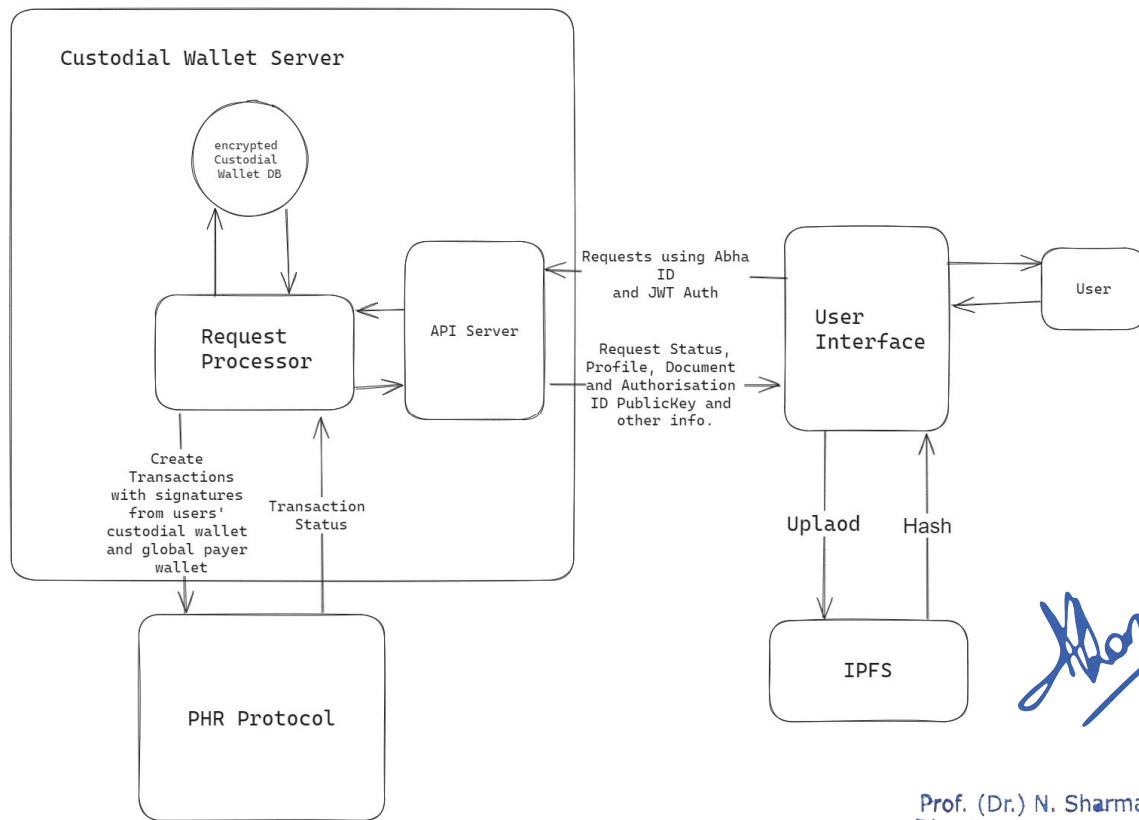


Figure 2: Data flow between components

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4. RESULTS

Since organisations are intricate systems, gathering and applying environmental data is a major issue. An organization's main duty is to come to an agreement over the gathering, handling, and distribution of data. The company's blockchain platform drives research into alternative technologies for exchanging and debating medical data, as well as proof of concept studies. Consequently, the pre- and post-processing analysis focused on three key areas: 1) information sharing, 2) effectiveness, and 3) usability, accuracy, transparency, and traceability.

A. Research Examples:

The findings of the study offer different approaches to the integration of blockchain technology with personal health record (PHR) interaction. Many challenges, including those related to isolation, security, and rivalry, plague the PHR systems of today, according to a survey of the literature. Furthermore, this research establishes the groundwork for evaluating the efficacy of blockchain technology by disclosing different applications and solutions employed to address these issues. Research on the application of blockchain in healthcare has yielded promising results, suggesting that it may be able to address PHR challenges. The impact- and shock-resistant characteristics of blockchain can enhance data security, facilitate simple information transfer, and grant patients independent access to their medical records. Agreements and information sharing may be managed with smart contracts in an effective and transparent manner.

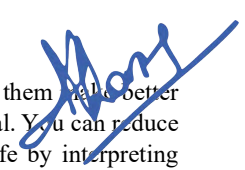
B. Studying the impact of blockchain on PHR interactions: The research into the influence of blockchain on PHR interactions has been quite fruitful. The robust security characteristics of blockchain reduce the possibility of illegal data access and usage. By offering security and transparency, blockchain addresses data integrity issues that plague

the PHR process. A thorough examination and evaluation of the influence of Blockchain on PHR interactions is possible. Blockchain enhances collaboration by offering safe and dependable data sharing. This not only enhances doctor-patient communication, but it also lowers mistakes and discrepancies in medical records. The fundamental advantage of blockchain technology is that it empowers patients. The present emphasis in healthcare on cooperation and self-management corresponds with the trend toward centralized patient data management. Even with these encouraging results, there are still obstacles to overcome. Blockchain adoption is hampered by its scalability, particularly when dealing with the massive amounts of data generated in the healthcare business. As the implementation process progresses, business integration is required to support the successful deployment of a blockchain strategy.

The primary advantage of blockchain technology is patient empowerment. The present focus in healthcare on collaboration and self-management aligns with the move towards centralised patient information management. Even with these positive results, there are still issues. Adoption of blockchain is hampered by its scalability, particularly when handling the massive volumes of data produced in the healthcare industry. Business integration is necessary as the implementation process progresses to guarantee the deployment of a blockchain strategy that works. The recommendations will be developed and communicated based on the clinical presentation of the patient. It is impossible to overlook information that is crucial to the patient's health because of this network. The whole medical history of a patient can be accessed through an EMR. As a result, statistical analysis of this data is possible. The accuracy and speed at which medical data is gathered, shared, and decisions are made can all be improved by digitization.

Patients will be made aware of the site's existence as well as any updates, integrations, or corrections, as well as its functionality, informational content, and purpose. the conditions that govern the transfer of information as well as how it is stored. Patients find it challenging to divulge their medical information. Sharing information from any location, including a pharmacy, radiology lab, or laboratory, is difficult for nurses, doctors, and other healthcare professionals. The platform for real-time patient health monitoring can forecast illnesses and enhance services. The definition of healthcare is the dissemination of clear, helpful information to the public, including high-quality data on health outcomes, efficacy, and user experience, with the goal of motivating medical professionals, nurses, patients, and others to attain better results. The foundation for processing personal data is trust. Giving patients information that is understandable, transparent, and clear is crucial. To help patients better understand English-language doctor's notes, our website provides pictures and health-related information. In addition, openness facilitates decision-making for patients and carers when selecting a treatment programme, facility, course of treatment, or alternative therapy. Also, it will strengthen the bond between patients and doctors and their trust during care.

Hospitals can improve health outcomes by using our medical information sharing strategy to help them make better decisions. Helping doctors with diagnosis, patient care, and treatment options are all part of the goal. You can reduce healthcare costs, predict and prevent infectious diseases, and enhance your general quality of life by interpreting patient data.



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5. CONCLUSIONS

This study aims to investigate the potential applications of blockchain technology in integrated health records and how patient willingness to engage with EHR systems is impacted by these applications. In this study, patients were empowered by blockchain-based information technology, which also enhanced their willingness to share information, decreased medical expenses, and lessened pain. Ideas, as well as findings and experiments, have a theoretical foundation thanks to the architecture of private accounting. The results of this article's discussion of endogeneity and bias demonstrate how biased and consistent the model is.

Everyone's right to health is vital to their daily lives. Improvements in medical technology have made it possible for people to live better, longer lives. In the areas of equipment and medicine, some noteworthy advancements have been made. Another improvement that EHRs—digital records of patients' medical records—offer is medical records management. Medical histories, treatment schedules, allergy information, and other health-related data are all included in EHR data. Encouraging the simple sharing and application of medical information is crucial. Users of today demand



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constant, up-to-date information. In order to provide better care, ePHR enables EMRs to store patient data and share it with other departments or hospitals. Electronic health records, medical software, and health management data are all being actively used by numerous healthcare organisations. Due to the fact that EHRs frequently contain medical data, they can be challenging for physicians to use. Furthermore, EMR supports every patient's medical requirement; it could be helpful to them. Our network enables end users to search for employment, select a course of treatment, and obtain healthcare information. It may also send messages promoting continuity or cooperation amongst providers. In order to facilitate EHR integration, we offer a blockchain network.

Many businesses have acquired or are acquiring the technology required to satisfy users' immediate information needs. Sadly, the course of treatment is postponed. A suggested solution for EHR integration is blockchain-based. The electronic core with one of the ineffective functions is supposed to be removed. Information technology transmission ensures the security of the system since no user can alter this list. In nursing, traditional education is hard, sluggish, occasionally demanding, and has little bearing on practise. Legacy systems' skewed health data makes it challenging to share because of inconsistent standards and conventions. To put it plainly, the current medical information system is disjointed and inadequate for the demands of modern patients. All patient data, including critical personal data like allergies, immunisations, prior hospital stays and abortions, mental health conditions, and torture, is fully available in electronic medical records (EMRs). from digital health records. Our policies are made to guarantee that medical information is accurate and private. While this method shows promise in safeguarding patient privacy, more privacy testing and protection are required. Medical records are used by many healthcare providers to monitor their systems; they frequently do not share this information with other organisations. As a result, numerous hospitals will receive the patient's medical data. According to this concept, doctors will receive assistance in completing the patient's electronic health record (EHR) from the time of initial contact. The hospital stores the patient's medical records and updates them regularly, which is a benefit of this approach for physicians. Patients should be able to examine their medical records thanks to a collaborative, adaptable, and robust approach.

Adding, removing, or changing inaccurate information in already-existing medical records could put doctors in danger of legal repercussions. Recovery evidence needs to be provided and finished on time. Failure will ensue if this isn't done. Patient medical records are published by numerous clinics, hospitals, networks, and nations. Patients' interactions with one another result in a great deal of contradictory information about the same patient being kept in various institutions. This information includes medical records and health data like blood test results. The duration of treatment is reduced, and patients do not need to see a doctor. You can get answers to a lot of significant questions over the phone. Nonetheless, by facilitating more efficient communication, blockchain has the potential to enhance the telemedicine patient experience for the benefit of medical professionals, patients, and society at large.

The design, deployment, and viability of a blockchain-based electronic health record system that establishes a private, permissioned blockchain network for the exchange and storage of medical records between practitioners are covered in this article. As a result, the issues with medical services brought about by the sharing of patient data between hospitals are eliminated by the blockchain network. The practise of tamper-proof electronic data management is supported by our findings. As a result, the strategic plan enables businesses to use blockchain technology by removing transactional interactions, simplifying processes, and improving overall effectiveness and efficiency. Support services have created a wide range of career options. One potential avenue for the future is the use of artificial intelligence to generate dynamic smart contracts that address diversity. It is obvious that applying blockchain technology to healthcare research can have several advantages, including tracking, sharing, and transparency as well as lowering patient privacy concerns. To address this issue, future work will also need to build network and incorporate into cloud architectures.

In summary, effective medical record administration guarantees correct information retrieval, continuity of care, clinical decision support, quality improvement, patient participation, and legal protection—all of which considerably improve patient care and healthcare delivery outcomes. Nonetheless, problems with process integration, data security, overloading with information, interoperability, and lack of standardisation continue to exist. Subsequent investigations may concentrate on tackling these obstacles through the creation of systems that are compatible, the augmentation of data security protocols, the optimisation of workflows, the advocacy of uniform documentation procedures, and the refinement of user interfaces. Investigating the possibilities of cutting-edge technology in healthcare record

administration, such as blockchain and artificial intelligence, may also present creative ways to get around present problems.

Enhancements in user experience, interoperability, and data standardisation may result in a smoother transfer of medical records between healthcare systems, promoting better care coordination and better patient outcomes. Furthermore, upholding patient confidence and adhering to healthcare laws requires ongoing efforts to improve data security and privacy measures. All things considered, there is hope that future advancements in medical record management research and innovation will further improve patient care and healthcare delivery.

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Telecom Industry Customer Attrition Prediction with Machine Learning Approach

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Abstract. In order to keep current customers, the organization in the telecommunications sector must focus on one of the very important research areas: customer churn identification. Customer attrition known as churn occurs when rivals discontinue selling certain products or services, or possibly when network issues arise. Customers often tend to abandon their service subscriptions in these kinds of circumstances. The churn rate significantly influences the client's lifetime value since it influences both the company's potential income and the length of service. The corporations are searching for a model that can forecast client attrition as the revenues are directly impacted. Machine learning techniques are used in the proposed model. For a more sustainable business environment, companies need to understand and effectively manage customer attrition. Reducing network issues, resource allocation optimization and waste reduction can improve customer satisfaction and thus decreasing churn rates. Optimizing service provisioning and resource allocation helps in promoting sustainable decision making and enhances revenue generation by development of predictive models utilizing machine learning concepts and methods for artificial intelligence. It empowers organization to build long lasting customer relationships and minimizing environmental impact of their operations.

Keywords: Customer Churn, Telecom, Predictive Analysis, Optimization, Client Retention



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1 Introduction

In industrialized nations, the telecommunications industry has emerged as one of the most important economic sectors. These service industries struggle, particularly as a result of client loss to competitors or consumer attrition. Scientific development and a surge in operators led to more opposition [1]. Businesses are putting in a lot of effort and depending on complex strategies to survive in this cutthroat market. The attrition of customers has a profound impact on the Indian telecom service providers for several reasons. There is an intense competition among service providers creating a highly competitive environment where customers have a plethora of options to choose from. Price sensitivity among Indian consumers is a major factor, with even slight differences in pricing leading service porting by clients in search of better terms. The introduction of Mobile Number Portability (MNP) provides an instant opportunity to change service providers while keeping the same phone numbers, making it easier for them to consider the switch. Additionally, the lack of significant differentiation between telecom operators in terms of core services like calling and data further contributes to customer churn, as customers may perceive little added value beyond price. Some telecom companies prioritize acquiring new customers over retaining existing ones, leading to a cycle of churn as efforts are focused more on attracting new subscribers rather than ensuring customer satisfaction and loyalty. This approach can result in a constant need to replace departing customers with new ones. Furthermore, evolving customer needs and expectations, driven by the emergence of data-driven services and Over-The-Top (OTT) platforms like WhatsApp and Netflix, require telecom operators to adapt their offerings to meet changing demands. Failure to keep pace with these evolving trends can lead to a loss of customers seeking more flexible and feature-rich services from alternative providers.

Customer turn over becomes a big problem and causes a considerable loss of telecom services to survive in this market [2]. Customer turn over becomes an immense problem leading to a considerable loss of telecom services. Three key techniques have been implemented to increase profitability: add untapped customers, retain the present clients, and eliminate churn. During the investigation by comparing the respective impact of these factors on the Return on Investment (RoI) values, the experiments have shown that the last method yields maximum benefits[3][4]. The remainder of this paper is organized as follows: Section 2 describes the literature survey, Section 3 explains methodology, results are discussed in Section 4 and Conclusion in Section 5.

2 Literature Survey

Several studies have shown that the Customer attrition as seen in the Indian telecom industry results from various factors as highlighted by researchers. These factors include:

1. Intense Competition and Price Wars: The telecom sector in India is a highly competitive market, leading to reflective pricing models and innovation in the strategies for marketing, which can prompt customers to switch providers.[14]
2. Shift in Customer Usage Patterns: It has been observed that a simple pattern showing a significant change in service usage happens before churn occurs, a term popularly known as revenue churn, which in turn potentially leads to customer attrition from the service provider..
3. Service Quality and Offers: Better subscription offers, service quality, and customer experience play a significant role in customer churn. Factors like digital experience, service delivery, consumer interaction, monetary benefits, and product promotions are crucial in influencing churn rates.[15]
4. Tariff Plan Changes and Product Offerings: Changes in tariff plans, product offerings, and service types can also impact customer churn. For instance, dissatisfaction with services or better offers from competitors can lead to churn.
5. Customer Expectations and Loyalty: Customers today are more demanding and comparison shoppers, expecting better services at competitive prices. This increased demand reduces customer loyalty and makes them more likely to switch providers.

Numerous techniques, like as machine learning, data mining, and hybrid technologies, have been employed to predict client attrition. Mentioned methods help businesses recognise, foresee, and hold on to churning clients. The methods can also be helpful for the customer relationship management, and strategic decision making for the industry. A majority of these methods made use of machine learning decision tree algorithms, which are a recognized method for figuring out customer turnover but not ideal with difficult situations [5]. However, the study demonstrates that a reduction in data quantity increases model accuracy. Some other techniques like data mining are also employed for consumer forecasting and historical research. In addition to other frequent prediction techniques like neural networks, rule-based learning, and decision trees, regression tree techniques were discussed [6].

In this paper, we employ several techniques, including Random Forest, and Logistic Regression augmented with XGBoost, to obtain precise values and forecast customer attrition [7][8]. Here, we model using a dataset that has undergone training and testing, giving the highest number of accurate results. The suggested model for churn prediction is depicted and its phases are described in Fig. 1. Data preparation is done in the first phase when we filter data and transform F it into a comparable shape before choosing features [9].

In the following stage, methods including Random Forest, XGBoost, and Logistic Regression (LR) are used for forecasting and categorizing data. With domain specific collected data, we apply training and test the model while observing and analyzing client behavior. Customer attrition prediction is performed using machine learning in several other recent works as well [10][11][12][13].

3 Methodology

3.1 Dataset



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The data set serves as the foundation for everything and must have sufficient data to enable machine learning of the issue. Datasets can be constructed or created from discarded data that is accessible online. Building a dataset that makes sense and offers direction on how to react depending on real-time inputs for the issue is one of the issues we face.

Some datasets suitable for telecom churn prediction in India and other regions include:

1. Telecom Churn Prediction Dataset on GitHub: This dataset offers a vanilla classification model for Telecom Churn predictions Asian Market including India [16]
2. Telecom Customer Churn Dataset on Kaggle: For analysis of customer-level data made available by a telecom leader to build predictive models identifying customers at high risk of attrition [17]
3. Telecom Churn Indian and South East Asian Market Dataset on Kaggle: Similar to the previous dataset, this project involves analyzing customer-level data to predict high-risk churn customers in the Indian and South East Asian markets [18]

The features included in telecom churn prediction datasets typically encompass a range of factors that influence customer behavior and the likelihood of churn. Some common features found in these datasets are:

- Information about customers' demographics such as age, gender, location, and income level.
- Service Usage Details: Data related to how customers use telecom services, including call duration, data usage, messaging patterns, and service subscriptions.
- Payment History: Details about customers' payment behavior, billing history, payment methods, and transaction records.
- Social Network Analysis (SNA): Utilizing customer social network data to understand relationships and influences that may impact churn prediction.
- Customer Interaction: Records of customer interactions with the telecom company, including complaints, inquiries, and feedback.
- Tariff Plan Information: Details about the tariff plans subscribed to by customers and any changes in pricing or offerings.

- Customer Satisfaction Metrics: Feedback scores, surveys, or sentiment analysis results reflecting customer satisfaction levels.
- Network Coverage: Information on network coverage quality and availability in different regions.

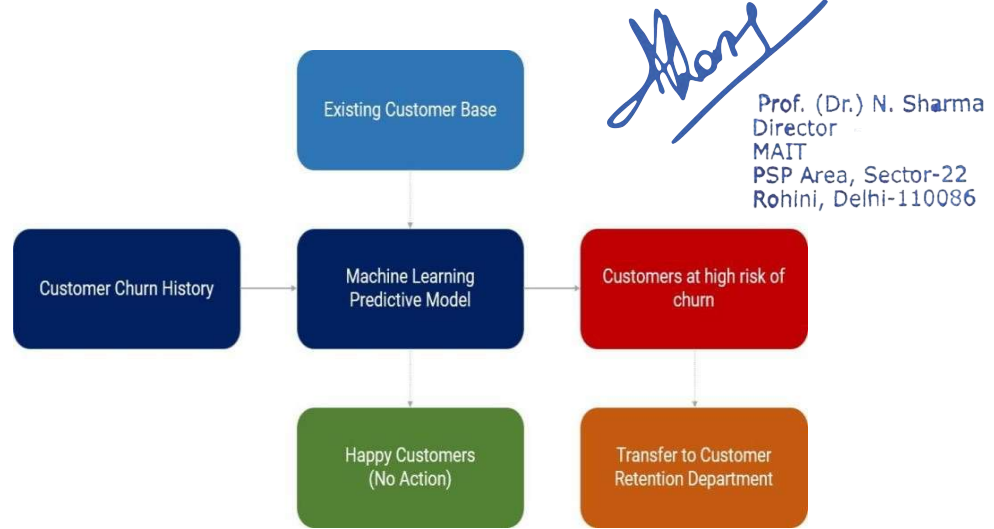


Fig. 1. Proposed Flow Diagram for customers attrition prediction

3.2 Data Preprocessing

A data set has N rows and contains a collection of features. Different forms exist for many values. In a dataset, there could be redundant or null values that cause some loss in accuracy and dependencies.

A single variable, such as gender, is noted using a variety of formats since the data were gathered from several sources. For example, M/F or Male/Female is used to indicate gender. A three-dimensional image should be converted to a two-dimensional format in order to prevent data that is noisy, has null values, and incorrect sizes as data shown since the machine can only interpret numbers 0 and 1. Panda's tabular data and OpenCV for pictures are both capable of doing data cleaning, data filtering and noise removal.

3.3 Feature Selection

Feature selection process of machine learning helps to select the relevant components from the collected data based on domain knowledge. The study employed a dataset with numerous characteristics, from which we identified those deemed most crucial for enhancing performance assessment and facilitating decision-making. Classification performance increases if the set of data only contains useful and highly predictable variables. As a result, classification performance is improved when the irrelevant characteristics number is kept to a minimum and only important features are used.

3.4 Algorithms used

A. Random Forest

We use Random Forest to forecast if a user is likely to unsubscribe his membership. Random Forest algorithms use decision trees to forecast if a customer would terminate their subscription. Each random forest decision comprises several separate decision trees of varying depths. A decision tree pinpoints a certain group. The classifier used for a certain customer will be the one with maximum votes. Decision trees' behaviour may vary depending on the dataset they are being trained on. For this reason, bagging is used. One method is to train the decision trees using a random sample from the dataset. The user selects the k nearest neighbours, indicated by the letter K in the classifier's name, and they represent.

B. naive_bayes.MultinomialNB

The simplest yet effective naive Bayes classifier works excellently in multinomial models. During the classification of data with discrete features, including data based on word counts towards text classification, the multinomial Naive Bayes classifier is expected to work well. Integer feature counts are typically utilized for multinomial distribution but some other features including fractional counts like tf-idf have also been found to be effective. Accordingly, using the multinomial Naive Bayes classifier makes sense.

C. SGDClassifier

For logistic regression and other such classifiers which are linear in nature, a model based on SGD training is also used. Essentially, the estimator in this technique uses regularised models based on stochastic gradient descent (SGD) learning, upgrading the model with a schedule of diminishing strength as we progress (termed **learning rate**). This strategy following a partial fit in SGD method allows the learning of online or out-of-core mini batch. It is essential to note that the default learning rate schedule can be applied to data having characteristics of zero unit variance and mean.

D. KNeighborsClassifier

This classifier uses, as the name implies, learning based on the k nearest neighbours. The appropriate value of k is determined by the data. The study demonstrates that decreasing the data enhances the decision tree's accuracy. Consumer prediction and historical analysis are two uses for data mining techniques. Alongside various famous data mining approaches such as decision trees, rule-based learning, and neural networks, regression tree techniques were discussed.

4 Results

To improve the accuracy further data balancing was performed because the data was imbalanced. Now label encoding and one hot encoding is used and in addition, SMOTE algorithm is used for managing the imbalance. Many firms, especially the telecom service providers, will benefit from the relevance of this study for attrition prediction in obtaining robust revenue and profitable earnings. Due to the difficulty in estimating customer churn in the telecom sector, companies aim on prioritizing on maintaining their existing clients above attracting the new ones.

Various performance measures like Accuracy, Recall, F1-score and Precision have been calculated and shown in Table 1.

Table 1. Various performance measures evaluated.

Classifier	Accuracy	Recall	F1-Score	Precision
Random Forest	0.80	0.97	0.87	0.80
Naïve_Bayes	0.89	0.91	0.90	0.89
SGD Classifier	0.76	0.80	0.80	0.85
K-Neighbors	0.83	0.86	0.90	0.85
Voting Classifier	0.90	0.90	0.91	0.92
SMOTE	0.97	0.95	0.96	0.96



Key Observations:

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1. Accuracy: SMOTE achieves the highest accuracy (0.97), indicating it correctly predicts churn in 97% of the cases. The next best model, Voting Classifier, has an accuracy of 0.90.
2. Recall: While both SMOTE and Random Forest have the highest recall (0.97), signifying they identify most churning customers accurately, it's a tie.
3. F1-Score: SMOTE has the best F1-Score (0.96), which balances precision and recall, demonstrating its effectiveness in churn prediction.
4. Precision: SMOTE has the highest precision (0.96), meaning most of the customers it identifies as churning actually churn.

SMOTE stands out as the most effective technique for telecom service attrition prediction in this scenario. It achieves superior performance in accuracy, F1-Score, and precision. While Random Forest ties with SMOTE in recall, SMOTE's well-rounded performance across all metrics makes it the preferable choice.

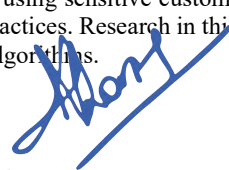
5 Conclusion and Future Work

The applicability and variety of three tree-based algorithms in this kind of application led to their selection. We will get more accuracy by combining Logistic regression with Random Forest. By using the SMOTE Algorithm we get good results. And accuracy is above 90 per cent. The selection of three tree-based algorithms was on the basis of their suitability and variety for this kind of application. We will obtain greater accuracy by utilizing Logistic Regression and Random Forest. Using the SMOTE algorithm, we achieve decent performance.

Massive amounts of data are produced in today's environment, and businesses rely on this data to advance. To be useful to companies, massive amounts of unstructured data stored in the cloud need to be prepared and analyzed. In the last ten years, data-driven technology has transformed both our personal lives and our professional lives. Drilling the data is a goal of data science in order to find hidden possibilities and provide value. At all levels of business, it has played a crucial role.

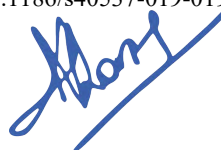
Potential research avenues in the area of customer attrition prediction, beyond the present study, could include:

- Causal Analysis of Churn Factors: Conducting in-depth studies to understand the causal relationships between various factors and customer churn. This research can help uncover the root causes of churn and guide targeted interventions.
- Segmentation Analysis: Exploring different customer segments based on behavior, preferences, and churn patterns to create more effective targeted retention strategies. It will also help to realize the individual needs of varied customer groups leading to tailored retention approaches.
- Longitudinal Studies: Undertaking longitudinal studies to track customer behavior over time and identify patterns that precede churn. This research can provide critical information into the ever changing dynamics of customer relationships with telecom service providers.
- Qualitative Research: Incorporating qualitative research methods like interviews, focus groups, or surveys to delve deeper into customers' perceptions, emotions, and experiences related to churn. Qualitative insights can complement quantitative data for a comprehensive understanding.
- Predictive Analytics Enhancements: Advancing predictive analytics techniques by integrating real-time data analysis for immediate action on potential churn signals. Research focusing on enhancing the accuracy and timeliness of churn predictions can lead to more proactive retention strategies.
- Ethical Implications and Fairness: Investigating the ethical implications of using sensitive customer data in churn prediction models to ensure fairness, transparency, and responsible practices. Research in this area can address concerns related to biases and discrimination in machine learning algorithms.


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Air Quality Index Prediction using Machine Learning Techniques

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Abstract. *Without air, humanity could not possibly survive. Air quality is negatively affected by continuous changes in almost every area of modern human civilization, posing a threat to sustainable development. By integrating sustainable practices into air quality monitoring and forecasting, we can aim to minimize the generation of risky contaminants and reduce the total environmental footprint of transportation, business, and home approaches. In comparison to standard techniques, machine learning based totally prediction technology studying techniques have been shown to be the best equipment for studying such contemporary risks. To analyze and expect air satisfaction, the prevailing take a look at appears at six years' really worth of air pollution facts from 23 Indian towns. The dataset has undergone thorough preprocessing, and correlation analysis was used to identify essential properties.*

An exploratory data analysis is conducted to determine the pollutants that might have a direct influence on the air quality index as well as to find patterns that are hidden in the dataset. Almost all contaminants have significantly decreased in the epidemic year of 2020. Four models of machine learning are employed to evaluate air quality while resampling is utilized to address the problem of data imbalance. The outputs of models are contrasted with established standard. The Support Vector Machine model is the least accurate. The most accurate model is the Gaussian Naive Bayes one. The known performance metrics is used to evaluate and compare these model's performances. The winning one was the XGBoost one, which also exhibited the highest degree of linearity between predicted and the data that was observed.

Keywords: Air Quality Index, Support Vector Machine, Random Forest, Machine Learning, Deep Learning.

1 INTRODUCTION

Air is the only thing that keeps humans alive. For our well-being, its quality needs to be monitored and comprehended. Millions of individuals worldwide have physiological problems and respiratory mortality as a result of air pollution. Scientific research indicates that the single biggest threat to the environment is the pollution of air. As a result of fast industrialization and the harmful emissions of gas it produces, population levels have significantly expanded. The quality of the air is seriously harming our health. Environmental and Public Health in Hindawi being contaminated by hazardous substances. The air quality has significantly decreased as a result of this unmanaged pollution.

A numerical index called the AQI is used to quantify and communicate air pollution levels. The AQI value that is high denotes extremely polluted air, which has a gravely detrimental effect on health. The AQI can be used to monitor the quality of air in real time. In our area, many weather stations have also recorded AQI data daily and hourly. To use this data in the proposed study, they will be mined and harvested.

2 LITERATURE SURVEY

The authors forecasted air quality using machine learning using Google Street View data at numerous places in California. He concentrated on the regions that had the missing data. For each neighborhood in a city, a web application to predict air quality was developed by the author [1].

The author attempted to use the Support Vector Regression (SVR) machine learning technique to predict the amounts of air pollutants and particles in California. The authors created a novel method for simulating hourly air pollution [2]. Few authors evaluated how effectively six ML classifiers predicted AQI of Taiwan using data spanning the previous 11 years [3].



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In [4], the authors examined twenty distinct literary works which was based on the contaminants they researched, the machine learning methods were employed, and calculated their performances. Several studies employed meteorological data, including temperature, humidity, and wind speed, as found by the author to accurately predict pollution levels. They found that compared to other well-known ML techniques, boosting models and neural network (NN) strategies performed better. The authors found that the air pollutants concentration was considerably influenced by temperature, humidity, direction of wind, and speed of wind [5]. The RF approach exhibited the fewest classification errors, according to the supervised machine learning methods the authors used to estimate AQI.

Bhalgat predicted the air's SO₂ content in Maharashtra, India, by applying machine learning. The authors concluded that due to their excessive pollution, this Indian region has some cities that need immediate medical attention [6].

The authors presented a very fascinating study in 2018 on their survey of the international research on pollution of air and respiratory health that has been peer review [7]. From the Scopus database, the authors took 3635 records from publications between 1990 and 2017. They noticed that the number of articles significantly increased between 2007 and 2017. After observing active nations, organisations, journals, writers, and international partnerships in the field, the authors stated that there is a great deal of interest in the relationship between respiratory health and air pollution research. They recommended gathering public opinion on investments in green technologies and the reduction of outdoor air pollution. The issue of AQI prediction was referred to be multi-task learning challenge by the authors [8] [9].

In [10], they sought to develop a model that linked air pollution and traffic density. The author claims that gathering this kind of traffic data may be done on a budget and that adding climatic information would increase the data's accuracy. The hybrid model outperformed all others, and according to the authors, morning time data has the highest accuracy [11].

3 METHODOLOGY

3.1 Data Preprocessing

The first and most crucial condition for the development of effective ML models is data quality. Preprocessing methods contribute to the reduction of data noise, which eventually accelerates processing and expands the use of ML algorithms. Data extraction and monitoring applications have two of the most common errors which are outliers and missing data. The data preparation step involves modifying or deleting outlier data, filling out data that is not a number (NAN), and performing other operations on data.

Many statistics may be missing for a variety of reasons, such as a station that has the capability to view data but not the means to record it. The proposed flowchart of the model is shown in Fig. 1.

At the first stage, Air Pollution dataset is taken and fed into the preprocessing stage followed by normalization of data through feature selection. Then the data is explored and divided into training and testing sets. Then we apply the Machine learning algorithm on the training dataset to train the model. After the training phase, the test data set is fed into the model for validation. As a final result, the AQI of the test data set is predicted by the designed model on which further evaluation is done and comparative analysis has been carried out with the state-of-the-art methods.



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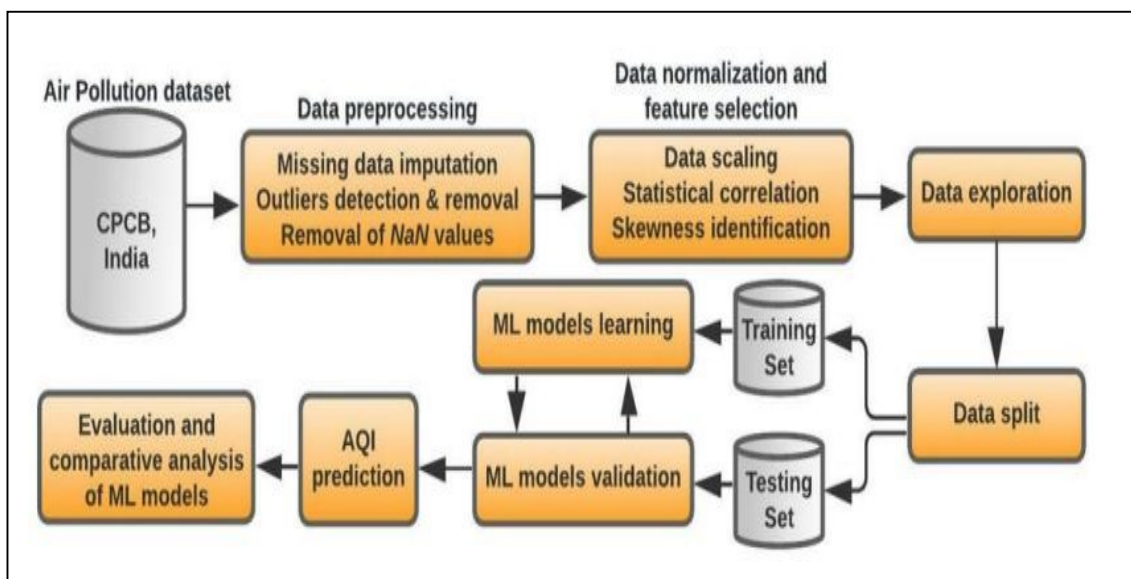


Fig. 1 Proposed model flowchart

3.2 Feature Selection

Government organizations utilize the specific metric, AQI, in the CPCB dataset under investigation to enlighten the public about the quality of air and to train forecasters. The National Ambient Air Quality Standards classify AQI into six categories: acceptable (0-50), tolerable (51-100), moderate (101-200), poor (201-300), extremely poor (301-400), and severe (401-500). Lowering the number of input variables, according to experts in the area leads to lowering of the computing cost of modeling and boosts prediction accuracy. In the current work, the quantity of contaminants (input variable) required to build a predictive model has been determined using a correlation-based feature selection technique.

Each set of both the target and input variables exhibits a correlation when features are chosen using algorithms based on statistical correlations. The variables are further investigated if they strongly correlate with the target variables. Since many machine learning algorithms are prone to outliers, it is imperative to identify any characteristic in the input dataset that deviates from the overall trend of the data. The outliers in the current dataset were discovered using a correlation-based statistical outliers identification method. A correlation investigation between the AQI characteristic and features of other contaminants was used to identify significant aspects.

3.3 Exploratory Data Analysis

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In order to know about the numerous patterns that are hidden within the dataset, this section of study focuses on data analysis and exploration. Exploratory data analysis is the initial step in the field of data analytics, which is implemented prior the utilization of any ML models. The concerned significant issues are being examined as a result: (a) assessing the current state of air pollution and its trends over the previous six

years, or from 2015 to 2020; (b) analyzing the top six most polluted municipalities and their average AQI parameters, as well as the distribution of pollutants in the air; and (c) determining the top four contaminants that are particularly contributing to the rise in AQI numbers.

Pollutants involved directly in increasing AQI values

The AQI and numerous pollutants have been correlated, and pollutants that have correlation coefficient values more than the threshold value of 0.5, indicating a highly positive link, have been discovered.

4 RESULTS

The plan of the experiment and the empirical evaluation used to anticipate AQI values based on airborne pollutants are covered in this section. Before ML models are assessed, the dataset is split into two sections: screening (25%) and training (75%). On the cloud platform known as Google Collab Pro, Python programs have been executed.

The dataset is then investigated to determine the value of the AQI concerning those contaminants that significantly contribute to increasing the AQI value. Table 1 shows comparison of model results.

Table 1 Comparison of model results

Model	Accuracy	Precision	Recall	F1-score	Prediction time (in seconds)
KNN	85	92	85	94	0.018
GNB	83	88	89	92	0.016
SVM	78	91	90	83	0.027
RF	86	92	91	90	0.023
XGBoost	90	96	95	91	0.041

An AQI timeline graph is displayed over a few particular contaminants that are directly responsible for elevated AQI readings. Winter pollution is more severe due to seasonal fluctuations in PM2.5 and PM10 pollution levels than summer pollution levels. While the level of O3 remained constant from 2018 to 2020, the level of SO2 started to increase after 2018. Levels of BTX2 exhibit a similar tendency as well. Almost all pollutants, except CO, have seasonal fluctuations. Observe how India's pollution levels decline from June to August. It can be a result of the Indian subcontinent experiencing its first monsoon at this time.

Between March and April, BTX levels significantly decreased; from May to September, they somewhat increased; and from October to December, they significantly increased. Given that 2020's median findings are lower as compared to those for previous years, it's possible that the year's pollution level was significantly lower. Human and industrial activities were forbidden.



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5 CONCLUSION

It can be challenging to anticipate air quality because of the changing environment, unpredictability, and range of contaminants present at different times and places. The AQI forecast in India, however, received little consideration from scientists. The train and test subsets of the dataset are divided by a 75-25% ratio, respectively. It contrasts the usage of the SMOTE resampling technique with ML-based AQI prediction. The outcomes of ML models are shown with respect to common measures such as precision, accuracy, recall, and F1-Score for both the train and test groups. In contrast to SVM model, which had the least accuracy, the model using XGBoost had the highest accuracy for both train and test sets.

The XGBoost model performs best overall because it produces the best outcomes during both the training and testing periods. The RF model exercised using SMOTE performed rather well for the training phase. However, throughout the testing phase, nearly all ML models demonstrated improvements.

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A handwritten signature in blue ink, appearing to read 'N. Sharma', with a long horizontal stroke extending to the right.

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Prediction of Defects with changes in Software

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Abstract: Software defect prediction proactively highlights critically vulnerable elements for a software system. Recent attempts in this domain have tried various machine learning techniques to automate and improve software defect prediction. It has been observed that recent research focusses on specific types of software and hence the solution is not suitable for all kind of software products. This paper proposes a generic approach based on Logistic Regression, Decision Trees, Random Forests, Naïve Bayes, Support Vector Machine for software defect prediction. Proposed approach is applicable on all type of software products and the results shows defect occurrence are not directly correlated with the quantity of modifications.

Keywords: Defect Prediction, Machine Learning Techniques, Software defect prediction Metrics, Ensemble Technique, Attribute correlation



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I. INTRODUCTION

The need for producing affordable, maintainable software without sacrificing quality has increased due to the software systems' growing dependence. The likelihood of the software having a flaw is therefore very high. If errors are identified later in the software development process, the associated costs for their prompt resolution significantly increases. Software prediction models can be applied to initial phases of the software development life cycles. Additionally, utilizing them cuts down on project costs, time, and effort spent on testing and maintenance, which boosts the software's quality. We can work to strengthen the software's weaker components by identifying the defective portions of those components. Thus, it is possible to create high-quality software with inexpensive development and maintenance costs.

Researchers have developed models that can predict these issues precisely and rapidly. These methods include the use of cutting-edge techniques like machine learning and data analysis. One of the efficient methods in this area may be ensemble techniques. They function by merging the results of various models, which increases their accuracy and dependability. It's similar to consulting with several experts before making a decision. This study focuses on investigating how ensemble techniques might be applied to improve software defect prediction. By doing this, we intend to raise the standard of software, lessen the effort required to address problems, and enhance the functionality of software systems as a whole.

This research paper's major goal is to examine how ensemble techniques can be used to forecast software flaws and to comprehend the advantages they have over more conventional single-model methods. We studied their attributes individually. The following are the objectives of the study:

1. Review and analyze the available investigation on ensemble strategies for predicting software defects, including their methodologies, algorithms, and performance measures.
2. To increase the precision and dependability of predictions, propose and create a defect prediction framework that integrates various base models, such as decision trees, support vector machines, or neural networks.
3. Run thorough tests and assessments on standard datasets to compare ensemble techniques' performance to that of individual models and other cutting-edge fault prediction techniques.
4. Highlight the strengths, weaknesses, and practical consequences of employing ensemble approaches for software defect prediction as you analyze and interpret the data.
5. After analyzing the weaknesses and the faults that were found while ensemble technique, we can now correct them by studying the correlation between the attributes and how they are dependable on each other.

The outcomes will aid the awaited testers in identifying the most effective evolutionary algorithm. We examined and inspected the outcomes of five data vaults using six different machine learning models. We further correlated the attributes individually and saw their dependencies and how they affect the defect in the software.

The information in the paper is arranged as follows: Section 2 of the linked effort contains investigations and related literatures. The proposed algorithm that will be used is described in Section 3 along with the calculated experimental findings. In Section 4, the findings were calculated, analyzed and drawn. The summary of the work done in the study is presented in Section 5. In section 6 we discussed the future scope of the research.

II. LITERATURE REVIEW

Software metrics are essential for managing projects, especially when dealing with new technologies like object-oriented design. There are some studies that introduce a set of metrics tailored for object-oriented systems [6][7], grounded in measurement theory and informed by experienced developers. The suggested metrics undergo a formal evaluation based on predefined criteria.

As object-oriented methods gain popularity in software development, researchers are working on metrics to develop new models and improve the old practices. An analysis of metrics by Chidamber and Kemerer [7] shows their usefulness for managers in industries. Empirical data supports these metrics, underscoring their significant impact on the ingenuity, modify effort, and creation effort in object-oriented systems.

The coupling dependency metric (CDM) [5] proves successful in design quality. When applied to case studies involving COBOL, C, C++, and Java systems, CDM outperforms other metrics in anticipating runtime failures and gauging maintenance requirements. This suggests that coupling metrics, like CDM, can reliably predict interaction levels in software products.

AUC, Accuracy, Precision, Recall and Mean are just a few of the different metrics that have been employed in numerous studies to predict the presence of faulty classes in software systems. These performance measures evaluate the connection between object-oriented metrics and flawed classes using statistical methods and classification algorithms. Observers have employed various methods, including Logistic Regression (LR), Naïve Bayes, Random Forest, Decision Trees, Artificial Neural Networks (ANN), Support Vector Machines (SVM), Bayesian approaches, and Artificial Immune Recognition System [(1)-(3)], to develop predictive models and evaluate their efficacy.

In study [3], the object-oriented metrics is employed in the Mozilla dataset in conjunction with LR gave good results in predicting defective classes. In other study, Linear Regression was compared with three machine learning methods (Naive Bayes, and Random Forest) to categorize object-oriented metrics based on the severity of defects. The investigation showed that models created for high severity levels had reduced prediction accuracy, and ML approach performance metrics were generally low.



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Other research [2] evaluated defect prediction models using various datasets, including NASA KC1 and Java Telecom, employing logistic regression, decision trees, ANN, SVM, and Multi Objective PSO approaches. The results highlighted the potential of neural networks and Bayesian methods by demonstrating improved performance with various models and strategies. Additionally, it was shown that decision trees (C4.5) produced greater accuracy when decision tree approaches were used together with neural networks, logistic regression, and SVM.

Another research [1] assessed datasets utilizing machine learning algorithms and 10-fold cross-validation methods. These studies demonstrate the efficacy of various methods and models in this field and jointly advance understanding of software fault prediction.

Software metrics, crucial for project management, are being developed for object-oriented systems, evaluated against established criteria. Object-oriented methods are gaining popularity, with metrics by Chidamber and Kemerer proving useful for managers and impacting productivity in empirical studies. The Coupling Dependency Metric (CDM) successfully predicts run-time failures in diverse systems, indicating its reliability in assessing interaction levels.

III. METHOD



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3.1 Research Question for Data

RQ1: What are the machine learning model does SDP uses?

Despite the fact that there are numerous machine learning algorithms, five are chosen for this paper: SVM, NB, DT, LR, and RF.

RQ2: What data sources are employed for SDP?

We employed five different Android software application packages in this paper: Telephony, Gallery, Email, Contacts, and Bluetooth.

RQ3: What performance metrics are utilized in SDP?

In this research, we employ diverse object-oriented measures, encompassing Tang et al. measurements, Chidamber & Kemerer indicators, Henderson Sellers indicators, Martin's indicators, and the QMOOD indicator suite. Subsequently, these measures are utilized as features, and we undertake a reduction process for optimization purposes.

RQ4: How can the effectiveness of evolutionary approaches be evaluated using machine learning models?

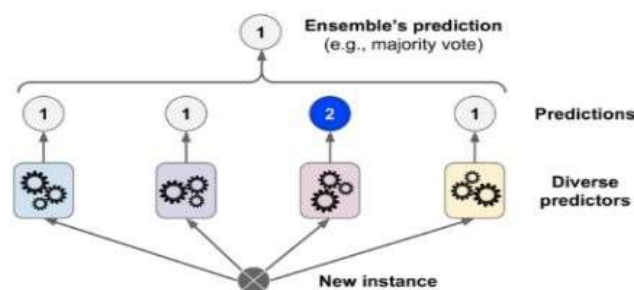


Fig.1: Working of Ensemble technique

Using the Ensemble approach, we validated the results in this work (As shown in Fig1 above).

RQ5: Are there any additional models or techniques used to find the software defect?

Yes, there is one more technique that is by using the dependencies of different attributes from the dataset to visualize how they affect the change in the software and hence create a defect.

3.2.1 Defect prediction (Algorithms)

The actions taken to apply the algorithm to the dataset for Android are as follows:

1. Collect data sets from Android software archives.
2. Calculate all classification techniques' precision, Recall, Accuracy, and F-1 scores using all available features.
3. The scores for Precision, Recall, F-1, and Accuracy obtained from various classification techniques are included in TABLE I, TABLE II, TABLE III, and TABLE IV, along with a comparison between them and the evolutionary algorithm Ensemble Technique. The data from TABLE I and II are represented by the precision graph in Fig. 1.
4. Repetition of step 3 is required for the remaining Android datasets.
5. Obtain the ensemble technique's precision, accuracy, F-1 score, and recall values.
6. Compare all the values using graphs and get the best fit model.

3.2.1 Defect prediction (Correlation between different attributes) (The method is explained in Fig.2 given below)

The description of the method shown in Fig.2 is explained as follows:

1. To propose a general method, we perform various visualizing techniques amongst the various attributes which does not depend on the type of software.
2. We take in consideration the following attributes:
 - i. Number defects
 - ii. Number of changes
 - iii. Number of Insertions
 - iv. Number of Deletions
 - v. Defect count
3. Now investigating the influence of the number of changes on the defect count to find the correlation between them and hence predicting the output on this basis.
4. Further investigating the attributes which might have influenced the number of changes to decrease and increase in the software.



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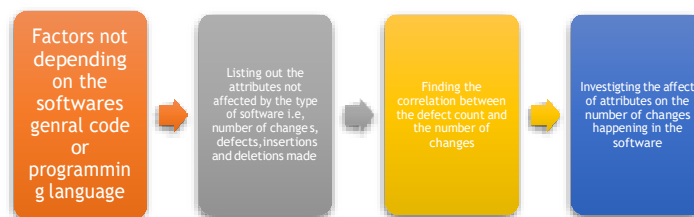


Fig.2: Working for the technique selecting special features to find the reasons for the defect in the software

IV. COMPARE THE RESULTS

4.1.1 Defect Prediction using ensemble technique

We used the ensemble technique to validate the findings.

Experimental Findings:

Precision is calculated as the effectiveness of all datasets for classification procedures in TABLE I. The determined Recall value for each type of dataset is shown in TABLE II. The F-1 scores for each dataset are calculated in TABLE III using various approaches. Accuracy is determined for each dataset in TABLE IV.

Figure 1 displays a graph generated from TABLE I for each of the created models. The table's investigation led us to the following conclusions:

- I. In comparison to standalone classification models, RF, DT, SVM, and NB yielded the most significant outcomes. The utilization of ensemble techniques is found to enhance precision.
- II. It also demonstrates that the model can produce the best results when employing the voting classifier Ensemble.

Graphs for each model are taken from TABLE II shown in Fig. 2. Following a review of the table, we draw the following conclusions:

- I. When compared to classification models alone, recall performed best for DT, RF, and NB. It is concluded that precision can be increased by employing the ensemble technique.

Here is the plot for each model using TABLE III shown in Fig. 3. Following a review of the table, we draw the following conclusions:

- I. Compared to conventional classification models, the F-1 score produced the greatest results for DT, RF, and LR. It is concluded that precision can be increased by employing the ensemble technique.

A graph plotted using TABLE IV for all created models is shown in Fig. 4. Following a review of the table, we draw the following conclusions:

- I. When compared to traditional classification models, accuracy produced the greatest results with DT, RF, and NB. It is concluded that precision can be increased by employing the ensemble technique.

TABLE I: Precision of Datasets using Ensemble Techniques and Classification

	LR	DF	RF	SVM	NB	ENSEMBLE
Bluetooth	0.5	1	0.8333	0	1	0.833333333
Contacts	1	1	1	1	1	1
Email	0.9375	1	1	0.3125	1	1
Gallery	0.8438	1	1	0.1563	1	1
Telephony	0.9574	1	1	1	1	1

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TABLE II: Recall Value of Datasets using Classification and Ensemble Techniques

	LR	DF	RF	SVM	NB	ENSEMBLE
Bluetooth	1	1	1	0	1	1
Contacts	1	1	1	1	1	1
Email	1	1	1	1	0.711111	1
Gallery	1	1	1	1	0.842111	1
Telephony	0.9	1	1	0.6912	0.94	0.979166667

TABLE III: F-1 scores of Datasets using Classification and Ensemble Techniques

	LR	DF	RF	SVM	NB	ENSEMBLE
Bluetooth	0.66667	1	0.909090909	0	1	0.909090909
Contacts	1	1	1	0.711111111	1	1
Email	0.96774	1	1	0.476190476	0.83117	1
Gallery	0.91525	1	1	0.27027027	0.91429	1
Telephony	0.92784	1	1	0.817391304	0.96907	0.989473684

TABLE IV: Accuracy of Datasets using Classification and Ensemble Techniques

	LR	DF	RF	SVM	NB	ENSEMBLE
Bluetooth	0.8636	1	0.954545455	0.727272727	1	0.954545455
Contacts	1	1	1	0.793650794	1	1
Email	0.9859	1	1	0.845070423	0.9085	1
Gallery	0.9558	1	1	0.761061947	0.9469	1
Telephony	0.9744	1	1	0.876923077	0.9846	1

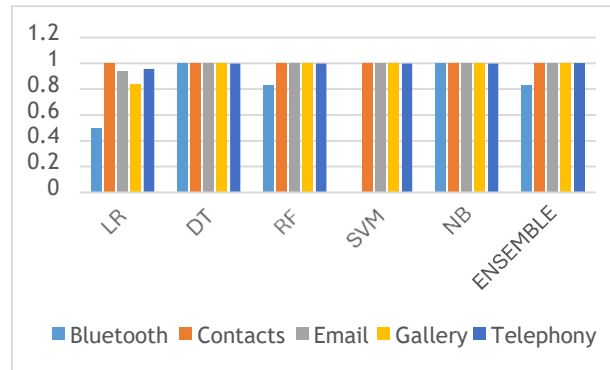


Fig. 3. Graph for computed Precision as performance measures

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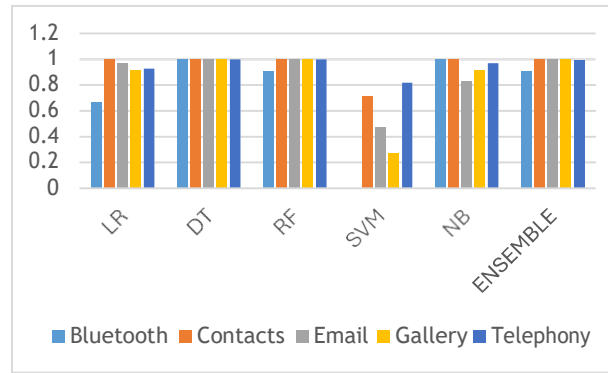


Fig. 4. Graph for computed Recall as performance measures



Fig. 5. Graph for calculated F-1 score as performance measures

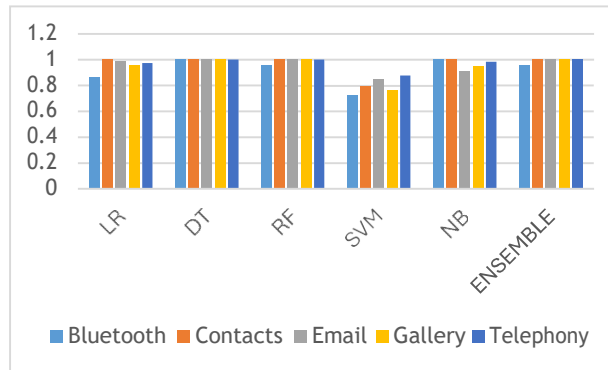


Fig. 6. Graph for calculated Accuracy as performance measures

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Following is a summary of the conclusions reached from the above findings:

- I. Precision was estimated and analyzed using various machine learning techniques by taking into account TABLE
- II. The calculation of Precision using different machine learning models exhibited optimal performance across diverse datasets. For instances, the Bluetooth dataset achieved superior results with the DT and NB Techniques, contact dataset, which performed best using all classification models and Ensemble method, Email dataset, which performed best using all classification models and Ensemble method, and Gallery dataset, which performed best using all classification models.

- III. By taking into account TABLE II, the recall computed across various machine learning models, demonstrated optimal performance on distinct datasets. Specifically, the NB technique yielded the best results for the Bluetooth dataset, while the Contacts dataset performed most effectively with DT, LR, RF, and Ensemble Technique. In the case of the Email dataset, superior results were achieved with DT, RF, and Ensemble Technique, whereas the Telephony dataset excelled across all models, except for LR and SVM.

4.1.2 Finding the correlation between the matrices

As for the results we obtained from 4.1.1 we can see that all the models have accurately predicted the defect which shows that the data is biased or either imbalanced and predicts the defect with the slightest of the errors.

As we now know that the data, we are using maybe having an incline towards one of the specific groups so we will now find the dependencies or the relation between the metrices.

We have visualized the relation between the matrices using scatter plots. The Visualization has taken place in between the following attributes:

- 1) Defect-Count vs Total Number of changes
- 2)The count of insertions vs Total Number of changes
- 3)Number of deletions vs Total number of changes
- 4)Defect-Count vs Number of Deletions
- 5)Defect-Count vs Number of Insertions



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The visualizations are as follows:

- 1) Defect-Count vs Total Number of changes

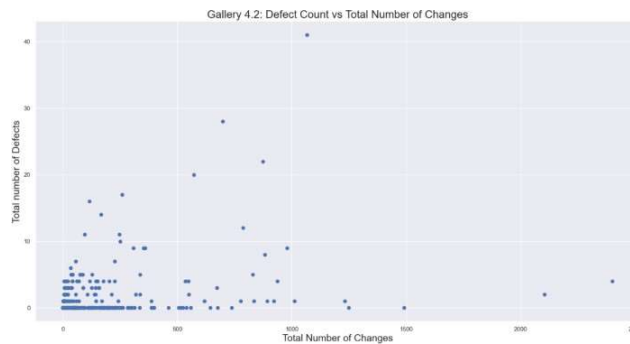


Fig. 7. Scatter plot showing the relation between the Defect Count and the Total Number of changes for Gallery version 4.2 dataset

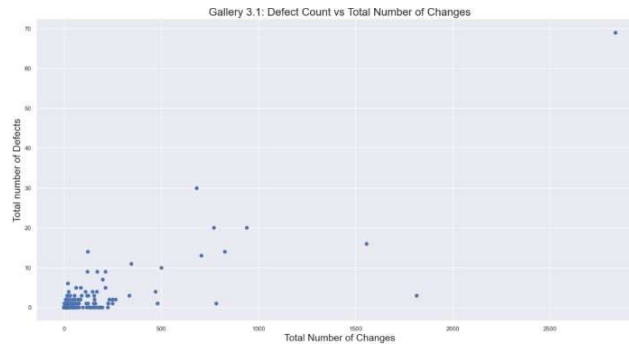


Fig. 8. Scatter plot showing the relation between the Defect Count and the Total Number of changes for Gallery version 3.1 dataset

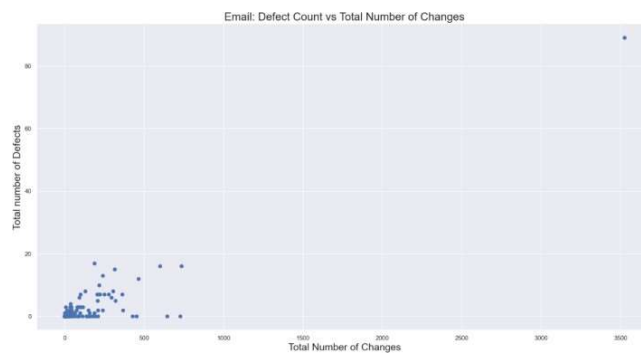


Fig. 9. Scatter plot showing the relation between the Defect Count and the Total Number of changes for email dataset

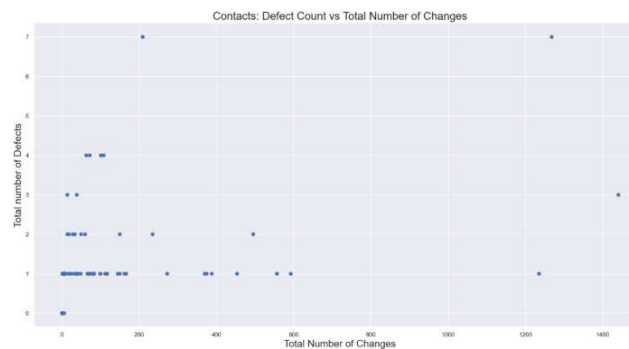


Fig. 10. Scatter plot showing the relation between the Defect Count and the Total Number of changes for contact dataset

- I. The relationship between the number of changes and the occurrence of defects is not strictly proportional. While there is an initial trend of increasing defects with the number of changes, this trend does not persist beyond a certain point, typically around an average of 1000 changes.
- II. After reaching this threshold, the number of defects remains relatively constant, indicating that additional changes beyond this level do not lead to a significant increase in defects. This suggests that the correlation between the two variables is not direct and may be influenced by additional factors or attributes. [Fig.7] [Fig.8] [Fig.9] [Fig.10]
- III. Further investigation into these contributing factors is needed to better understand the dynamics of defect occurrence in relation to changes.


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2) Number of insertions vs Total Number of changes

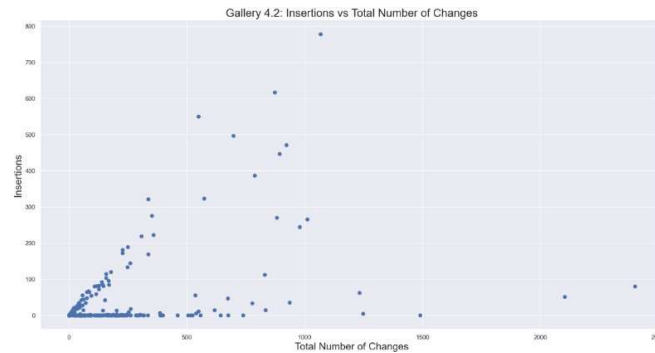


Fig. 11. Graph showing the association between the number of insertions and the Total Number of changes for Gallery version 4.2 dataset

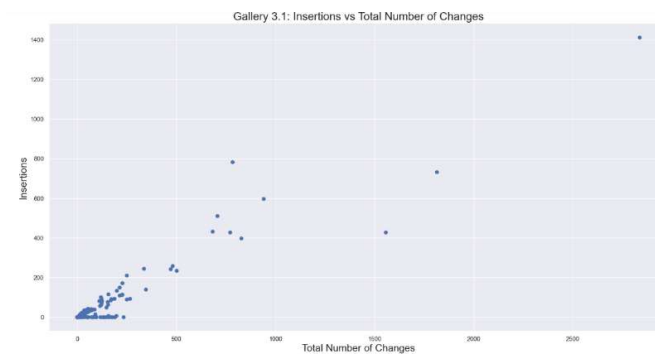


Fig. 12. Scatter plot showing the association between the number of insertions and the Total Number of changes for Gallery version 3.1 dataset

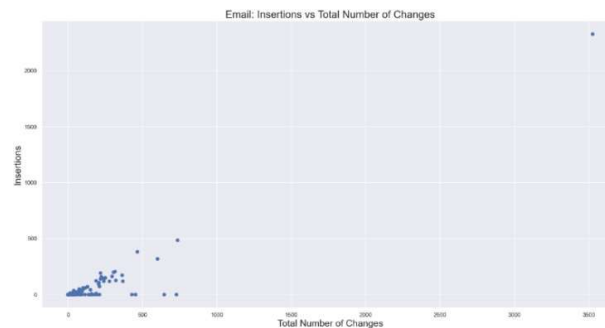


Fig.13. Scatter plot having the association between the number of deletions and the total number of changes

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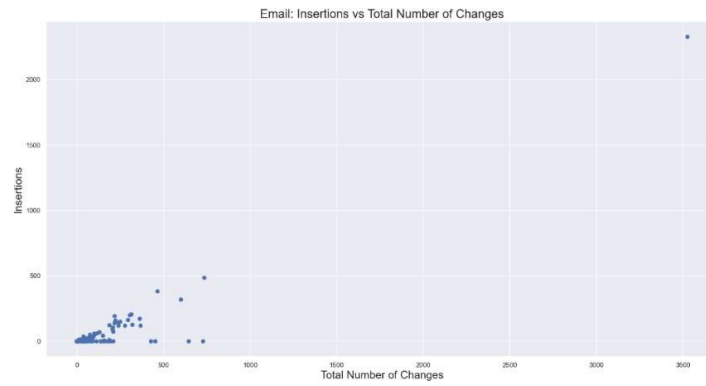
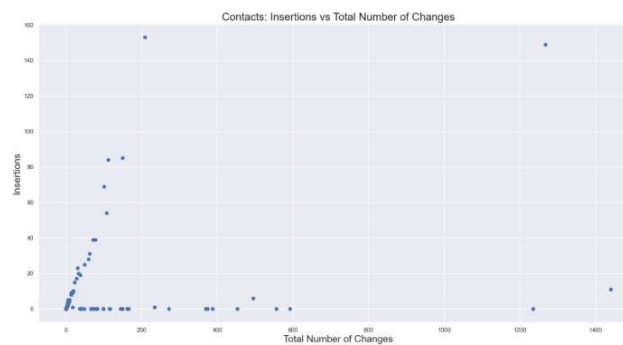


Fig. 14. Scatter plot showing the association between the number of insertions and the Total Number of changes email dataset

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Fig. 15. Scatter plot showing the association between the number of insertions and the Total Number of changes contacts dataset

- I. Based on the presented findings, it is evident that an increase in the number of insertions does not result in a notable escalation in the software's modification rate. Consequently, it can be concluded that the frequency of changes remains unaffected by the quantity of insertions made. [Fig.11] [Fig.12] [Fig.13] [Fig.14]

3) Number of deletions vs Total number of changes

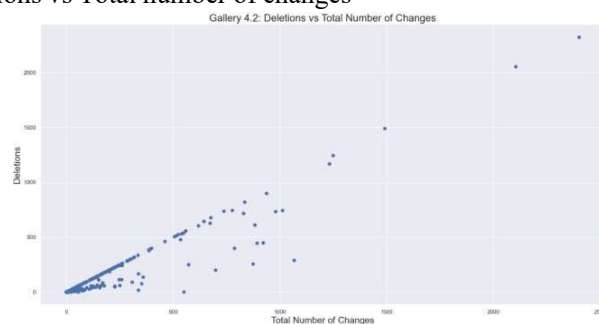


Fig. 16. Scatter plot showing the association between the number of deletions and the Total Number of changes for gallery version 4.2 dataset

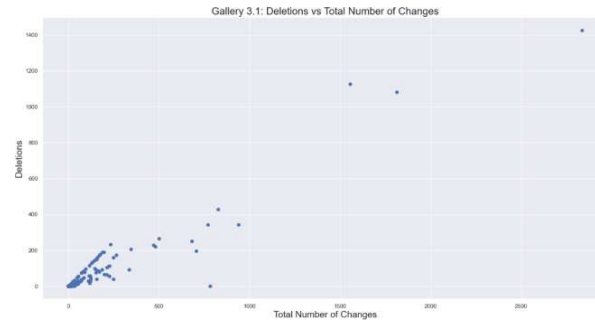
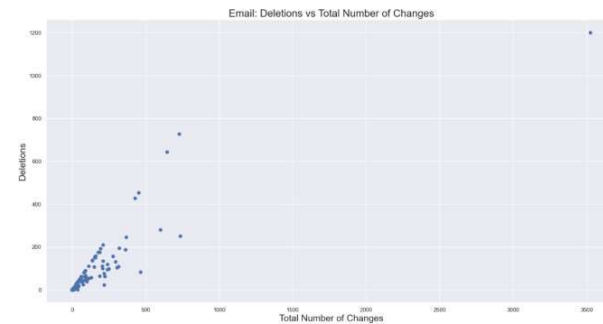


Fig. 17. Scatter plot showing the association between the number of deletions and the Total Number of changes for gallery version 3.1 dataset



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Fig. 18. Scatter plot showing the association between the number of deletions and the Total Number of changes for email dataset

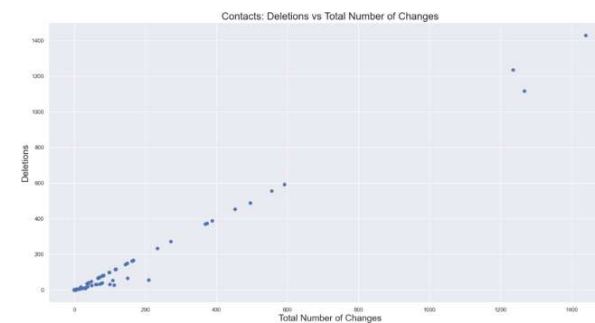


Fig. 19. Scatter plot showing the association between the number of deletions and the Total Number of changes for contacts dataset

- I. From the above findings, it is evident that an increase in the number of deletions leads to a rise in the software modification rate. Consequently, it can be concluded that the frequency of changes is affected by the number of deletions happening in the software. [Fig.16] [Fig. 17] [Fig.18] [Fig.19]

4) Defect-Count vs Number of Deletions

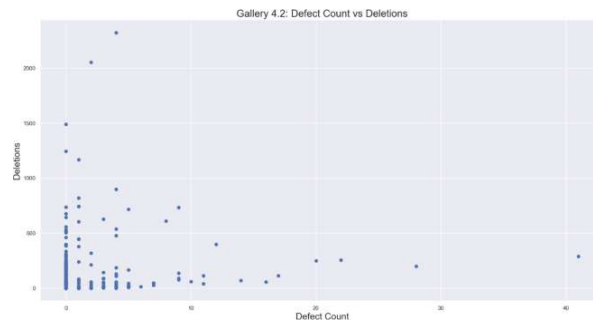


Fig. 20. Scatter plot showing the association between Defect-count and the Total Number of deletions for gallery version 4.2 dataset

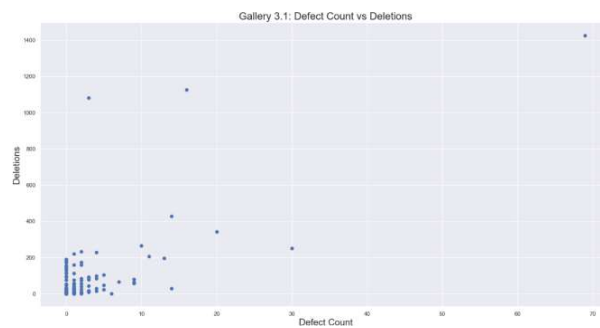


Fig. 21. Scatter plot showing the association between Defect-count and the Total Number of deletions for gallery version 3.1 dataset

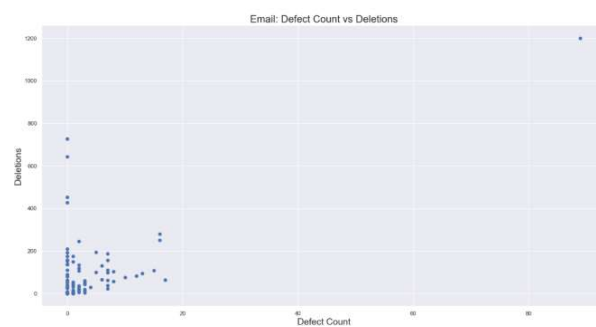


Fig. 22. Scatter plot showing the association between Defect-count and the Total Number of deletions for email dataset


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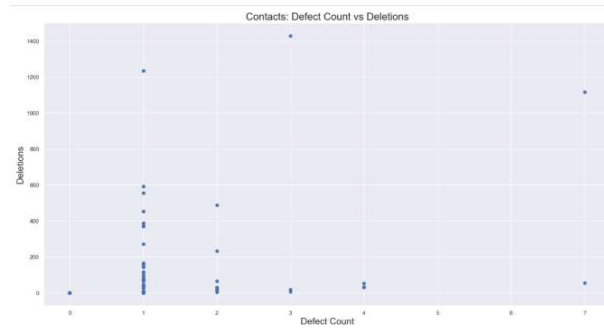


Fig. 23. Scatter plot showing the association between Defect-count and the Total Number of deletions for contacts dataset

- I. Based on the presented findings, we can observe that the even after increasing the count of deletions does not surpass an average of 30 defects. Hence it can be concluded that the increase in the number of deletions does not escalates the number of defects in the software design. [Fig.20] [Fig.21] [Fig.22] [Fig.23]
- 5) Defect-Count vs Number of Insertions

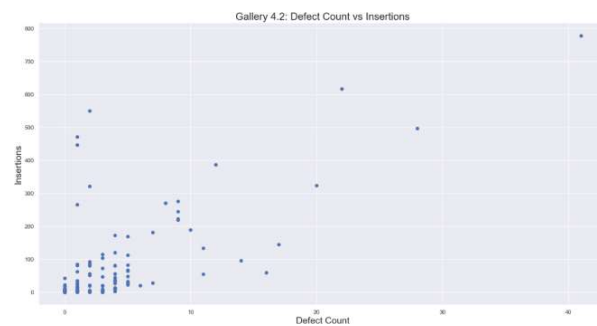
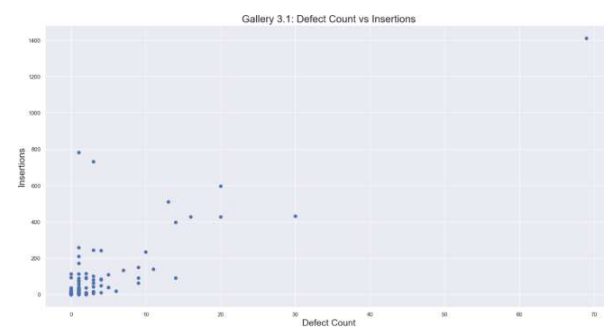


Fig. 24. Scatter plot showing the association between Defect-count and the Total Number of insertions for gallery version 4.2 dataset

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Fig. 25. Scatter plot showing the association between Defect-count and the Total Number of insertions for gallery version 3.1 dataset

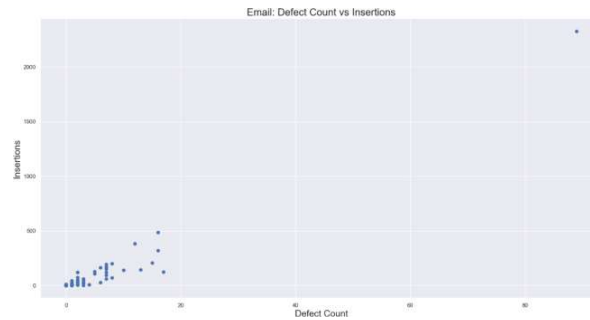


Fig. 26. Scatter plot showing the association between Defect-count and the Total Number of insertions for email dataset

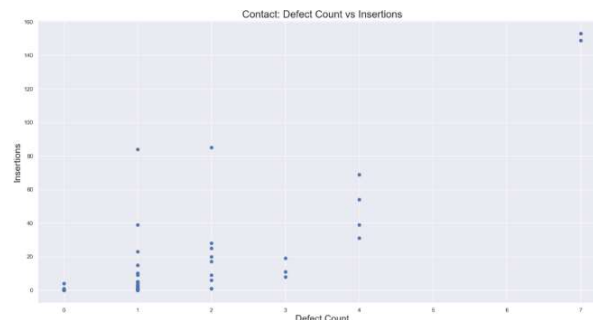


Fig. 27. Scatter plot showing the association between Defect-count and the Total Number of insertions for contacts dataset

- I. The relationship between the number of changes and the occurrence of defects in software is complex and not strictly proportional. While there is an initial trend of increasing defects with the number of changes, this trend plateaus after a certain point, typically around an average of 1000 changes.
- II. Beyond this threshold, the number of defects remains relatively constant, suggesting that additional changes do not significantly impact defect occurrence.
- III. Moreover, the statements indicate that the frequency of changes is not significantly influenced by the number of insertions or deletions in the software.
- IV. It is evident from the visualization that defect occurrence is not directly correlated with the number of modifications and may be influenced by additional factors or attributes that require further investigation. [Fig.24] [Fig.25] [Fig.26] [Fig.27]

V. CONCLUSION

Using the Ensemble technique, we were able to provide useful results for future research. The results indicate that applying the Ensemble Technique, the metrics provided over 100% accuracy, indicating that our data is either biased or imbalanced.

For further investigation the relationship between the number of changes and the occurrence of defects in software were compared which were found to be complex and not strictly proportional. While there is an initial trend of increasing defects with the number of changes, this trend plateaus after a certain point, typically around an average of 1000 changes (according to the software dataset taken in consideration which can be different for different software). Beyond this threshold, the number of defects remains relatively constant, suggesting that additional changes do not significantly impact defect occurrence. Moreover, the statements indicate that the frequency of changes is not significantly influenced by the number of insertions or deletions in the software. It is evident that the occurrence of defects is not directly correlated with the number of modifications and may be influenced by additional factors or attributes that require further investigation.

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Our research used different prediction techniques for our studies, but we found some issues with our data accuracy, possibly due to bias. When looking at how software changes relate to defects, we noticed that defects increased with more changes, but only up to the threshold the defect occurrence stayed constant. Interestingly, the number of defects wasn't influenced by the new addition or removal of the software components. This complexity suggests there are other factors affecting the number of defects such as the change in the functionality of the software which can be further be taken in consideration while using different techniques.

VI. FUTURE SCOPE

There is room for more learning because the dataset used for the article was biased and unbalanced. For improved outcomes, we can also use the transfer learning technique. The future scope may also include studying about different metrics available in the dataset for evaluation which play a role in shaping defect dynamics, contributing to a more comprehensive understanding of software development challenges and solutions.

VII. REFERENCES

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Carbon nanotube (CNT) Based Electrodes in Supercapacitors: A Review

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Abstract: In today's world, quest for energy storage has gained significant momentum and many innovative energy storage solutions have turned up due to global efforts in power generation. One of the possible energy storage solutions is the use of supercapacitors that has turned out to be a significant development owing to its high charging-discharging speed, enhanced power density with long-term cycling stability when compared to customary batteries. The current review focusses on the use of one of the carbon materials viz. CNTs as supercapacitor electrode material, another refined material that can be used in making sustainable and highly efficient energy storage devices. The use of CNTs increases the surface area and the electrodes show high electrical conductivity.

Keywords: Supercapacitors, Electrodes, CNTs

1. INTRODUCTION

Past several decades have witnessed an urban sprawl leading to continuous perversion of natural resources leading to greater energy demands. Also, increasing human population globally has further put a challenge for meeting up the required energy demands. In keeping view of the above discussed factors, the current power infrastructure is unable to cope up with the ongoing trends and is thus a threat for a sustainable future. So far, the requisite needs of power have been largely catered through the use of fossil fuels. The large-scale exploitation of fossil fuels has contributed to rising environmental changes like global warming, an increased pollution, question on fuel economy and accountability of various other impactful geographical factors. Thus, focus of many researchers and academicians has been shifted to finding ways so as to reduce our dependence on fossil fuels. Further, acknowledging alternate renewable energy sources can bring into account more effective, efficient and high-performance energy storage devices and systems [1].

Therefore, there was much of dependence on conventional energy storage technologies like capacitors, fuel cells and batteries to name a few [2-5]. Recently a significant work has been carried out in the field of advanced energy storage technology using "supercapacitors". Supercapacitor or electrochemical capacitor or ultracapacitor have surpassed the use of traditional devices like batteries, cells etc owing to their unique high-power density ($>10 \text{ kW kg}^{-1}$), prolonged life cycle ($>10^5$), sufficient peak power, high power efficiency and providing inherently safe and environmentally clean, friendly energy storage systems solutions. and efficient storage devices.

An impressive combination of its high-power delivery and long cycle-life has extensively shown its popularity whether it be automobile industry or portable electronics or in memory backup systems. Discrete features of supercapacitors viz. high surface area electrodes and thinner dielectrics have made them exceptionally remarkable with maximum capacitance [6-10] when compared to traditional capacitors. A close comparison to the batteries reveals the fact that the supercapacitors possess high orders of power density magnitude and specific energy making them a viable candidate for an alternative energy storage system [11]. Their ability to store and release energy is one thousand times more than the batteries and thus make them suitable in many device applications where power delivery is a requisite; charge accumulation however is around 3-30 times low when compared to batteries. Fig.1 [12] below represents a plot showing fuel cells with highest energy in contrast to supercapacitors with greatest power. However, in case of batteries it possesses intermediary power and energies.



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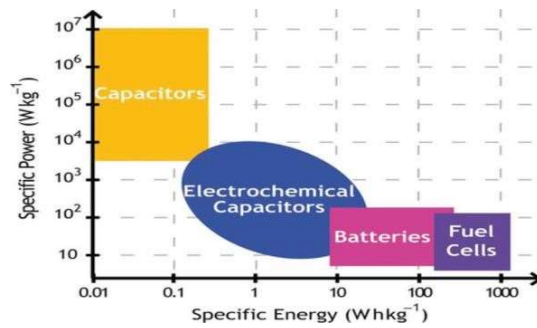


Fig. 1 Specific power density plotted against specific energy density for different types of energy storage devices. Reproduced with permission [2] Copyright 2004, American Chemical Society.

Supercapacitors thus stands suitable for energy storage applications meeting all the desired requirements be in terms of energy density or maximum power, their compact size, initial cost, weight or long life span or power to energy ratio. Energy is the main concern globally thus, development of these high energy systems like supercapacitors is the need of the hour.

2. OVERVIEW: CONVENTIONAL CAPACITORS Vs SUPERCAPACITORS

Traditional supercapacitors comprise mainly a non-conducting insulator or dielectric substance/medium placed in between two conducting electrodes. When voltage is applied, positive and negative charge accumulation takes place on the electrodes separated by the dielectric thereby resulting in the production of electric field so that energy storage can take place in capacitors.

Capacitance C is defined as the amount of charge Q stored on the electrodes to the applied potential difference V across the electrodes i.e.

$$C = \frac{Q}{V} \quad (1)$$

The capacitance for a capacitor can be calculated using the primary relation:

$$C = \epsilon_0 \epsilon_r \frac{A}{d} \quad (2)$$

where ϵ_0 : dielectric constant or permittivity of free space; ϵ_r : dielectric constant of the insulating material or the dielectric used between the electrodes, A : surface area of each electrode, d : separation gap/distance between the two electrodes. Eq. (2) shows direct relation of the capacitance of the capacitor with the area A of each electrode and dielectric constant of the material but an inverse relation with the distance d between the electrodes.

The direct relationship between the capacitance of the capacitor and its stored energy E is given as:

$$E = \frac{1}{2} CV^2 \quad (3)$$

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Other important factors that need lot of attention is the energy density of a capacitor i.e. how much of the energy can be stored by a capacitor per unit volume and its power density i.e. the rate at which the capacitor can absorb or deliver energy per unit volume. Power for a capacitor can be understood by knowing how much is the energy converted per unit time. Power determination in a circuit for a capacitor requires a capacitor and external load resistance R in series. Ideally a capacitor has an infinite capacitance but the assembly of various constituents like electrodes, current collectors, and dielectric material of the capacitors etc offers some cumulative resistance known as Equivalent Series Resistance (ESR). The efficiency of any capacitor for storing and releasing energy depends largely on ESR. Once it is calculated some restriction is imposed on the maximum power ($P_{\max}$) delivered by the capacitor [6-7,10] using the following Eq. 4 as:

$$P_{\max} = \frac{V^2}{4 \times \text{ESR}} \quad (4)$$

While batteries and fuel cells can store more of energy due to high energy densities and less power delivery due to low power densities supercapacitors show a contrast to this. They can unleash their stored energy inside them by delivering immense power. Eqs. (2)-(3) above clearly indicates that high storage capacity in a supercapacitor depends on the high capacitance [16]. This can be accomplished by maximising surface area of the electrodes and minimising dielectric gap(d) between them.

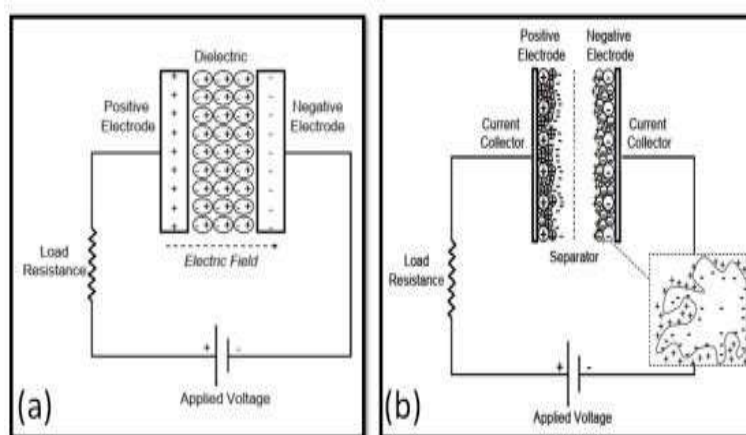


Fig. 2 a) Conventional Capacitor, b) Supercapacitor Source: reproduced with permission from [16]

3. SUPERCAPACITORS: CLASSIFICATION ON THE BASIS OF ENERGY STORAGE MECHANISM

Highly efficient storage system for a supercapacitor depends on: large surface area of electrodes, electrolyte for ionic conduction, separation of charges followed by accumulation of charges on the electrodes forming an electrically double layer.

Based on various mechanisms involved in energy storage of supercapacitors, they can be categorised as: Electrochemical double-layer capacitors (EDLCs), pseudo capacitors, and hybrid supercapacitors.

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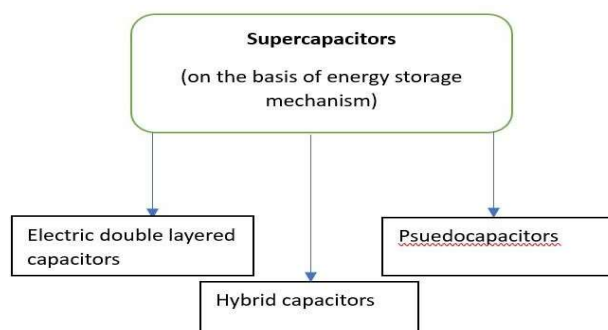


Fig.3 Classification of Supercapacitors (based on energy storage mechanisms)

3.1 EDLCs:

EDLCs involves three important elements:

- (i) **Electrodes:** These are generally made of combination of two carbon-based materials having high surface area essential for high energy storage capacity.
- (ii) **An Electrolyte:** Either an aqueous or an organic conductive liquid is chosen so that an ionic flow is maintained throughout in between the electrodes during charging or discharging.
- (iii) **Separator:** In between the electrodes, a thin insulating ion-permeable membrane exist preventing short circuit while still allowing the flow of ions through the circuit.

The charge storage in EDLCs can be either: electrostatically or by a non-faradic process. The latter avoids any chemical changes but involves only the physical separation of charges i.e. non electron transference between the electrodes and the electrolyte [12-14] resulting in a non-faradic redox reaction [15]. Thus, energy storage in case of EDLC's depends on the formation of electrochemical double layer. A significant potential difference can be observed after applying voltage that leads to accumulation of charges on large electrode surface area. Diffusion of ions from electrolyte takes place to the oppositely charged electrodes. Formation of double layer of charges at electrode leads to non-recombination of ions. All the factors including double layer formation, high surface area and minimising the separating distance between the electrodes contributes to the higher energy density [16] in EDLC's.

Thus, EDLC's show high capacitance and high-power density when compared with conventional capacitors. This very fact allows for a high charging and discharging. Since a non-faradic process causes no chemical change, there is no material degradation or a volume change in any active material which in contrast is shown by the batteries during the charging and discharging process.

3.2 Pseudocapacitors:

The principle involved in case of pseudocapacitors for the storage of charges is Faradic process wherein the charges are transferred between electrode and electrolyte [17] highlighting reversible redox reactions or intercalations [18]. After applying potential, oxidation-reduction reaction occurs at electrodes. Thus, electron transfer between electrode and ions generates faradic current thereby enhancing specific capacitance and energy densities in pseudocapacitors in contrast to EDLCs. However, the redox reactions are responsible for an instability during cycling resulting in low power density [19-21].

3.3 Hybrid SCs:

These aims at combining the advantages of both batteries and capacitors. Two different electrodes based on two distinct mechanisms of electrical charge storage exist: one battery-type Faradic providing high power density and other capacitive [22]. A proper selection of electrode material can lead to high performance of SCs with an increased

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cell voltage and enhanced energy and power densities. However, it is seen that in case of hybrid devices, electrode material degradation takes place over time due to faradic processes that ultimately decreases the charge storage and its release ability decreasing its capacitance and thus a failure as a high-power supercapacitor in long run. Based on the electrode configuration, one can categorize hybrid supercapacitors into three different types: symmetric, asymmetric supercapacitors (ASCs), and battery-type.

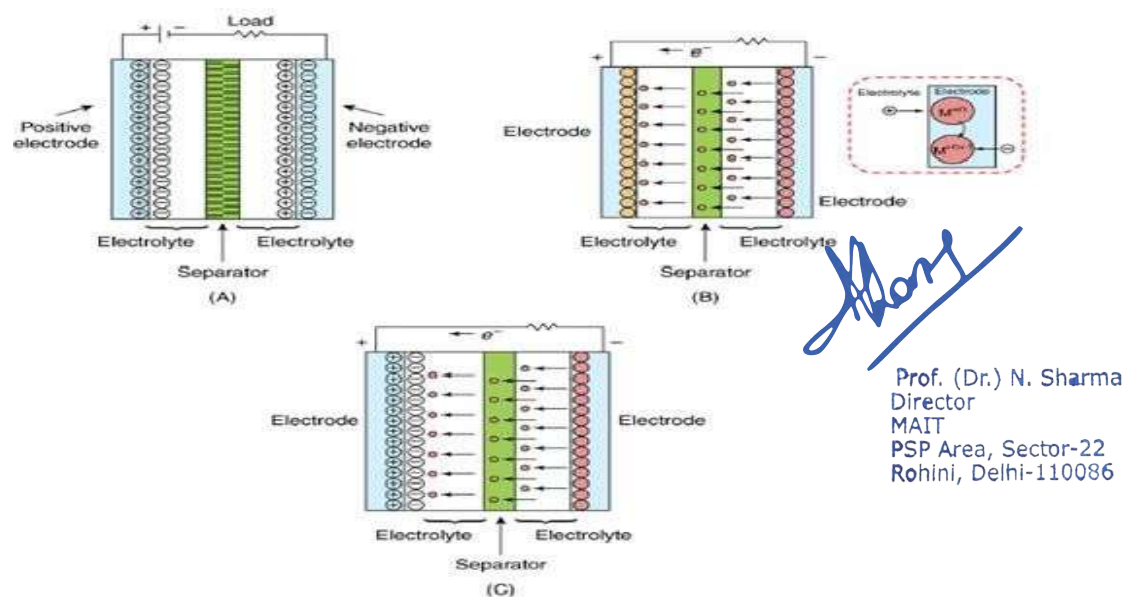


Fig. 4 Supercapacitor types: A) EDLC, B) pseudocapacitor, C) hybrid capacitor Source: reproduced with permission from Ref. [1]

Unlike symmetric supercapacitors, which use identical materials for both electrodes, asymmetric supercapacitors employ two distinct materials for the positive and negative electrodes. This setup allows for the integration of electrode materials with contrasting charge storage mechanisms, or even the utilization of the same electrochemical double-layer capacitor (EDLC) material as positive and negative electrodes but with varying surface functional groups [22].

Asymmetric configuration exhibits significant advantages over symmetric configuration, notably the ability to operate within broader and more consistent voltage ranges. Most of the symmetric supercapacitors are restricted to function below 1.0 V, constrained by the thermodynamic limit of water molecule decomposition when using aqueous electrolytes. Conversely, asymmetric supercapacitors allow for higher operational voltages, facilitating them to attain higher energy densities (E_d) by effectively utilizing increased operating voltages (V) [22,23].

4. Choice of CNTs as Electrode materials in Supercapacitors

The increased energy density [24] of any supercapacitor depends largely on the choice of electrolytes that can hold a high-voltage window as there is a direct relationship between the energy density of supercapacitors and square of the working voltage. While using such kind of electrolytes which work with large working voltages, the functional groups holding oxygen in them viz. COOH, OH, or C = O etc, must be avoided so as to get rid of any breakdown of these groups at high voltages [25] that can lead to lower capacitor stability. Instead, a better choice between two sp^2 carbon nanomaterials viz. carbon nanotubes (CNTs) or graphene that are independent of any surface-dangling bonds stands best suited. Both of these can be used widely as electrode materials due to synergism between the chemical stability and extraordinarily high surface area ($\sim 1300 \text{ m}^2/\text{g}$ and $\sim 2630 \text{ m}^2/\text{g}$ for CNTs and graphene respectively) realising a large electrolyte-electrode interface, ideal for double-layer capacitance. In between carbon atoms, the presence of covalent sp^2 bonds facilitates a large movement of electrons that increases the electrical conductivity thereby reducing the overall resistance of the system. These materials act as basic building blocks in the development of novel 3D architectural structures along with graphene nanofibers (GNFs), CNT foam, etc. [26-31]. Whether it be graphene or CNTs, each of these carbon materials contributes uniquely to the performance and efficiency of EDLCs, highlighting the versatility and potential of carbon-based technologies in energy storage applications. Ega et al. [32] demonstrated

the performance of PANI//AC asymmetric cell, where activated carbon material has a high BET specific surface area of 860 m²/g and a large total pore volume of 199 cm³. PANI//AC exhibits a high specific capacitance of 157 F/g @ 5 mA/cm² and cycle life stability over 5000 cycles with a coulombic efficiency of 93% @ 10 mA/cm². Habib et al.[33] showed reduced graphene oxide (rGO), conducting polymer polyaniline and Tellurium composite (rGO/PANI/Te₅₀) symmetric electrode cell attained its maximum specific capacitance of 895 F/g @ 10 mV/s. The sample exhibits high coulombic efficiency ~ 92 % alongside impressive energy and power densities of 41 Whkg⁻¹ and 3679 Wkg⁻¹ and cyclic stability of ~ 91% after 5000 charge-discharge cycles. Additionally, the rGO/PANI/Te₅₀ showed electrical conductivity of 86.2 S/m.

In a study conducted by Wang et al. [34], covalently modified graphene (DMFrGO180) has been found to possess outstanding supercapacitive properties. Specifically, when tested using a PVA/KOH gel as the electrolyte, DMFrGO180 exhibit specific capacitance of 193.5 Fg⁻¹ @ 1 Ag⁻¹ and 86.9 Fg⁻¹ @ 50 Ag⁻¹ along with high energy density 11.35 Whkg⁻¹ and 5.09 Whkg⁻¹ at power density of 649.7 W/kg and 32.4 KW/kg respectively.

As, the right choice of electrode material [35-38] depends on an extensive large surface area, high electrical conductivity, and large electrolyte accessibility, CNTs can be taken up as excellent candidate for building up new electrode materials. As electrodes and electrolyte are key elements for a CNT SC, an extensive research work has been carried out to evolve out with variety of CNT electrode materials and studying further their combinations with various electrolytes. Further both SWCNTs and MWCNTs [39] can be fruitful in making electrochemical supercapacitor electrodes as they exhibit unique structures, nanometre range size distribution, high surface area, reduced resistivity with enhanced cycling stability. Cyclic stability refers to the ability of a supercapacitor to retain its performance characteristics, such as energy storage capacity and power delivery, over numerous charge-discharge cycles. The cyclic behavior depends on different factors, such as the cyclical operations of both the positive and negative electrodes, the durability of the membrane, and the properties of the electrolyte [40]. Mu et al. [41] showed that electrode based on CNT/rGO/MnMoO₄ achieved a remarkable specific capacitance of 2374.9 F/g @ 2 mV/s and displayed impressive durability over time, retaining 97.1% of their initial specific capacitance even after undergoing 3000 charge-discharge cycles. Zhang et al. [42] synthesized a novel MWCNTs/PANI/MoS₂ via a facile in situ polymerization and hydrothermal method which exhibits impressive rate capabilities, with a capacity retention of 62.5% at a high current density of 10 A/g. Furthermore, the composite exhibited outstanding cycling stability, retaining 73.71% of its capacitance over the course of 3000 cycles.

Liang et al. [40] Ti₃C₂Tx-MWCNT//Ppy coated MWCNT asymmetric supercapacitor exhibited capacitance retention rates of 94% and 72% over about 1000 cycles when cycled within voltage windows of 0-1.6 V and 0-1.8 V, respectively. Ryan et al. [43] demonstrated that incorporating a small amount of SnO into SWCNTs significantly improves cycling stability. Specifically, under a current density of 10 A/g, this enhancement allows the system to maintain 95% of its initial capacity after undergoing 7,500 cycles. Additionally, in a setup involving an asymmetric device with MXene, a similar level of improvement was observed, with the device retaining 90% of its initial capacity over the same number of cycles. In their research titled "High-performance wearable supercapacitors based on PANI/N-CNT@CNT fiber with a designed hierarchical core-sheath structure," Tian et al. [44] found that the capacitance of PANI/N-CNT@CNT fiber could be preserved at 95.5% even after being subjected to repeated bending tests for up to 10,000 cycles. Other researchers like Zhang et al [45] have investigated Fe₂O₃/CNTs composite having shell-core hierarchy architecture and fabricated them using microwave-assisted Fenton's reagent technique. The conductivity is improved tremendously when CNT is introduced into Fe₂O₃ at current density of 0.5 A/g, A high capacitance of about 204 F/g is observed, however with 1 kW/kg power density, 28.3 Wh/kg energy density is observed. The Fe₂O₃/CNTs composite thus results in an increased capacitance, high cycling stability and enhanced energy density. Fe₂O₃/CNTs composite stands as one of the best electrode materials for SC's. Large scale fabrication of Fe₂O₃/CNTs composite can be taken up using microwave-assisted Fenton's reagent technique. Yang et al. [46] have successfully deposited binder-free Ti₃C₂ MXene/carbon nanotubes (Ti₃C₂/CNTs) on graphite substrate using electrophoretic deposition (EPD) technique for supercapacitor electrodes. When compared to pristine Ti₃C₂ and CNTs films, the as-grown Ti₃C₂/CNTs electrode showed an increased specific capacitance. Ti₃C₂/CNTs electrode exhibits remarkable cycling stability even at 5 A g⁻¹ without any loss of capacitance over 10,000 cycles. CNTs in the hybrid film act as interlayer spacers for Ti₃C₂ providing non-stoppable charge transportation thereby preventing restacking of Ti₃C₂ nanosheets and magnified electrochemical performance. Yue et al [47] in their present work fabricated CoFe₂O₄/CNTs composite using simple hydrothermal method. CoFe₂O₄ nanoparticles are spread on the CNT surface externally. The CoFe₂O₄/CNTs composite is then used as an electrode material exhibiting high specific capacitance of 1240 F/g at 0.5 A/g. Retention of around 75.8% capacitance i.e. 941 F/g took place even when the current density increased to 10 A/g i.e. around 20 times from the earlier figure using traditional three-electrode system. They also achieved energy density as high as 30.4 W h/kg and power density as high as 400 W/kg for an asymmetric supercapacitor (ASC) fabricated with CoFe₂O₄/CNTs composite and active carbon (AC) as the positive and negative electrode respectively. Even after 1000 charging-discharging cycles specific capacitance retention of around 86.5%

could be observed at a current density of 2 A/g. These remarkable observations indicate CoFe₂O₄/CNTs composite as suitable electrode materials for supercapacitors. Li et al [48] have explored in their recent study a high-performance electrode material, viz. a hierarchically hybrid composite of CuCo₂S₄/CNTs. This was synthesised using a simplistic process comprising both hydrothermal and sulfuration. A right proportion of CNTs in the CuCo₂S₄ composite may lead to an increased specific surface area. A low series and charge transfer resistance for CuCo₂S₄/CNTs electrode indicates a higher specific capacitance (557.5 Fg⁻¹) with high cyclic stability for long term charging-discharging cycles if compared to pristine CuCo₂S₄ (373.4 Fg⁻¹) and Co₃O₄/CuO/CNTs (356.5 Fg⁻¹) electrodes at a current density of 1 Ag⁻¹. When compared to earlier reported CuCo₂S₄ based ASC devices, CuCo₂S₄/CNTs-3.2%/AC ASC devices were far better and improved even after 10,000 cycles with energy density ~ 23.2 Whkg⁻¹ at a power density ~ 402.7 Wkg⁻¹. It can be concluded that for supercapacitors though CuCo₂S₄ stands as one of the finest electrode materials, but limited conductivity and low cyclic stability has restricted its wide-range uses. The addition of CNTs into binary metal sulphides improves largely high capacity and high-performance of energy storage devices with remarkable cycle stability. Below is a comparative table of different CNTs based electrodes.

Configuration	Electrode	Electrolyte	Operating voltage	Specific capacitance (F/g)	Energy density (Wh/kg)	Power density (kWkg ⁻¹)	Reference
Symmetric configuration	PANI/MWCNT (5:1)	0.5 M Na ₂ SO ₄	0-1 V	300	9.8	-	[49]
	FCNT-MOF	1M KOH	0-1 V	465 @ 2Ag ⁻¹	40.5	11.9	[50]
	Free standing electrode						
	Polyaniline/MWCNTs composite (8%)	PVA/H ₂ SO ₄	-0.2 to 0.8 V	446.89	248.29	16.86	[51]
	CNTs/GNFs			270 @ 1 Ag ⁻¹	72.2	686.	[52]
	Polyaniline/f-MWCNTs composite (PFC1)	0.1 M H ₂ SO ₄ + 0.1 M Na ₂ SO ₄	0 - 0.8 V	865	77	801	[39]
Asymmetric configuration	MWCNTs/NiS/graphitic carbon nitride // AC	2M KOH	0.8-1.6 V	206 @ 0.5 Ag ⁻¹	73.3	1.599	[53]
	Ti ₃ C ₂ T _x -MWCNT // Ppy coated MWCNT	Na ₂ SO ₄	0-1.6 V	0.94 Fcm ⁻²	-	-	[40]
	NiMOF/CNTs//AC	2M KOH	0-1.6V	320 @ 1 Ag ⁻¹	113.8	800	[54]
	SWCNT/SnO//MXene	H ₂ SO ₄	-0.4 to 1 V	-	6.6	51.5	[43]
	Co ₃ O ₄ @CNTs@NF//AC@NF	-	-	1291 F g ⁻¹ at 5 mA/cm ²	57.6	273.4	[55]

5. Limitations of carbon-based electrode for supercapacitors

The limitations of carbon-based materials includes low capacitance and energy density than pseudo-capacitive materials which may be due to several key factors low packaging density, hydrophobic nature of carbon-based materials impedes their compatibility with aqueous electrolytes, leading to suboptimal ion transport and overall performance in electrochemical system, low DOS in carbon materials that limits the charge storage capability per unit volume and chemical inertness that inhibits effective interaction with electrolytes, particularly impacting the ion intercalation process crucial for capacitor charging, thus affecting both capacitance and energy density [56,57].



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6. CONCLUSION

The present review provides an overview on the contrasting features of supercapacitors and traditional batteries. Latest research on use of one of the carbon materials viz. CNTs as supercapacitor electrode material has been taken into account owing to its unique and distinctive property of high electrical conductivity, resistive to corrosion, low density, remarkable stability and high specific surface area. Addition of CNTs thus enhances the electrochemical performance of the devices. Still much of the research work is coming up to upgrade the energy storage devices by improving their energy and power density of devices.

7. FUTURE SCOPE

The improvisation in performance can pave the way to increased applications of CNTs as supercapacitor electrode material ranging across various sectors from portable electronics to large scalable energy storage solutions. The recent advancements in this field is a clear indicator of future prospects of CNT-based supercapacitors being understood more efficiently so as to provide renewable energy solutions globally. The future scope involves its integration with latest emerging technologies of IoT and smart grid to get sustainable energy solutions. Focus on better biomedical devices with biocompatibility is another area where its scope can be explored. Whether it be energy harvesting and storage or sensor integration sensing capabilities of CNT based supercapacitors can further be explored. Further many new hybrid or composite materials can be chosen so as to cut down the cost of CNT-based electrodes for their access in various applications.

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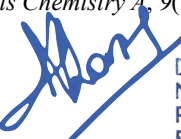
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Blockchain Role in Safeguarding and Streamlining Student Data Management

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Abstract – Keeping track of students' data is tedious in big countries like India. Different generations used different technologies and adopted various methodologies in organizing and storing this data. This data should be kept secure for diverse purposes so that it can be utilized in the future. That's why colleges and universities have to spend a lot of money preparing and managing this information. Blockchain is the next big thing in technology and it will take the world by storm. Using blockchain technology to store information helps ensure that information is stored in a secure, publicly accessible location. Document Search is the best way to organize and store student information at a college or other institution.

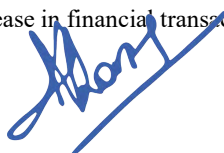
Keywords – *Blockchain, Ethereum, Solidity, Smart Contracts, Web3.js, Ganache, Transactions.*

1. INTRODUCTION

Blockchain technology has become popular in managing and storing educational information. Since blockchain technology is a ledger, it can store information decentralized and independent of central authority. It is ideal for organizing and storing educational materials as it provides a secure, open and immutable data storage platform. . In addition to improving the certificate and certification process, blockchain technology also enables schools to securely verify and verify certificates. Blockchain technology can also be used to provide secure payment methods and improve financial communication between students and institutions. By leveraging the immutability and security of blockchain technology, institutions can increase the efficiency, security and trust of financial transactions. By leveraging the immutability and security of blockchain technology, institutions can increase the efficiency, security and trust of financial transactions. Finally, blockchain technology can also facilitate secure communication between students, parents, teachers, and administrators, and schools can use Output blockchain technology to control and manage communication for transparency and security purposes.

2. LITERATUTE SURVEY

The history of blockchain in storing student records of colleges and universities dates back to the early 2000s. At that time, blockchain technology was still in its infancy, but it was already being used for a variety of business applications. In the past two decades, blockchain technology has grown in popularity. Blockchain technology has been used to store student information at colleges and universities since the early 2000s. Since then, Blockchain technology has been used more frequently than traditional technology to store student information and educational information efficiently and securely. This is because blockchain technology provides enhanced data confidentiality and integrity. Blockchain ensures that information is immutable and can only be changed with the consent of all parties. This means student information is kept secure and cannot be tampered with or altered. Additionally, blockchain enables secure data exchange, allowing student data to be securely shared between schools and organizations. Blockchain's ability to store student information without intermediaries is one of its main benefits. By eliminating the middleman, the process is streamlined and the amount of data collected is reduced. Hisam O Mbaidin (2023) et al in their cerebral research work on applications of Blockchain for banking sector have concluded that “Implantation of smart contracts, risk management, risk mitigation and faster payment are the opportunities for the banking sectors of developing countries to increase trust and transparency in their financial systems as well as formalization of their economy. Upon the adoption of Blockchain technologies, there will be ease in financial transactions and transfers of money for financial institutions.[7]



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Additionally, students information stored in blockchain technology is encrypted, thus increasing their security.

Although there are many benefits to using blockchain technology to store student information, there is still room for improvement. For example, scalability is an issue because the amount of data that needs to be stored and the number of transactions that can be made will reduce the size of the blockchain network. Additionally, organizations currently face problems in sharing information and coordinating projects due to the lack of a well-designed and well-structured blockchain network.

3. METHEDOLOGY

The methodology which is adopted for the development of the project which is associated with this research paper can be broadly classified into four parts:

- Setup of the Development Environment.
- Development of the Smart Contract.
- Deployment of the Smart Contract.
- Connection to a blockchain node.

Now let us look at a detailed explanation of the above-mentioned categories:

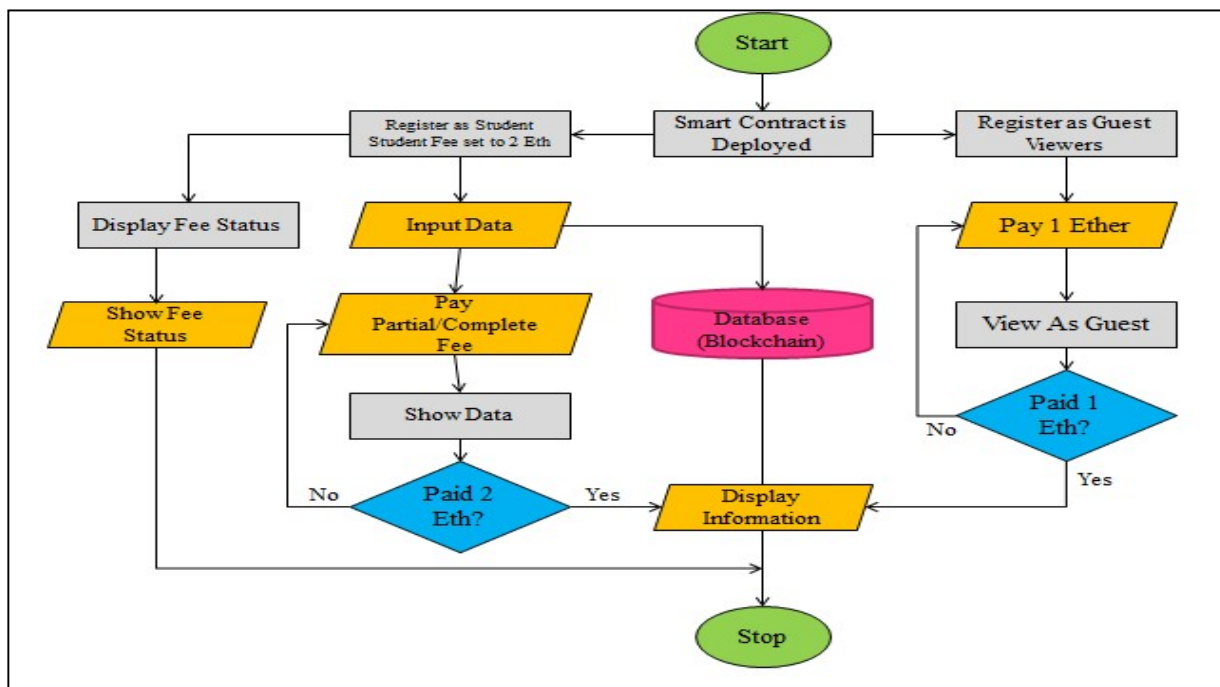
A. Setup of the Development Environment

As we are dealing with blockchain, what could be more suitable to employ the local development framework, namely Truffle? To develop our project in Truffle, we initially installed Node JS. After the successful set-up of Node JS, we installed Truffle from the npm package manager. Truffle is a framework that furnishes various tools and files for forming a blockchain project.

Truffle offers us files to compose our Solidity code, JavaScript files to write the deployment code, testing files that are utilized to investigate the different elements of the project, and Truffle configuration files that assist us in selecting a particular network on which our project will be launched.



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Flowchart

B. Development of the Smart Contract

A smart contract is a computer program, or set of instructions, stored on a blockchain that automates the performance of an agreement between two or more parties, without the need for a third party to facilitate.

These contracts are self-executing, meaning they carry out the terms of an agreement without requiring any manual input from either party. The most common programming language that is used for writing Smart Contracts is Solidity and we'll be using it too.

Once the Truffle framework has been installed, a project is created with several different files, including Build, Client, Contracts, Migrations, Test, etc. All Solidity files should be saved under the Contracts folder with the ".sol" extension.

Our Smart Contract is a piece of code that manages the data that the admin or students wish to store. There are three types of users who can interact with the contract: the Admin, the Student(s), and the Guest Viewer(s). The address of the Account that deploys the smart contract is allocated to the Admin, who has the ultimate authority over the operations. The Student(s) are the individuals who will be inputting their data. The Guest Viewer(s) is an external individual who wishes to gain access to the data for various purposes. Accounts to be utilized as Students must have their address registered as Students through the RegAsStudent() function, so as to enable the program to determine which account belongs to the Student. Likewise, the Guest Viewer(s) must register the address of their account with the RegAsGuest() function in order to gain access to the data. Furthermore, as they are a third party, they must pay a specified sum, in this case, 1 Ether, to register themselves.

Prior to beginning any project, it is essential to select the appropriate platform for its development. In this instance, we decided to use the renowned VS Code Editor.

C. Connection to a Blockchain Node

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It is not feasible to deploy a smart contract without connecting to a Blockchain node due to the fact that they are always "deployed on" the Blockchain. If the Blockchain is not in existence, where would the contract be deployed? Consequently, as developers, we are practically unable to work with the main Ethereum Network, instead, we opt to use Test Networks or Developer Blockchains. 'Ganache' is a private Blockchain that we will be utilizing to deploy our smart contract. By default, Ganache instead, we opt to use Test Networks or Developer Blockchains. 'Ganache' is a private Blockchain that we will be utilizing to deploy our smart contract. By default, Ganache provides us with 10 accounts, each possessing an amount of 100 Ethers.

Now, the assignment is to link the Ganache Blockchain with Truffle. This can be accomplished with the aid of the truffle-config file. The truffle-configuration or truffle-config file is a JavaScript file that oversees the configurations that influence the Truffle project. The Ganache is constantly connected to the RPC Server and has a network ID as well. Example is shown below



- i. Ganache connected to the RPC Server and has a network ID

D. Connection to a Blockchain Node

It is not feasible to deploy a smart contract without connecting to a Blockchain node due to the fact that they are always "deployed on" the Blockchain.

If the Blockchain is not in existence, where would the contract be deployed? Consequently, as developers, we are practically unable to work with the main Ethereum Network.

Apart from financial industries, blockchain technology also has a bright future in other sectors.

Let us have a look at the future scope of Blockchain technology in different sectors:

- Blockchain in Digital Advertising.
- Blockchain in Cyber Security.
- Blockchain will remove the requirement of the third party.
- Governments will provide their digital currencies.
- Blockchain beyond the world of computing.
- Managing World trade with the help of Blockchain Technology.
- Supply chain Management.
- The Blockchain in Forecasting.
- Use of Blockchain in the Internet of Things and Networking.
- Blockchain in Cloud Storage.

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4. RESULTS

The system created using the overhead methodology is capable of storing information about a particular student. When this code is deployed on a private blockchain, such as Ganache, we can interact with the various functions we have written.

Firstly, the account registers itself as a student through the RegAsStudent() function, and its address is registered. Now, the student's data can be entered by both the Student and the Admin, as this is a practical approach that allows the Admin to upload data in case the student is unable to do so. As Students should

have access to their personal data, they can view their information through the dedicated DisplayData() function. However, if any third party wishes to view the data, they first need to register as a Guest Viewer through the RegAsGuest() function and make a payment of 1 Ether.

After completing the registration as a Guest Viewer, they can access the data in view mode using the ViewAsGuest() function.

```
2_Deploy_Contract.js
=====
Replacing 'StudentData'-----
> transaction hash:
> Blocks: 0      Seconds: 0
> contract address:
0x96Ce5118B470CBc8b28b1346EF5a65d5ee53C1
53
> block number:      1
> balance:           99.97597622
> gas used:           1201189 (0x125425)
> gas price:          20 gwei
> value sent:         0 ETH
> total cost:         0.02402378 ETH
```



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5. CONCLUSIONS AND FUTURE SCOPE

Blockchain's potential for managing student records is very bright. Educational institutions can do away with traditional paperwork by using blockchain technology to securely store, manage, and track student records. This technology also provides an immutable record of data. This can simplify the student life cycle, facilitating quick access to information and cutting down on record-keeping expenses. Universities may also prevent data manipulation and unauthorized access to student records, as well as guarantee data privacy and security, by implementing blockchain technology. Additionally, by lowering the possibility of fraud and identity theft, this can ease the minds of institutions and students. Due to its capacity to handle and preserve sensitive data in a secure manner, blockchain can be a very useful tool for educational Organizations.

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Exploring the Potential of 3D Printed Molds for Rapid and Affordable Prototyping of Carbon Fiber Composites

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Abstract

This research paper aims to investigate the feasibility and effectiveness of using 3D printed molds for producing carbon fiber composites in an inexpensive prototyping process. The study delves into the manufacturing process of 3D printed molds and their compatibility with carbon fiber composites. In this paper, our team conducted tensile testing on the specimen and further x-ray diffraction was done to study the matrix composition and at last to study the feasibility of the process our team designed custom molds for application based parts.

Keywords: additive manufacturing, epoxy resin, chopped carbon fiber, molds, composites

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1. Introduction

Many industries, including the aerospace, automotive, railway, naval, sports industry, medical, and civil construction industries routinely employ carbon fiber-reinforced polymers (CFRPs) since they frequently provide higher advantages than the majority of other commonly used materials [1,2]. In additive manufacturing (AM) techniques, the usage of polymers is quite common and has applications in a wide range of fields [3]. According to the ISO/ASTM 52900:2015 standard, fused deposition modeling (FDM) or fused filament fabrication (FFF) is a material extrusion technique [4]. Recently, the technology around FDM/FFF has advanced quite quickly due to the low manufacturing costs and capacity to include a high level of automation [5-8]. With the help of this technique, complicated parts can be made from a variety of thermoplastic filaments, such as polylactic acid (PLA), acrylonitrile butadiene styrene (ABS), polycarbonates, nylons, etc., at a relatively cheap cost of manufacturing. However, FDM is too intrusive for many people. For example, the mechanical properties of thermoplastics parts are significantly worse than a more conventional manufacturing process like injection molding [9].

PLA is preferred over other materials in the context of Fused Deposition Modeling (FDM) owing to its low cost, strong three-dimensional (3D) printability, and natural biodegradability. In addition, the PLA has a lower thermal stress and this diminishes warping during the FDM process. [10]. The enhancement of mechanical properties and surface finish of a product produced through FDM printing can be achieved through the utilization of post-processing methodologies and modifications in the printing parameters. In the research conducted by Porter et al., an examination was carried out to determine the optimal infill percentage for PLA beams in order to enhance specific flexural rigidity, revealing that the optimum infill percentage is situated within the range of 10% to 20% [11].

In the realm of composite material (CM) production, there exists a diverse array of manufacturing methodologies and processes that are currently within reach. The utilization of molds, generated through various techniques and technologies, is a common practice for manufacturing components with intricate geometries. Conventionally, molds are crafted through the computer numerical control (CNC) milling of a solid block of raw material or diverse types of epoxy resins. This particular technological approach demands a substantial investment of labor and time, often accompanied by significant expenses. The adoption of CM presents an alternative route for mold creation; in this scenario, a prototype model is essential, generated through a technique tailored to the specific composite material intended for mold fabrication. In this

procedure, FRP layers are applied to the component model, the manufactured part is polymerized after which the mold is removed from the master model. Despite being time-consuming, this technique has a pretty high level of accuracy.

Rapid tooling (RT) [8,10,12,13] is a 3D printing process that was developed for short manufacturing runs. Depending on the material used, the technique can be used to create soft or hard tooling. Through the use of a master 3D printed model or directly through AM, RT is able to make tooling and molds. Thus, using additive manufacturing (AM) enables the direct and quick production of hard tooling, jigs, and molds from a variety of durable materials of the designer's choosing (metals, resins). This study [14] showed that 3D printed molds can be used in dental applications by 3D printing compression molds using PLA and ABS filaments, which were subsequently polished to create customized tooth fillings.

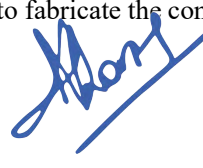
Forging [15, 16], injection molding[17], and CFRP[18] parts are just a few of the processes that have increased interest in the measurement of tools and molds by optical 3D scanning. Traditional molds, such as metal or epoxy resin blocks or composite molds, are frequently very durable but only economically viable when used in conjunction with mass production. Molds that can be created rapidly and for a reasonable price are becoming more and more necessary for the production of small quantities or customized items. An approach that will considerably cut manufacturing time and costs to make molds for CM is 3D printing using FDM/FFF processes and low-cost filaments, like PLA or ABS.

1.1 Literature review

bera et al [1] discuss the unconventional method to manufacture a complex carbon fiber reinforced part using a fused depositional modeled die. In their research they discuss the advantages of carbon fiber reinforced polymer and their application in various industries. [1] Has taken the sports industry as their application. Since there are many categories of additive manufacturing they have chosen fused deposition modeling with an ASTM standard since out of all the categories fused deposition modeling has the lowest production cost and has high degree of automation. [1] Has also discussed about the capability of FDM to manufacture low cost part as compared to conventional manufacturing method. Although FDM is cost effective, it also has a lot of limitations when compared to traditional methods of manufacturing. To manufacture the molds [1] has chosen Poly lactic acid as the material as compared to acrylonitrile butadiene styrene and have subsequently discussed the application of PLA and ABS. [1] has defined rapid tooling. [1] Concludes that 3D printed molds can be effective approach for limited production runs of composite parts. [2] Stated that additive manufacturing with chemical smoothening of molds can give a smooth external surface finish to the component to be made. [2] Compared the advantages of FDM molds as compared to fiberglass molds. [2] Gave an explanation on chemical smoothening by isopropyl alcohol. [2] Fabricated Fuel Tap Protection for Husqvarna Motorbike with carbon fiber sheets. [2] Sliced the component in cure and chose the optimized orientation of the component. The orientation with minimum surface defects on the curvature and minimum staircase effect on the surface was chosen. Settings of cura were optimized so that there was minimum material wastage. Dimensional Verification of a 3D-Printed Mold was done with an Optical 3D Scanner. [2] Used vacuum lamination process to fabricate the component.

1.2 Literature gap

In this research paper our team has used the FDM process for manufacturing molds. PLA was chosen to manufacture the molds since it is more economic as compared to other materials. Our team used chopped carbon fiber to fabricate the specimen. Compression molding was done.



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2. Materials and Methods:

2.1 Design of Connecting

Materials:

Chopped Carbon fiber (Plain weave)

Epoxy resin (Clear)

Hardener (Non-toxic)

3D printer filament (PLA)]

Methods:

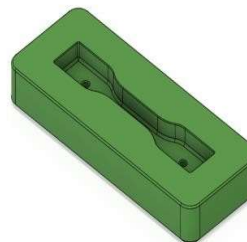
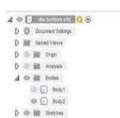
CAD design and 3D printing of molds: The CAD model of the required part was designed using computer-aided design software. The mold design was then converted to an STL file and 3D printed using a fused deposition modeling (FDM) 3D printer. The printing material used was polylactic acid (PLA) filament.

Mold preparation: Once the mold was printed, it was cleaned and coated with a release agent to prevent the carbon fiber composite from sticking to the mold during the curing process.

Composite layup: The carbon fiber fabric was trimmed to the specified measurements and positioned onto the mold. Subsequently, epoxy resin was blended with hardener in accordance with the guidelines provided by the manufacturer, and then administered onto the fabric using either a brush or roller.

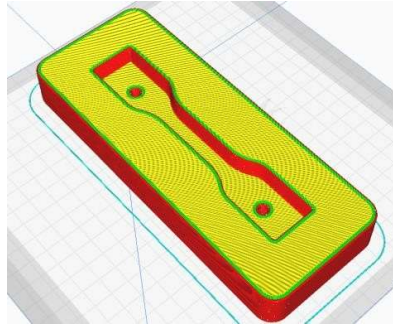
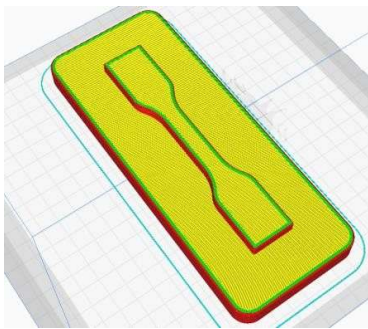
Curing: The carbon fiber composite underwent the curing process within a regulated setting at ambient temperature for duration of 24 hours.

Mold removal: Following the completion of the curing process, the mold was cautiously extracted from the component made of carbon fiber composite.



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Fig. 1. (a) Male Die CAD design; (b) Female Die CAD design



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Fig. 2 (a) Male Die ; (b) Female Die



Table 1. 3D printing process parameters

Parameter	Value and Unit
Nozzle diameter	0.4 mm
Layer height	0.2 mm
Wall thickness	0.8 mm
No. of walls	4
Infill density	45 %
Nozzle temperature	205 °C


Table 1. Chopped carbon fiber properties

Property	Value and Unit
Fiber length	12 mm
Density	1.81 g/cm ³
Carbon content	95%
Tensile strength	3800 Mpa
Elastic modulus	242 Gpa

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Table 2. Epoxy resin properties

Property	Value and Unit
Mixing ratio	3:1
Curing time	24 hrs
Tensile strength	78 MPa
Ultimate strength	68 MPa
Tensile modulus	3250 MPa
Flexural strength	90 MPa
Flexural modulus	3700 MPa
Shear strength	58 MPa

Conclusion

Thus this study presents the investigation of 3D printed molds for fabricating carbon fiber composites as a cheap prototype alternative with applicable feasibility and effectiveness. These 3D-printed molds were then fabricated and investigated for their composite properties in the research analysis. The results showed that 3D-printed molds are able to produce carbon fiber composites, which have similar properties as those manufactured using conventional methods.

Further, the non-contact 3D scanning technology facilitated an accurate and dependable operational one for quality control, where the derived information generated necessary tweaks to improve final product quality. The cost-effective and suitable alternative of 3D printed molds was demonstrated by cost-time efficiency analysis compared to traditional methods. In general, this study establishes 3D printed molds for CFRP production as an applicable and encouraging route to low-cost prototyping in the composites industry with potential for improvements to increase manufacturing efficiency and part performance.

Molds manufactured via FDM with thermoplastic polymers exhibit notably reduced expenses and quicker production times, approximately 37.5% and 30% lower, respectively, in comparison to aluminum molds milled using CNC techniques. At first, a high-viscosity epoxy resin designated for casting purposes was utilized, yielding test specimens with slightly inferior strength. Transitioning to a lower-viscosity epoxy resin tailored for carbon fiber composites resulted in enhanced strength.

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Deep Fake Video Detection Using ResNext and LSTM

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Abstract— Deep-fake technology has led to a great deal of anxiety around face alteration on the internet, which has prompted extensive study into detecting techniques. Conventional methods approach deep-fake detection as a binary classification problem, in which global features are extracted by a backbone network and classified as real or false. However, this approach is considered poor because of the tiny and localized changes between false and actual images. We present a novel deep-fake detection paradigm in our paper, which reframes the issue as a task of fine-grained categorization. Three essential elements make up the multi-attentional network that our approach presents. Initially, separate local portions of the image are the focus of several spatial attention heads. Secondly, tiny artefacts inside shallow features are amplified using a textural feature augmentation block. Finally, using attention maps as a guide, we combine high-level semantic information and low-level textural features. We present a new regional independence loss and an attention-guided data augmentation technique to support learning in this intricate network. Numerous tests conducted on a variety of datasets show how effective our method is when compared to conventional binary classifiers. Our approach demonstrates its superiority in accurately detecting deep fake content by achieving state-of-the-art performance

Keywords— Residual Networks, Long Short-Term Memory, Convolutional Neural Network, Recurrent neural network, amalgamation.

Introduction

To efficiently detect deepfakes (DF), it's crucial to understand how Generative Adversarial Networks (GANs) produce them. GANs take an input image and a target person's image to create a video where the target's face is swapped with a different person's (the source). Deep adversarial neural networks, trained on target videos and face photos, translate the source's expressions and faces to the target. After post-processing, the resulting videos can appear very realistic.[1] The GAN method divides the video into frames, replaces each frame with the input image, and reconstructs the video, often using autoencoders. We propose an advanced deep learning method to distinguish authentic videos from deepfakes (DF). Our approach generates DFs similarly to GANs, relying on specific DF video traits. Due to production and computational limits, DF techniques synthesize face images of a given size, requiring affine warping to fit the source's facial shape. This results in observable aberrations from resolution differences between the distorted face region and its context. By analyzing frames and isolating the face areas, we identify these artifacts. We use ResNext Convolutional Neural Network (CNN) features and a Recurrent Neural Network (RNN) with Long Short Term Memory (LSTM) to detect temporal discrepancies between frames introduced by GAN. [2]

Related Work

A range of deep learning methods, such as hybrid architectures, GAN-based models, and conventional CNNs, have been investigated for deep fake detection. According to research by David G'uera and Edward J. Delp, recent developments in CNN architectures like ResNext have shown promise in capturing complex elements essential for spotting corrupted information.[1]

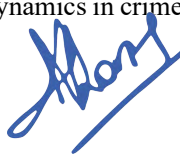
ResNext expands ResNet by using grouped convolutions to enhance performance and scalability. Its ability to extract frame-level details enables it to detect subtle signs of deep fakes, as shown in studies by Nicolas Rahmouni and colleagues. LSTM-based RNNs are effective for temporal analysis in videos, identifying patterns and anomalies over time. While prior deep fake detection research has explored RNNs for temporal context and CNNs for image analysis, little research has combined advanced CNNs like ResNext with LSTM-based RNNs specifically for deep fake detection. [2]

Challenges include the need for extensive annotated datasets, interpretability of deep learning models, and resilience to adversarial attacks. To improve detection accuracy and generalization, opportunities include multimodal data fusion, attention mechanisms, and transfer learning. Common evaluation metrics for deep fake detection are AUC-ROC curve analysis, accuracy, precision, recall, and F1 score. The effectiveness of the proposed ResNext CNN + LSTM-based RNN architecture, as discussed in "An Overview of ResNet and its Variants," will be determined through comparative tests against baseline models and advanced techniques. [3]

Gao et al. developed a deep learning model that integrates spatial and temporal data to predict crime hotspots. The model, tested in several urban areas, showed a significant improvement in accuracy compared to traditional statistical methods [15].

Ramirez and Thompson utilized reinforcement learning to dynamically allocate police resources. Their approach not only predicted crime but also optimized patrol routes, leading to a reduction in response times and crime rates in pilot cities [16].

Lee and Kim applied a spatiotemporal clustering algorithm to identify emerging crime hotspots in real time. Their study emphasized the importance of temporal dynamics in crime analysis, revealing that certain hotspots exhibit cyclical patterns [17].


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Singh et al. used a combination of GIS and machine learning to map crime across rural and urban settings. Their findings indicated significant differences in crime patterns between these areas, which can inform targeted interventions [18].

Miller et al. conducted a case study on implementing a predictive policing system in Chicago. The system's deployment led to a noticeable reduction in property crimes, although its impact on violent crimes was less pronounced [19].

Davies and Clark reported on using AI-driven crime analysis in London, focusing on its integration with existing law enforcement workflows. They identified significant improvements in crime clearance rates and operational efficiency [20].

PROPOSED SYSTEM

The goal of our suggested approach is to solve the lack of instruments for identifying deepfakes (DF), which can stop them from spreading widely over the internet. We are confident that our strategy will significantly lessen the dissemination of DF information. We intend to provide an easy-to-use online platform where people can post films and mark them as authentic or fraudulent. This platform has the potential to be expanded into a browser plugin that facilitates automated DF detection. This would allow users to identify DF before sharing content with others and access it from a variety of applications, including Facebook and WhatsApp.

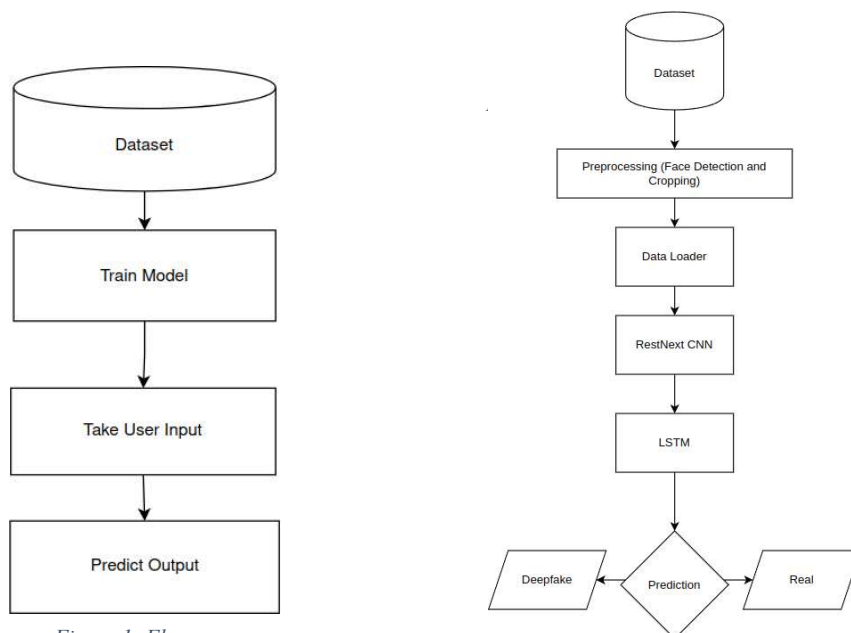


Figure 1: Flow

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Assessing the system's performance in terms of security, usability, accuracy, and dependability is our main goal. Our approach is intended to identify different kinds of DF, such as replacement DF, retrenchment DF.

Working Methodology: SYSTEM ARCHITECTURE

Our system architecture, as depicted in Figure , is straightforward and effective for DF detection

Dataset

To optimize our model for real-time prediction, we curated a comprehensive dataset from diverse sources, including FaceForensic++ and Celeb-DF. This amalgamation yielded a robust dataset comprising 6000 videos having half fake and half real videos. This balanced distribution, with equal proportions of real and fake videos, mitigates training biases and enhances the model's ability to generalize across various scenarios. By leveraging this rich dataset, we aim to achieve both accuracy and efficiency in real-time deep fake detection, addressing the challenges posed by audio-altered content and ensuring a robust evaluation framework.

Pre-processing

Video preprocessing involves a number of changes to remove unnecessary noise and extract important content. At first, the videos are divided into frames, and then facial recognition software finds and crops the frames that have faces in them. These trimmed frames are then put back together to create new videos, creating a dataset that only includes facial content. A deliberate threshold of 150 frames per movie was set in order to maintain consistency and efficiently handle computing needs. The decision was impacted by two factors: the need for consistency throughout the dataset and computational limitations, which took into account the GPU's processing capacity in our test configuration. 300 frames make up a 10-second video at 30 frames per second, therefore processing so many frames at once presents substantial computational difficulties. By following the 150-frame cutoff, we achieve a balance between homogeneity of the dataset and computational feasibility.

Model

Their model uses a combination of RNN and CNN components to detect deep fakes. For frame-level feature extraction, they use a pretrained.

The ResNext CNN model, in particular the ResNext50_32x4d version, is renowned for its speed optimization and depth. A sequential LSTM layer receives the 2048-dimensional feature vectors produced by the last pooling layers of the ResNext model.

This LSTM network has 2048 hidden layers, one layer with 2048 latent dimensions, and a 0.4 dropout probability to increase model resilience.

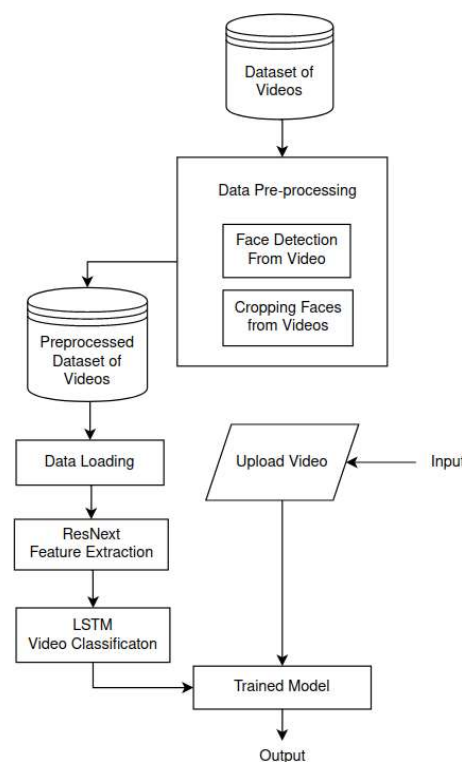


Figure 3: Model Architecture

They intend to add more layers to the architecture and adjust the learning rate to the model to help with gradient descent convergence. By comparing frames taken at various time intervals, the LSTM's sequential processing capabilities allow for temporal analysis, which improves the model's capacity to identify temporal irregularities suggestive of deepfakes.

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In order to successfully learn the correlation rate between inputs and outputs, their model architecture incorporates a Leaky ReLU activation function and has a linear layer with 2048 input dimensions and 2 output dimensions. The adaptive average pooling layer is utilized to attain goal image sizes in the H x W format, with an output parameter of 1. A sequential layer facilitates sequential frame processing, and batch training is carried out using a batch. Training is done using the Adam optimizer, which has an initial learning rate of 0.001. When learning rate scheduling is used, the learning rate is decreased by a factor of 0.1 in the event that the validation loss reaches a plateau after two epochs. Using random search, hyperparameters are adjusted to maximize validation accuracy.

Accuracy, precision, recall, F1 score, ROC-AUC, and confusion matrix analysis are used to assess the performance of the model on the testing set. Plotting training and validation curves allows you to keep track of your progress and identify any overfitting.

Future research will examine attention processes to concentrate on educational areas in films and include audio analysis for thorough deep-fake detection, as well as implementing the model in live applications for ongoing observation.

Different Model Layers:

- ResNext CNN: The model employs a ResNext50_32x4d model that has already been trained. This kind of A 32 x 4 convolutional neural network (CNN) with 50 layers. The purpose of this model is to extract features from photos.

- Sequential Layer: To arrange the feature vectors derived from the ResNext model in a sequential fashion, a Sequential Layer is employed. The characteristics must be passed to the next LSTM layer in an ordered sequence, and this arrangement is essential.

- LSTM Layer: For processing sequences and capturing temporal changes in data, like frames in a movie, Long Short-Term Memory (LSTM) networks are utilized. One LSTM layer with 2048 latent dimensions, 2048 hidden layers, and a dropout probability of 0.4 are all included in the model. This layer bears accountability.

- Rectified Linear Unit (ReLU) Activation Function: ReLU is the activation function that is employed. When inputs are negative, it outputs 0; otherwise, it outputs the input value favourable contributions. ReLU is favoured over other activation functions like sigmoid because of its non-linearity and effective training qualities.

- Dropout Layer: To stop the model from overfitting, a Dropout Layer with a dropout rate of 0.4 is included. During training, this layer randomly switches the output of neurons to zero, which helps the model become more broad and less sensitive to particular features.

- Adaptive Average Pooling Layer: This layer is used to collect low-level information from nearby elements and to lower computational cost and variation. For these uses, a 2-dimensional Adaptive Average Pooling Layer is incorporated into the model.



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Prediction:

The trained model is applied to new videos in order to make predictions. The new video format is aligned with the trained model by preprocessing, which includes face trimming and putting clipped frames directly into the detector without storing them locally. By greatly improving DF detection capabilities, this system architecture and methodology will contribute to a safer online environment.

ROLE OF SOCIETY

Crime data analysis is not solely the domain of law enforcement agencies and researchers; society plays a critical role in the collection, interpretation, and application of this data. The involvement of the community can enhance the accuracy, relevance, and ethical considerations of crime data analysis. This section explores the multifaceted role of society in crime data analysis, emphasizing the importance of public participation, transparency, and ethical engagement [21].

1. Community Participation in Data Collection

Active participation of the community in crime data collection can significantly enhance the richness and accuracy of the data. Community members can provide firsthand information and insights that might not be accessible through official channels.

- **Crowdsourcing Data:** Platforms like mobile applications and online reporting systems enable community members to report crimes or suspicious activities in real-time. For instance, the use of mobile apps in cities like New York and London has allowed residents to contribute to real-time crime mapping, thus providing law enforcement with up-to-date information (Ahmed et al., 2024).
- **Neighborhood Watch Programs:** These programs encourage residents to monitor and report any unusual activities, fostering a sense of collective responsibility and vigilance. The data collected through these initiatives can be integrated into broader crime analysis efforts to identify patterns and trends [22].

2. Public Engagement and Transparency

Ensuring transparency in crime data analysis fosters trust and cooperation between the community and law enforcement agencies. Public access to crime data and the methods used for analysis can lead to more informed and engaged citizens.

- **Open Data Initiatives:** By making crime data publicly accessible, law enforcement agencies can promote transparency and accountability. Open data portals allow researchers, journalists, and the general public to analyze crime data independently, potentially uncovering new insights and fostering a collaborative approach to crime prevention (Ahmed et al., 2024) [21-22].
- **Public Forums and Feedback:** Hosting public forums and soliciting feedback on crime data analysis methods and findings can help ensure that the community's concerns and perspectives are considered. This inclusive approach can also help identify and address any biases or inaccuracies in the data.

3. Ethical Considerations and Bias Mitigation

The role of society is crucial in addressing ethical issues and biases in crime data analysis. Community input can help ensure that the methodologies and applications of crime data are fair and just.

- **Bias Identification:** Community members can help identify biases in crime data analysis that may disproportionately affect certain groups. For example, public scrutiny and input can highlight racial or socioeconomic biases in predictive policing models, prompting necessary revisions and improvements (Johnson & Harris, 2023).
- **Ethical Oversight:** Ethical oversight bodies comprising community representatives, ethicists, and legal experts can review and guide the use of crime data analysis tools. This oversight can ensure that these tools are used responsibly and do not infringe on individuals' rights or privacy [21].

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4. Educational Initiatives and Awareness

Educating the public about crime data analysis and its implications can lead to more proactive and informed community participation.

- **Workshops and Training:** Offering workshops and training sessions on how to access and interpret crime data can empower community members to engage more effectively with crime prevention efforts [22].
- **Awareness Campaigns:** Public awareness campaigns about the benefits and limitations of crime data analysis can help manage expectations and foster a more nuanced understanding of its role in crime prevention.

Results & future scope

The combination of ResNext and LSTM in the proposed architecture significantly enhances the accuracy and robustness of deep fake video detection. The model demonstrates high effectiveness in identifying deep fakes, particularly when augmented with multimodal data and attention mechanisms. However, future work should focus on improving resilience to adversarial attacks and further exploring interpretability techniques to ensure comprehensive and reliable deep fake detection.

Future research in deep fake video detection using ResNext and LSTM should focus on enhancing adversarial robustness, optimizing real-time detection, integrating multimodal data, leveraging transfer learning and domain adaptation, improving model interpretability, expanding annotated datasets, addressing ethical concerns, exploring hybrid and novel architectures, incorporating user feedback systems, and ensuring cross-platform compatibility. These advancements will make deep fake detection more effective, reliable, and user-friendly across diverse applications and environments.

The model is accurate to about 84% when predicting whether a video is a deep-fake or real based on only 10 frames or less than 1 second (assuming a 30 frames-per-second video).

Trained Model Results:

Model Name	Dataset	No. of Videos	Sequence Length	Accuracy
model_90_acc_20_frames_FF_data	FaceForensic++	2000	20	90.95
model_95_acc_40_frames_FF_data	FaceForensic++	2000	40	95.22
model_97_acc_60_frames_FF_data	FaceForensic++	2000	60	97.45
model_97_acc_80_frames_FF_data	FaceForensic++	2000	80	97.73
model_90_acc_100_frames_FF_data	FaceForensic++	2000	100	97.76
model_93_acc_100_frames_FF_data	FaceForensic++, Celeb-DF	3000	100	93.95
model_87_acc_20_frames_FF_data	FaceForensic++	6000	20	87.95
model_84_acc_10_frames_FF_data	FaceForensic++	6000	10	84.56
model_89_acc_40_frames_FF_data	FaceForensic++	6000	40	83.45



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Figure 4: Results

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Performance Enhancement of Electric Vehicle with Super capacitor

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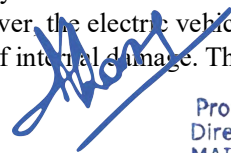
Abstract: This paper investigates the benefits of integrating super capacitor with battery based propulsion system to reduce the overall transient losses and efficiency improvements of electrical vehicles. The super capacitor provides the inrush starting current of the electric vehicle (EV) due to its high rate of discharge current characteristics, and thus, inrush current from the battery is avoided. This results minimum voltage drop due to battery internal resistance across battery terminal while electric vehicle accelerates. The EV motor dynamic torque is increased which is especially useful for racing cars. The regenerative braking is utilized to charge the battery while EV decelerates during brakes are applied. This also enhances the battery efficiency and makes the battery long lasting.

1. INTRODUCTION

The global warming concerns, limited stock of exhaustible fuels and embargo compels to adopt the electric vehicles. This has revolutionized the mobility industry. The EV market is growing exponentially and people are always comparing the performance of EV with fossil fuel based automobiles [1]. The overall efficiency of electric vehicles are 75-80% and gasoline engine are 30-35% [2]. The racing car industries demand high performance and brilliancy of engineering to achieve the goals. The current scenario in the field of electric vehicles and powertrain has observed the emergence of utilizing battery and super capacitor in hybrid model. The basic structure includes the parallel operation of battery and super capacitor, which are connected at DC bus and utilizes a DC bus controller to deliver power.

The starting current of the electric motors is very high till it reaches to base speed [3], this causes the bandwidth of transient state to expand causing the battery to provide high current for longer time period. Thus, battery life reduces due to overheating caused by battery internal resistance [4]. The motor dynamic torque is limited due to insufficient battery current [5], and the battery high discharge current decreases the power backup of battery and range [6]. These shortcoming are overcome by utilizing the super capacitors. The properties of charging and discharging of super capacitor at high rate is used to deliver the required current surge at the transient state of the circuit [7]. Moreover, the super capacitor high power density and short charging and discharging time capability meets the dynamic current demand of electric vehicles without loss of energy in internal resistance beside facilitates rapid energy recovery associated with regenerative braking and rapid energy dissipation associated with sudden torque requirements [8]. The Charging time of capacitor is $5RC$ and discharging time is RC where R is active part of load impedance [9].

This paper investigates the use of super capacitor in addition to battery to feed the electric vehicle, and thus, to improve the dynamic torque performance of the vehicle. Moreover, the electric vehicles are prone to sudden jerks and continuous vibrations which increases the chances of internal damage. Thus, a flexible polymer based double layered super capacitor is utilized in this work.



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2. PROPOSED PROPULSION SYSTEM BLOCK DIAGRAM

The block diagram of the proposed propulsion system is depicted in Fig.1. This block diagram includes battery charger, battery, super capacitor charger, super capacitor, Induction Motor controller, Regenerative braking system and the induction motors (M1 and M2). The regenerative braking system converts the kinetic energy of vehicle to charge the battery and thus, the overall efficiency of vehicle is increased. Typically, a C5 rating battery is used. The efficiency drops during transient state of vehicle and optimum

level of performance is not achieved. The higher C rating battery increases the cost of vehicle. The Super capacitor is used to achieve similar performance to that of higher C rating battery, which results in significant decrease of cost, weight and power loss.

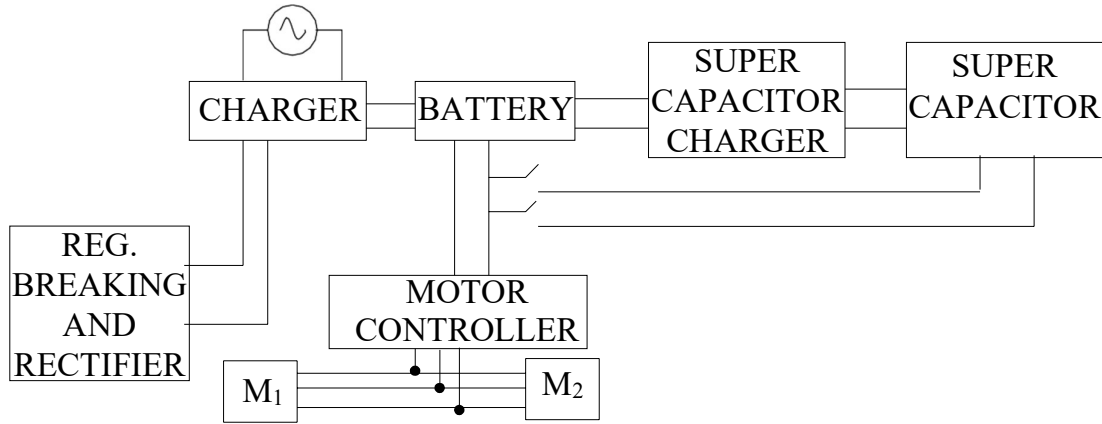


Fig.1 Block diagram of propulsion system

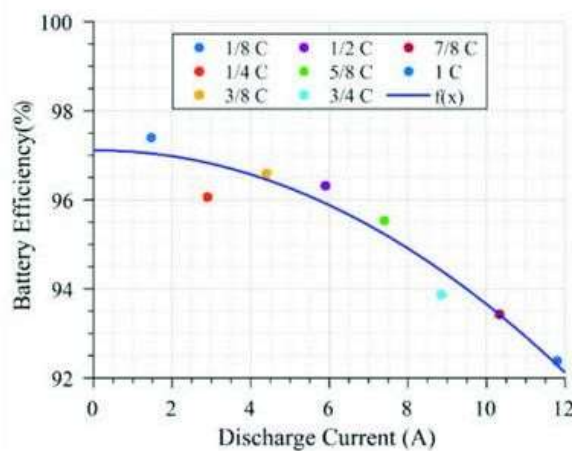
3.

METHODOLOGY

The torque produced by induction motor is given [5] as,

$$T_m = \frac{3P}{2} \times \frac{L_m^2}{L_m + L_R} i_{sd} \times i_{sq} \quad (1)$$

Thus, torque produced by motor is proportional to the product of currents. The motor requires higher torque at the time of initiation of motion and acceleration. Which results in higher discharge rate of battery and therefore rapid decrease of battery efficiency. This is clear from the plot of battery discharge rate and efficiency for various C rate battery as depicted below,



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Fig. 2 Discharge current and battery efficiency

The super capacitor is integrated to the battery to overcome these draw backs. The charging and discharging equations of capacitor are given as,

$$i_c = i_0 (1 - e^{-t/T}) \quad (2)$$

$$i_d = \left(\frac{i_0}{T}\right)e^{-t/T} \quad (3)$$

The super capacitor is simple capacitor but have very high capacitance which make it effective for storing energy in form of electric field. The capacitance of super capacitor is increased by

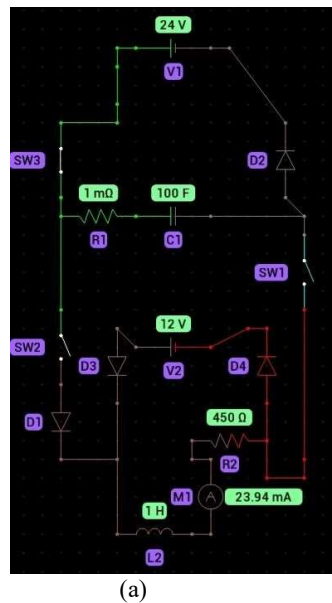
- Use of graphene allotrope of carbon which is conducting in nature so that equivalent distance (**d**) is reduced and capacitance is increased.
- Use of activated carbon which increases the surface area (**A**) and increases capacitance.
- Use of dielectric material of high dielectric constant so that relative permittivity(**ε_r**)is increased and capacitance is increased

The energy stored by super capacitor is given as,

$$E = \frac{1}{2} \times C \times V^2 \quad (4)$$

4. CIRCUIT DIAGRAM AND IMPLEMENTATION

The circuit diagrams of electric vehicle propulsion system is depicted in Figs. 3(a)-(b). Inductor and resistor connected in series represents the motor parameters connected to 12 V battery supply. Fig. 3(a) illustrates charging of the super capacitor to its full potential while switch SW1 and SW2 are open and main motor circuit (SW3) is closed. The constant current of 23.94mA flows, and the super capacitor charges to 24V. This is achieved by controlling the operation of switch SW3. The open state of switch SW1 and SW2 prevents leakage current of main motor circuit. Fig. 3(b) depicts that super capacitor is fully charged and SW3 is open while SW1 and SW2 are closed which is creating the pathway through the motor for the discharge current of super capacitor and the current has reached the value of 50.69mA. The switch SW1 and SW2 are the boost converter switches. The unipolar voltage switching concept is used to control the switching of the switches. Diode provides restriction in backward flow of current or shorting of capacitor through the battery. The MATLAB code to realize the electric vehicle is given in Appendix.




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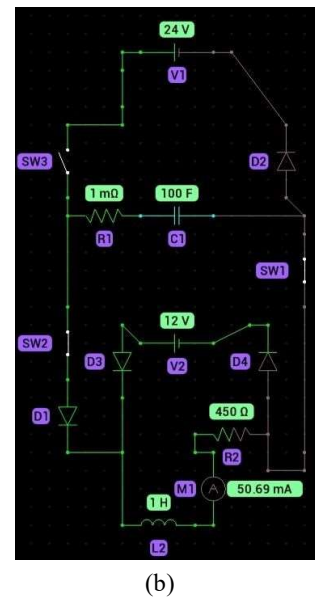


Fig.3 Circuit diagram of electric vehicle propulsion system (a) Switch SW1, SW2 open and SW3 close (b) SW1, SW2 close and SW3 open

5. RESULTS AND DISCUSSIONS

Fig.4 depicts the plot for variation of motor current, motor torque and motor speed with respect to time in both the conditions while super capacitor is integrated with battery and super capacitor is not integrated with battery. It is observed that the torque produced by motor while super capacitor is integrated during transient conditions is much more than the super capacitor is not integrated to battery. Moreover, the stress on the battery, especially, during transient conditions is reduced because major part of the motor current is fed by the super capacitor. The quick acceleration is also observed while the super capacitor is integrated.

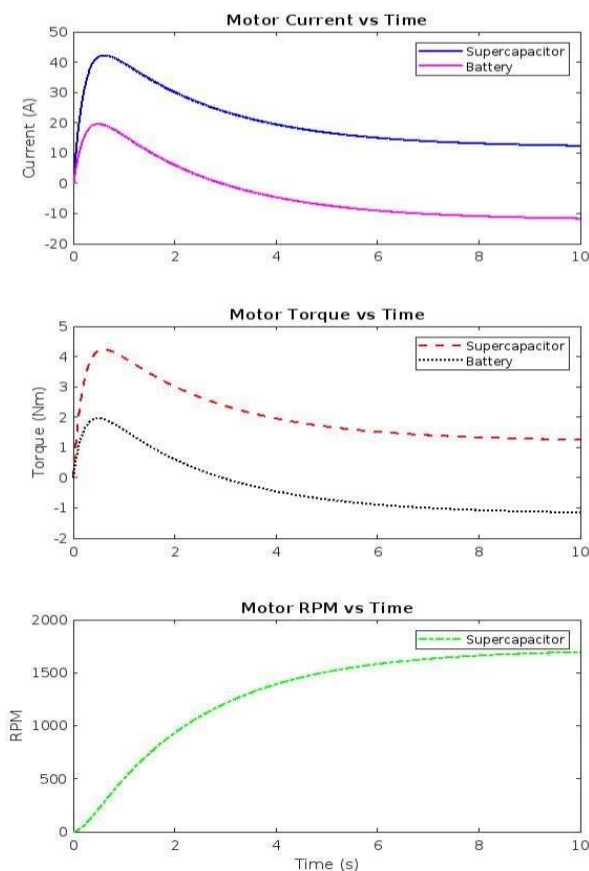
6. CONCLUSION

The performance of the electric vehicle integrated with super capacitor is investigated. The super capacitor provided the inrush current required by the electric vehicle motor during dynamic conditions such as during initiation of motion and acceleration. Thus, rapid increment of electric vehicle torque is achieved which results in quick acceleration of vehicle. Furthermore, the control circuit and super capacitor add on to the total cost. The implementation of more effective control unit is still in research.



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Fig.4 Plot of motor current vs time, motor torque vs time and motor speed vs time




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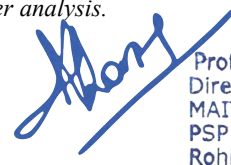
Bidirectional Visitor Counter using ESP32 with SpO2 Screening and Light Automation

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Abstract. This paper presents a system that counts the number of people who enter a specific room after it has been screened for heat, heart rate, SpO2 and lights it appropriately. After a certain number of visitors have entered a room, the shutters will close. The visitor will be denied to enter the room if the visitor does not pass thermal, heart rate and SpO2 screening, but can be allowed through the telegram app if screening results just cross the threshold value. Telegram app can also be used to check the number of persons in the room and change the light color of the room. The RGB LED is switched ON, when somebody enters the room and the LED is switched OFF, when nobody is in the room automatically. The MLX90614 sensor is used for checking temperature, the MAX30102 sensor is used for checking heart rate and the SpO2 of visitors. A servo motor is used for controlling the shutter of the room. All the visitor's data and logs are saved on Google Sheets automatically for further analysis.

Keywords: counter, automation, ESP32, MAX30102, MLX90614.



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INTRODUCTION

The system is built using ESP32 microcontrollers, MAX30102 sensor for checking heart rate and blood oxygen, MLX90614 sensor for checking temperature, infrared sensor for counting the number of visitors, RGB LED for light automation and servo motor is used as a shutter for the room. The ESP32 continuously monitors the three infrared sensors, first one is placed at the entrance, the second one after the screening and the third one at the exit. When a visitor passes through the first infrared sensor, infrared rays are mirrored back to the receiver, sending an active low signal to the ESP32. The status LED colour turns dark orange from green and closing the shutter to half-closed. During the screening, the status LED colour changes from dark orange to light orange. After the thermal, heart rate and SpO2 screening is done using MLX90614 and MAX30102 sensors, if the visitor has any abnormalities the status LED colour changes to red from light orange, sending a request access message to the Telegram app. If the administrator using the telegram app gives access, then the status LED colour will change to green from red and opening the half-closed shutter of the room and if the administrator denies then the status LED colour will remain red and closing the half-closed shutter of the room. Due to denial of the entry, the visitor exits from the first infrared sensor. Thus, resetting the count of the first infrared sensor. If the visitor has passed the screening successfully, then the status LED colour will change to green from light orange and opening the half-closed shutter of the room. As soon as the visitor crosses the second infrared sensor, the number of persons entered is incremented by one and the screening data of the visitor along with the date and time is logged on the Google Sheets automatically. The RGB LED is switched ON when any visitor enters the room and the LED is switched OFF when nobody is in the room automatically [7, 13]. The room LED colour can be changed using the Telegram app. If the number of persons reaches a certain value, the shutter of the room will close. Thus, allowing no one to enter the room. This maximum limit can be changed using the Telegram app. The third infrared sensor placed at the exit, counts the number of visitors exited and logging the date and time of the visitor on the Google Sheet. This project can be used in schools, colleges, auditoriums, offices, etc. for maintaining social distancing after screening to prevent the spread of COVID-19 [11] since the project can count the number of visitors and do thermal, heart rate and SpO2 screening without any human interference.

LITERATURE REVIEW

A number of writers talked about different weather monitors and bidirectional visitor counter systems that count visitors to a specific room. The use of a MAX30102 photometric biosensor in conjunction with an ESP32 microcontroller to build a system for ongoing patient oxygen saturation and heart rate monitoring is covered in the paper by Contardi et al. [1] The sensor, microcontroller, and web server for data analysis and display are all part of the system architecture that the authors outline. The accuracy of the system's measurements is demonstrated by the experimental results they also present. A "system to count the number of individuals entering and leaving a room by incorporating infrared sensors and microcontrollers" is designed [2]. To summarize, an automated room light controller and a security feature combating unapproved entry were created. In conclusion, the authors designed and

implemented this program providing a detailed guide to experimental findings showing the operation of the system. Additionally, in an industrial automation installation, the integration of a bidirectional visitor counter is feasible [3].

To aid plant managers in capacity preparation and resource distribution, the system has been designed to count the number of individuals that enter a production facility and the numbers in real-time. The microcontrollers and infrared sensors that make up the system architecture are explained by the authors, who also provide test results that establish the accuracy of the system's measurements. Khushal Verma et al. not only reconstruct a sanitization and monitoring system to distribute the number of people that move in and out a building but also provides a means to check for deadly diseases and prevent their spread [4]. In the investigation, the authors test the system, which has a sanitization facility, thermal screening cameras, and an infrared sensor and microcontroller to count individuals, and demonstrate the accuracy and efficiency of each component. Another study elaborates on an approach, which is counting the number of people moving in and out of a room using an Arduino microcontroller and Infrared sensors. The authors also incorporate a Room Light Controller that is triggered automatically to dim the lights of any empty space and hence conserving energy [5]. The authors of the study describe how the system was designed and implemented. They also present the experimental results, which showed that the system was effective.

The next system "Automatic Room Light Controller with Bidirectional Visitor Counter" counts room's people entering and leaving and automatically turns on and off the light depends on the occupancy of the room. Infrared sensors determine the existence of humans, while a microcontroller is responsible for turning on and off the light. There is also a bidirectional visitor counter that tallies the number of people who enter and exit the room [8]. This work also demonstrates the experimental evidence that the proposal is effective and detailed information about the system software and hardware is provided. The next system "Smart Heart Health Monitoring System Using IoT" suggests a system that monitors a person's heart condition [9]. The system includes a wearable gadget that takes a user's blood pressure and heart rate before sending the information to a cloud server. A mobile application that shows the data and sends out alerts in the event that any abnormalities are found is also part of the system. The paper includes experimental results demonstrating the efficacy of the suggested approach along with a thorough description of the system's hardware and software components. The article "Health Measure Kit and Finding a Potential Covid-19 Suspect Using IoT" suggests a method for tracking a person's health and looking for possible COVID-19 suspects using IoT technology [10]. A wearable gadget is part of the system that takes a user's body temperature, heart rate, and oxygen saturation and sends the information to a cloud server. Additionally, the system has an AI-based algorithm that examines the information to find probable COVID-19 suspects. The paper offers a thorough explanation of the system's hardware and software components as well as experimental findings demonstrating the efficacy of the suggested methodology. The 2021 paper by T. H. Hafsiya and B. Rose presents describes a wearable device that monitors COVID-19 patients' health using cloud and Internet of Things (IoT) technologies [11]. The purpose of the device is to track the patient's vital indicators, including heart rate, body temperature, and oxygen saturation level. The device transmits the data it has collected to the cloud for analysis and storage. Additionally, the device has an alert system that can alert medical professionals if the patient's condition worsens. The gadget is accurate and dependable, according to the authors' testing.

Contactless systems that takes attendance automatically using thermal imaging camera is proposed by dibyayan patra et. al. in 2021. They measure person's temperature with or without mask along with camera that basically records the use's face. The complete analysis is done by some machine learning algorithms [12]. The complete system is intended to analyse and based on this analysis, to share person's health with authorities about feverish and whether person is with mask or not. A smart temperature measurement system for a milling process application is presented in the paper "Smart Temperature Measurement System for Milling Process Application Based on MLX90614 Infrared Thermometer Sensor with Arduino [13]." The system measures the milling process's temperature in real time using an Arduino microcontroller and an MLX90614 infrared thermometer sensor. The system is accurate and dependable, according to the authors' testing in a lab environment. SpO2 Several authors discussed on various bidirectional visitor counter systems to count the number of visitors visiting a particular room. The paper by K Mohana Prasad et al. [3] shows Industrial Automation build using Arduino. It will bidirectionally count the number of persons in an industry. Humidity and temperature sensors in the industry will check the humidity and temperature of an industry respectively. The paper by Subhankar Chattoraj et al. [5], Gaurav Waradkar, et al [6] and Kadam Shah [8] shows Arduino being used for bidirectional visitor counter with automatic light controller. The paper by Saikat Sarkar et al. [2] shows a circuit which works as a security system with a camera attached as well as is used to toggle the light in the room according to the number of the visitors in the room. This gave the idea of using RGB LED for light automation with bidirectional visitor counter. The paper by Jayanthi G et al. [9] shows smart health monitoring system for the heart using IoT built on Arduino Uno. The paper by Radwa Sameh et al. [7] shows the use of Arduino with MAX30102 to collect SpO2 and Heart Rate data from the user. The paper by U. A. Contardi et al. [1] shows the utilisation of the photometric biosensing module MAX30102 attached to ESP32 to continuously collect and process SpO2 and Heart Rate data from the user on the webserver. This gave the idea of using MAX30102 for checking the HR and SpO2 values of the visitors. The paper by Agus Sudianto et al. [13] shows the use of MLX90614 Infrared temperature sensor with Arduino and stores the temperature data on Microsoft Excel. The paper by N. Sikka et al. [10] shows a health

measure kit which can check blood oxygen, heart rate, temperature, lung capacity and detect COVID-19 suspects. The paper by T. H. Hafsiya et al. [11] shows patient's heart rate, blood oxygen, temperature and blood pressure data which are recorded on IoT cloud platform for remote diagnosis. The paper by Dibyan Patra et al. [12] shows a contactless attendance system built using ESP32, RFID and a temperature sensor to detect the temperature. The paper by Khushal Verma et al. [4] shows a bidirectional visitor counter that can be integrated with thermal screening and sanitizing.

PROPOSED SYSTEM

This section contains the block diagram that explains the hardware used circuit diagrams of complete system and describes components and the workflow of the proposed model.

BLOCK DIAGRAM

The proposed model consists of two ESP32, three infrared sensors, two RGB LEDs, a MLX90614 sensor, a MAX30102 sensor and one servo motor, this section contains the block diagram (Fig. 1.), hardware used, circuit diagram (Fig. 6.), a flow chart (Fig. 7.) and schematic diagram (Fig. 8.). As figure 1 shows the block diagram, consist of microcontroller ESP 32 which has Max 30102 sensor for SpO2 reading, RGB light for in or out positioning. It also comprises MLX 90614 sensor to get temperature readings. Along with it Servo Motors are there for room door closing. All these things are connected with Wi-Fi and cloud as the data will be on application (Telegram), which stores all the data.

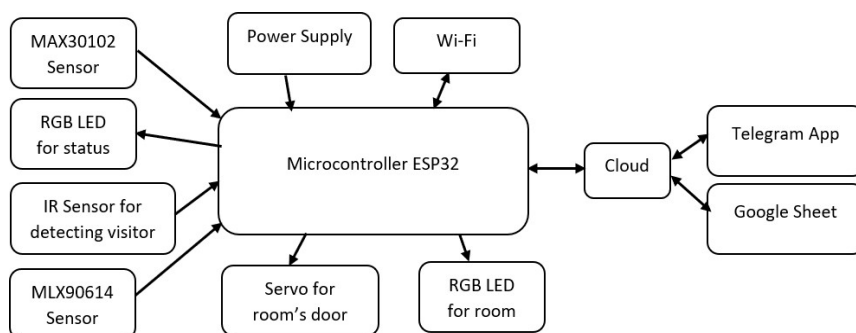


Fig. 1. Block Diagram of the Proposed Model

ESP 32: Fig. 2. shows an ESP32 microcontroller with Bluetooth and integrated Wi-Fi connectivity for various applications. In the proposed model, it is used to read the infrared sensor, temperature from the MLX90614 sensor and calculate heart rate and blood oxygen. It is also used to drive two RGB LEDs, one as a status LED and another as a room LED along with one servo motor for opening and closing the shutter of the room.



Fig. 2. ESP32 Microcontroller

Infrared Sensor: An electronic device that emits infrared rays which are mirrored back to the receiver, sending an active low signal to the ESP32. In the proposed model, there are three infrared sensors: two placed at the ends and one in the middle. The first infrared sensor is used to start the screening of the visitor, the second infrared sensor is used to tally the number of persons entered the room after the screening round and the third infrared sensor is used to tally the number of persons exited from the room.

MLX90614 Sensor: Fig. 3. shows an infrared thermometer used for getting measurements of a visitor's temperature. It can detect the temperature in the range of -70°C to 382.2°C [3]. It works from 3.3V to 5V input voltage [4]. It sends the value to the ESP32 using I2C protocol [12] [13]. In the thermal screening, the value sent to ESP32 is compared with the previous set limit for temperature.

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Fig. 3. MLX90614 Sensor



Fig. 4. MAX30102 Sensor

MAX30102 Sensor: Fig. 4. shows an integrated heart-rate monitor and pulse oximetry biosensor module which is used for getting heart rate and SpO₂ measurements of the visitor. It consists of two LEDs (a RED and an infrared LED), optimized optics, and a photodetector to detect heart rate (HR) and pulse oximetry (SpO₂) signals [1]. It works with any microcontroller with 5V, 3.3V and 1.8V level input/output [7]. It sends the value to the ESP32 using I2C protocol [9]. In the heart rate and SpO₂ screening, the values sent to ESP32 are compared with the previous set limits for heart rate and SpO₂. This will indicate effectiveness of lungs performance.

Servo Motor: Fig. 5. shows a closed loop system with a feedback system and a motor driver to change the speed and direction of the motor. It uses one power line, one ground, and one control pin which is connected to ESP32. A servo motor is used in the shutter of the room.



Fig. 5. Servo Motor

Using ideas from above discussed papers, bidirectional visitor counter with thermal, heart rate and SpO₂ screening with light automation of the room was built using ESP32. It can also send the number of visitors entered and exited over the internet through the Telegram App and record data on the Google Sheets. Figure 6,7 and 8 shows Circuit Diagram of Proposed Model, Flow chart of proposed system and Schematic Diagram respectively.

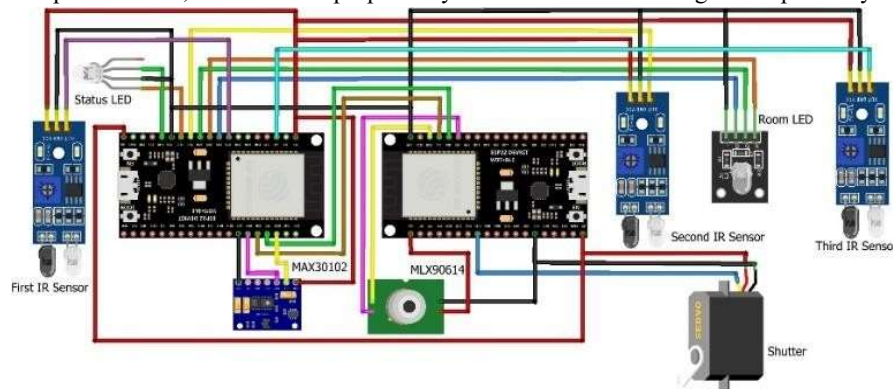
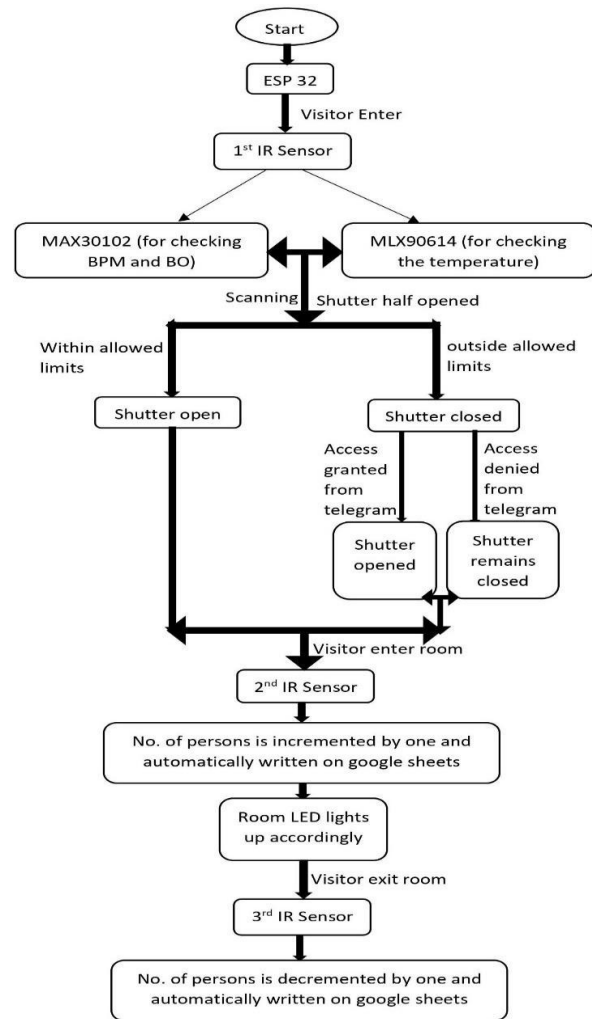


Fig. 6. Circuit Diagram of Proposed Model using Fritzing

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Fig. 7. Flow chart of proposed system

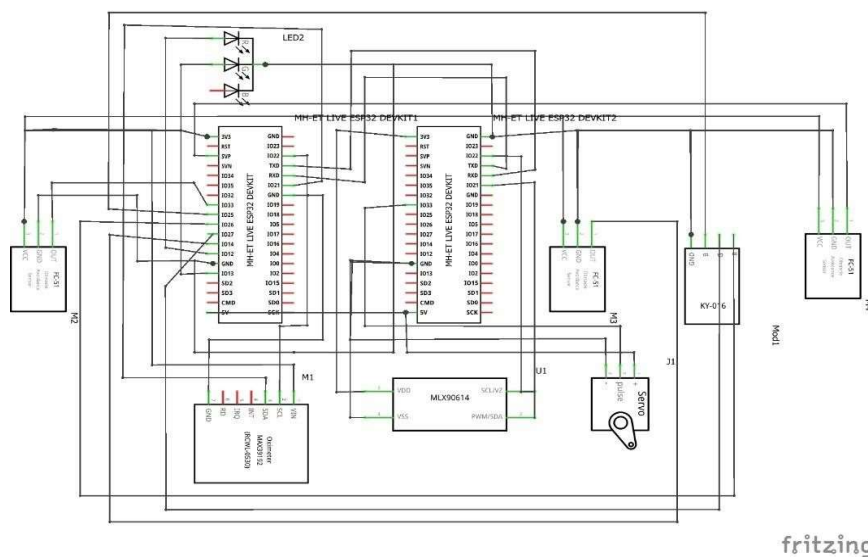


Fig. 8. Schematic Diagram of Model using Fritzing Software

Fig. 9. and Fig. 10. shows the final proposed model of bidirectional visitor counter using esp32 with thermal, heart rate and SpO2 screening and light automation and a box which is simulated as a room in the proposed model respectively. MAX30102 sensor is connected to the first ESP32 and MLX90614 sensor is connected to another ESP32 on GPIO 21 and 22 using I2C protocol. Three infrared sensors are connected to GPIO 27, 32 and 36 pins of the first ESP32. Both the ESP32 communicate with each other using UART protocol using GPIO 16 and 17 pins on both the ESP32. Room RGB LED's red, green and blue pins are connected to GPIO 26, 25 and 33 pins of the first ESP32 respectively. Status RGB LED's red and green pins are connected to GPIO 12 and 13 pins of the first ESP32 respectively. All the sensors and actuators are powered up by 3.3V and all the ground pins are connected to the common ground.

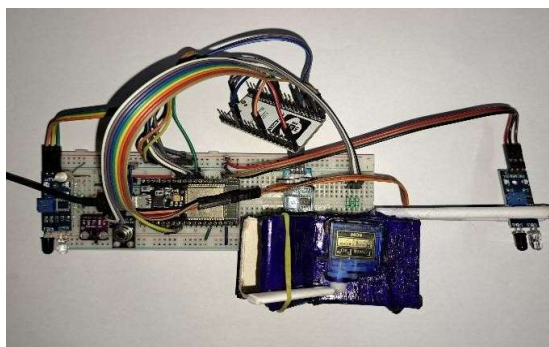


Fig. 9. The Final Product

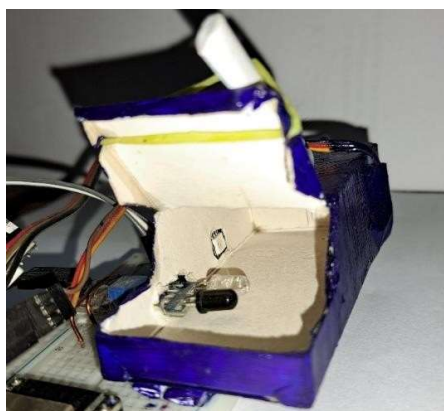


Fig. 10. Inside view of the simulated room

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RESULTS AND DISCUSSIONS

Different results of the proposed model are discussed in this section. Results shows cost effective, simple and efficient device can be modeled to get information. Telegram outputs shows complete information of a person entered or go outside, which is helpful from security point of view and information about these vital parameters are with us for necessary action if any. Also as it counts two way entry, so total number of person in room can be countable always.

Screenshots of the Telegram App:

Fig. 11 shows four screenshots of the Telegram App. The first screenshot shows how by typing “/start”, we can start a conversation with the bot. The bot sends a menu of options. By typing “/pin”, “/pout” and “/proom”, we can get number of persons entered, exited and are there in the room respectively. By typing “/change”, the bot sends a menu of options which can be used to change limits of various parameters such as the allowed number of persons in the room, room LED colour, telegram chat ID for adding or removing access of the user to chat with the room bot, etc. Typing “/view”, the bot sends the link for viewing the Google Sheet.

Screenshot of the Google Sheet:

Fig. 12 shows the screenshot of the Google Sheets where data of the visitors are automatically logged whenever somebody enters the room or exits the room. The first and second column shows the date and time of the visitor respectively. The visitor number is written in the third column. If the visitors enter from one side or exit from another side, it is written in the fourth column accordingly. The data of the visitor is written in the fifth, sixth, seventh and eighth

column. If the visitor is allowed or denied to enter is written in the ninth column and in the last column, the number of visitors in the room is written.

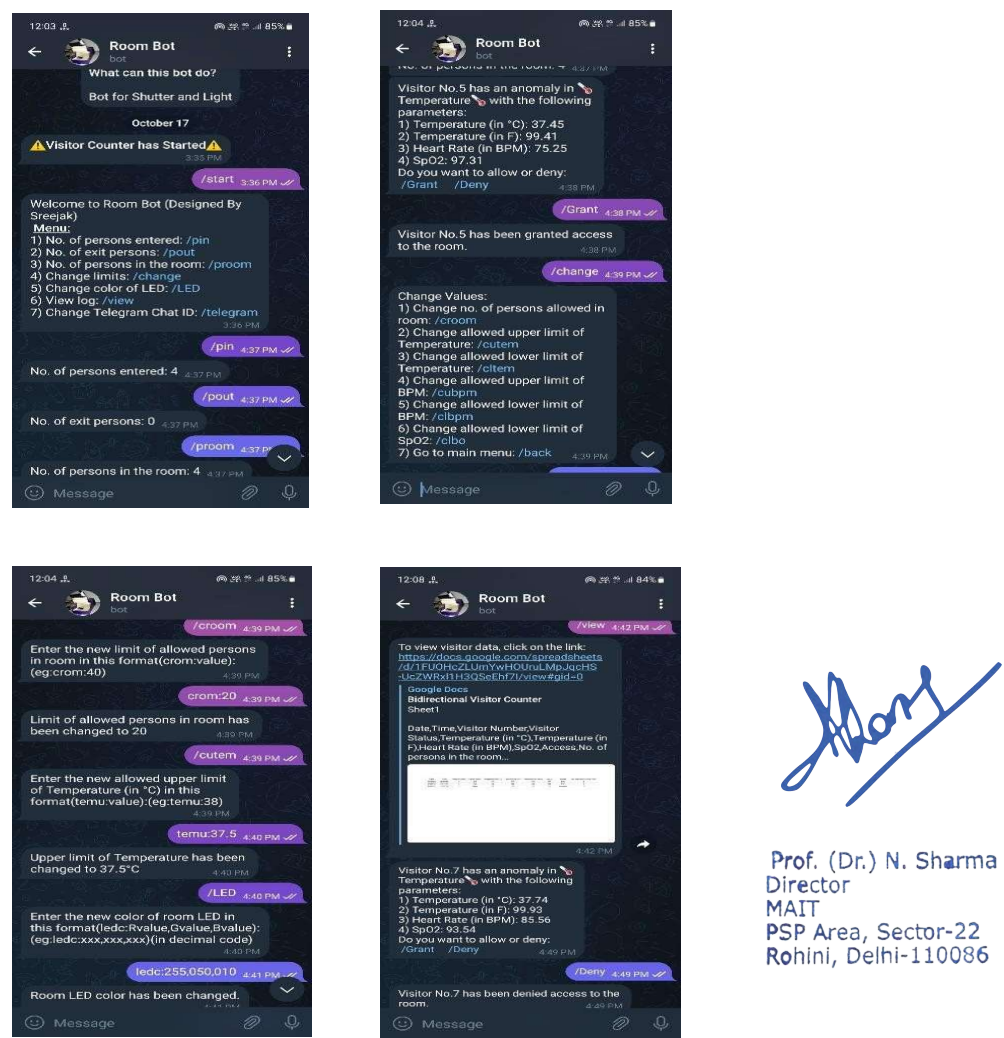


Fig. 11. Four screenshots of the Telegram App

A1	B	C	D	E	F	G	H	I	J	K
	Date	Time	Visitor Number	Visitor Status	Temperature (in °C)	Temperature (in F)	Heart Rate (in BPM)	SpO2	Access	No. of persons in the room
1	10/17/2022	15:36:35	1	Enter	36.8	98.24	64.25	96.32	Allowed	1
2	10/17/2022	15:40:21	2	Enter	36.41	97.54	85.75	97.34	Allowed	2
3	10/17/2022	15:59:07	3	Enter	36.24	97.23	80.5	98.23	Allowed	3
4	10/17/2022	16:30:53	4	Enter	37.02	98.64	79.25	98.35	Allowed	4
5	10/17/2022	16:38:39	5	Enter	37.45	99.41	75.25	97.31	Granted	5
6	10/17/2022	16:46:25	6	Enter	36.41	97.54	68.25	96.45	Allowed	6
7	10/17/2022	16:49:25	7	Enter	37.74	99.93	85.56	93.54	Denied	6
8	10/17/2022	16:52:25	7	Enter	36.83	97.93	73.75	97.35	Allowed	7
9	10/17/2022	16:55:25	1	Exit	NA	NA	NA	NA	Exit	6
10	10/17/2022	16:58:25	2	Exit	NA	NA	NA	NA	Exit	5
11	10/17/2022	17:01:25	8	Enter	36.24	97.23	72.25	97.68	Allowed	6
12	10/17/2022	17:04:25	3	Exit	NA	NA	NA	NA	Exit	5
13	10/17/2022	17:07:25	4	Exit	NA	NA	NA	NA	Exit	4
14	10/17/2022	17:10:25	5	Exit	NA	NA	NA	NA	Exit	3
15	10/17/2022	17:13:25	6	Exit	NA	NA	NA	NA	Exit	2
16	10/17/2022	17:16:25	7	Exit	NA	NA	NA	NA	Exit	1
17	10/17/2022	17:19:25	8	Exit	NA	NA	NA	NA	Exit	0

Fig. 12. Screenshot of the Google Sheet

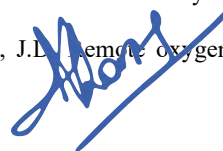
5. CONCLUSION AND FUTURE SCOPE

A system having bidirectional visitor counter with thermal, heart rate and SpO2 screening is proposed and implemented using an ESP32 microcontroller. Visitors having any abnormalities can be granted access to the room through telegram if screening results just cross the certain threshold value set through Telegram App. Light automation helps to light up the room accordingly. In the future, a few more sensors can be added like an RFID card reader for getting visitor details and a camera for checking the facemask of the visitor to the proposed model. An automatic hand sanitizer dispenser machine can also be added to the proposed model. All the data of the visitors are automatically saved on the Google Sheets. Since this system does thermal, heart rate and SpO2 screening along with visitor counting without any human interference which saves a lot of energy and time of the individual standing for the screening and keeping track of the visitors entered.

Project link -- [Bidirectional Visitor Counter using ESP32 with Thermal, HR & SpO2 Screening & Light Automation \(youtube.com\)](https://www.youtube.com/watch?v=...)

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Foreword by
Dr. Nand Kishore Garg

Founder & Chief Advisor, MATES
Chancellor, Maharaja Agrasen University (HP)

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MAIT Journal of Management

FOREWORD

Dr. Nand Kishore Garg

Founder and Chief Advisor, Maharaja Agrasen Technical Education Society, Delhi
Chancellor, Maharaja Agrasen University, Baddi, H. P.



Education must be accompanied by innovative research and development to hold true value for the community, especially in our globally interconnected world where contributing to global knowledge is essential. I am pleased by the enthusiastic response from contributors and fellow educational institutions towards the inaugural volume of the 'MAIT Journal of Management' from Maharaja Agrasen Institute of Technology.

I commend the Editorial Board for their successful effort in compiling the diverse ideas and aspirations of our students and faculty into a cohesive publication. Additionally, I am delighted to see that this marks the third publication from Maharaja Agrasen Institute of Technology within just six months. Congratulations to its Office Bearers and Chief Editor for this remarkable achievement.

Dr. Nand Kishore Garg

MESSAGE

A blue ink signature of Prof. (Dr.) N. Sharma, written in a cursive style.

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Shri Vineet Kumar Gupta

Chairman, Maharaja Agrasen Technical Education Society, New Delhi



Nurturing creativity and sparking innovation are essential pillars of effective education, and an Institute Journal embodies this perfect blend. It captures the creative spirit of the academic community, distilling their inspired ideas in a remarkable manner.

I am delighted to announce the forthcoming publication of the 'MAIT Journal of Management' an Annual Refereed Journal from Maharaja Agrasen Institute of Technology, Delhi. I extend my heartfelt congratulations to the Editorial Board for achieving this milestone as per schedule, which is truly commendable considering the dedication and effort invested. May our students continue to ascend to new heights, bringing honor to the world and their professions through the power of education!

Vineet Kumar Gupta

Preface



Professor (Dr.) Neelam Sharma

**Director, Maharaja Agrasen Institute of Technology &
Editor-in-Chief MAIT Journal of Management**

The Maharaja Agrasen Institute of Technology is pleased to launch its Annual Refereed and Peer Reviewed Journal, i.e. MAIT Journal of Management in the month of May 2024. It provides a forum for publishing research based original contribution and comprehensive articles on all important Management related topics. The Journal encourages all experienced and qualified young and senior researchers, professionals, academicians and other stakeholders to share their knowledge and experiences. The journal is published annually and it has applied for its ISSN no. Authors may submit manuscript as per the template to editor.mgmt@mait.ac.in.

AIMS AND SCOPE

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A handwritten signature in blue ink, appearing to read 'N. Sharma', with a long horizontal stroke extending to the right.

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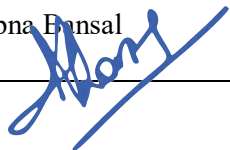


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Unlocking Financial Sustainability: An In-depth Analysis Using NVivo

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Abstract

Financial sustainability has become critical in the modern world for everyone—individuals, companies, and governments. Due to an array of connected elements, financial sustainability is extremely important in the contemporary era. First and foremost, organizations and businesses need to make sure they are long-term viable enough to withstand unanticipated challenges and disruptions in an era of growing economic unpredictability and volatility. Furthermore, stakeholders expect businesses to operate in an environmentally and socially responsible manner as a result of increased knowledge of environmental and social issues; this often necessitates the use of solid financial procedures. Furthermore, firms can invest in innovation, technology, and people to stay competitive in the market as a result of preserving financial sustainability, especially as global rivalry heats up. Furthermore, businesses that put a high priority on financial sustainability are better positioned to adjust to shifting compliance needs and reduce risks apparently changing regulatory landscapes. The foundation of organizational resilience, expansion, and resource management is financial sustainability. A systematic review methodology was applied to examine the literature on financial sustainability using the Scopus Database, which included 45 studies. The findings revealed the significant facets or attributes of financial sustainability. Using NVivo, a thorough literature review of 45 relevant financial socialization research papers is conducted. The results show how financial sustainability that people encounter at different stages of life are examined and comprehended through the use of visualization analysis, such as word clouds, tree maps, and cluster analyses. This review's recommendation for identifying potential future directions and mitigating methods for financial sustainability was based on these findings.

Keywords: Financial Sustainability, NVivo, Qualitative analysis

Introduction

The ability of a person, system, or organization to manage their finances in a way that guarantees resilience and long-term viability is referred to as financial sustainability. In our day and age, with its unpredictable economy, environmental issues, and social demands, financial sustainability is crucial in a lot of different areas.

Ensuring financial sustainability helps organizations to efficiently manage ups and downs as well as unanticipated interruptions in a turbulent economic environment, protecting their growth and continuity. Furthermore, given the growing focus on environmental sustainability and corporate social responsibility, financially sustainable practices are in line with societal norms and build confidence and trust among stakeholders.

Moreover, financial sustainability enables organizations to make investments in personnel, technology, and innovation, boosting their ability to compete and adapt in the marketplace. It also makes it easier to comply with changing risk management plans and regulatory frameworks, which promotes organizational stability and resilience.

Literature Review

Antoniuk, Y., & Leirvik, T. (2024) demonstrates that in a number of industries, the criteria are not yet in place to facilitate the shift to carbon neutrality. With the intention to do this, a comprehensive public consultation that included in-depth answers from numerous stakeholders regarding the particular thresholds are examined. Distinguishing between low-emission and high-emission activities—the latter of which is incompatible with a low-carbon future—is necessary for the sectors not included in the Taxonomy are also highlighted.

Elkhwesky, Z. et. al. (2024) summarized and categorized common forms, causes, and effects of sustainable innovation by methodically locating and critically analyzing the literature on sustainable innovation in H&T during COVID-19 (conducted in 2020 and 2021). The authors provided a thorough analysis of the 58 publications on sustainable innovation in H&T that were published over a two-year period (2020–2021) using the Web of Science (WoS) database. Important practical implications for the H&T sectors in the post-pandemic and digital era are provided by this study.

Alhawamdeh, H., et. al. (2023) investigated the relationship between financial attitudes, financial knowledge, financial anxiety, and sustainable financial retirement planning, and how these relationships are impacted by financial acceptance and the involvement of a financial adviser management. The findings indicated that financial attitudes, financial knowledge, and financial worry have a significant influence on retirement planning. Furthermore, the existence of a financial adviser management and financial risk tolerance act as mediators in this relationship.

Cecchetti, S. G. (2023) focused on two major things. Firstly, the recently implemented Basel III rules, the international financial system is likely still not safe enough, despite being much safer now than it was. Secondly, the expenses associated with raising capital requirements have turned out to be far lower than anticipated. Thirdly, avoiding adopting discretionary regulatory measures that change over time.

Dağıstanlı, H. A. (2023) used trend analysis and multi-criteria decision making (MCDM) to compare the financial performances of energy businesses trading in Turkey's Borsa Istanbul Sustainability Index. First, the Hesitant Fuzzy Technique for Order Preference by Similarity to Ideal Solution (HFTOPSIS) was used to evaluate the data. Following that, trend analysis was performed on each variable independently. Comparative findings reveal that fuzzy set theory-based MCDM rankings differ from analyses carried out independently.

Scott, T., & Guan, W. (2023) analyzed the various obstacles that prevents higher education institutions from improving the perception of their academic excellence both at home and abroad. The emphasis is on the necessity of more government control and financing for education. Better institutional cooperation and national exams will reinforce the need to address the underlying issues impeding any significant shift to a workforce that is knowledge-intensive.

Thiemann, M., & Stellinga, B. (2023) implemented such policies, with a particular emphasis on countercyclical measures put forth by financial stability committees in Germany, France, and the Netherlands starting in 2015 to reduce the systemic risks associated with housing booms. Committees' functioning is typified by protracted consensus-building procedures, in which technocrats gather data and look for politically acceptable.

Trinh, V. Q. et. al. (2023) suggested that there is a greater chance of seeing extraordinarily significant deprivation in the stock values of the world's banks as a result of the pandemic. Nonetheless, banks with greater degrees of financial stability and profitability are less likely to experience severe equity devaluations because they are better equipped to handle the crisis. Consequently, we argue that, subsequent to the pandemic, financial stability serves as a "vaccine" against the bank tail risk. Finally, we restrict the results to a few specific geographic areas; generally, they are stronger in nations with larger banks, middle-class populations, and greater financial independence.

Yao, N., Fabus et. al. (2023) examined from 2000 to 2021, the relationship between the financial sector and energy efficiency in 21 APEC member countries. According to the findings, improving the degree of financial openness and the green finance market both help to boost the effectiveness of natural resources. It is recommended that the countries under examination concentrate on developing digital green financial markets and encouraging green foreign direct investment so that to improve resource efficiency. Establishing an early warning system can also be extremely important for reducing economic uncertainty.

Huerta de Soto, J et. al. (2021) aimed to apply Austrian economics to examine the COVID-19 pandemic and its handling. Based on political economy, capital theory, and Austrian business economic cycles, the emphasis is on the State's coercive interference. In order to propose a more sustainable and well-being economics, this review ends with a suggestion to alter the dominant paradigm.

Pavlov, O. V., & Katsamakos, E. (2021) used scenario analysis and stress testing with a system dynamics model of a typical tuition-dependent college to examine the short- and long-term

implications of the pandemic on the financial health of a college. The impact of pandemic mitigation strategies on an academic institution's financial sustainability varies is identified.

Gabor, D., & Brooks, S. (2020) In order to organise development intermediation through networks of state institutions, international development groups, philanthropy investment, and fintech enterprises, this paper identified the growing significance of digitally based financial inclusion. The cybernetic transformation adds new layers to the material cultures of financialised inclusion, providing global finance with new means of "profiling" impoverished households into producers of financial assets and the state with new avenues to increase incorporation of "legible."

Osazefua Imhanzenobe, J. (2020) determined which management techniques' financial facets should take precedence in order to improve these industrial organizations' long-term profitability, sustainable growth, and financial distress. Financial sustainability in the Nigerian manufacturing sector is currently declining, which is driving away financially unsustainable businesses. This research fills these gaps by looking into how financial activities affect the sustainability of money across different metrics.

Ahamed, M. M., & Mallick, S. K. (2019) highlighted that increased bank stability is a direct result of higher levels of financial inclusion. The research demonstrated that an enabling inclusive financial environment increases the soundness of banks in the treated countries by 36%. This complementary effect is more pronounced when banks have greater market power and operate in countries where political stability, rule of law, and regulatory environment are stronger. The result showed that, in addition to being a development aim, ensuring an inclusive financial system is something that banks should prioritise because it will contribute to their stability.

Frost, J., Gambacorta et. al. (2019) demonstrated that in nations with less competitive banking markets and laxer regulations, BigTech companies lend more. By examining the instance of Argentina, we are able to provide evidence in favour of the theory that BigTech lenders have access to more information when evaluating credit than traditional credit bureaus. We discover that businesses who used credit increased the range of products they offered more than those who did not. Evaluating insofar as BigTech will eventually progress into the financial services industry is premature.

Aleixo, A. M. et. al. (2018) The findings implied that while the various collaborator are aware of the notion of sustainability, they are not familiar with the idea of sustainable higher education institutions. In particular, by identifying new funding sources, more adaptable organisational structures, more thorough mission statements, more customised educational offers, lifelong learning and a commitment to internationalisation, and more strategic human resource management, this research emphasised the significance of a conceptual and organisational change in higher education institutions.

Alshehhi, A. et. al. (2018) Research on the connection between company sustainable practices and financial success is beginning to gather steam, but a consensus is still elusive. This study highlighted emerging patterns and the problems preventing a firm agreement on that relationship. The literature is gradually moving away from the concept of overall sustainability and towards a more limited definition of corporate social responsibility (CSR), which emphasises the social

aspect of sustainability while leaving out most or all of its environmental and economic components.

Azarenkova, G. et. al. (2018) aimed to assess financial sustainability and enhance the techniques and strategies used in its assessment. The study employed the following methodologies: economic and financial survey, economic and mathematical modeling, synthesis, analysis, and comparison. The taxonomic index of financial sustainability has been calculated, its noteworthiness has been forecasted, the theoretical and fundamental characteristics of enterprise financial sustainability have been established, the financial status of PJSC "Turboatom" has been examined, and strategies for enhancing enterprise financial sustainability have been put forth.

Cai, J., Eidam et. al. (2018) concentrated on bank liquidity generation, which is an all-inclusive indicator of bank output that takes into account both on- and off-balance sheet activity. The research discovered that only small banks are impacted by monetary policy during normal times, and that during financial crises, the effects of monetary policy are less pronounced for banks of all sizes. Furthermore, after adjusting for other variables, large liquidity creation (compared to trend) aids in the prediction of future crises.

Campiglio, E., Dafermos et. al. (2018) observed a significant expansion of the scholarly and policy discussion concerning the role of financial regulators and central banks in mitigating climate-related financial risks. The first major problem seemed to be creating a thorough analytical framework to evaluate the possible effects of climate change and the low-carbon transition on financial stability. The policies of central banks could then be implemented and financial rules may be developed with these improved risk measures in place.

Caporin, M. et. al. (2018) demonstrate that, during the 2008–2011 period, the spread of shocks in Europe's CDS has been relatively stable, despite the fact that a sizable portion of the sample periphery nations have experienced severe effects from their sovereign debt and fiscal circumstances. The examination of bond data indicated a shift in the shock propagation strength between the pre-crisis years of 2003–2006 and the post-Lehman period of 2008–2011; nonetheless, the coefficients actually decrease rather than increase!

Schoenmaker, D. et. al. (2018) Principles of Sustainable Finance offers numerous examples and resources to help address this, as well as explaining how the financial sector may be mobilised to do so. We can veer the planet and its economy from their current course and create a future that is sustainable for all by using finance as a tool to accomplish social goals. It demonstrates how bankers and investors may direct capital towards sustainable businesses and initiatives without compromising profit, hastening the shift to a sustainable economy. It contains definitions of important terms, recommendations for additional reading, and significant use of figures, boxes, and tables to support learning objectives and make concepts clear.

Shahbaz, M., Nasir et. al. (2018) expressed that whereas energy research discoveries damaging ramifications on French carbon emissions, FDI has a favourable effect. Development in the financial sector reduces carbon emissions, which enhances the environmental quality of France. Financial development implies that both energy research innovations and financial stability are necessary conditions for enhancing environmental quality. On the contrary, there is a positive

correlation between energy use and carbon emissions. However, the environmental Kuznets curve (EKC) is validated by the inverted-U relationship between economic growth and CO2 emissions.

Berger, A. N. et. al. (2017) spotted alternate "competition-stability" theory contends that increased bank risk could arise from increased market power in the loan market since higher interest rates for borrowers make loan repayment more challenging and exacerbate issues with moral hazard and adverse selection. By regressing metrics of bank risk, loan risk, and bank equity capital on various market power measures and business environment variables, the author tests these theories. One aspect of the "competition-stability" view—that market power raises loan portfolio risk—is also somewhat supported by the data.

Bruno, V., Shim, I., & Shin, H. S. (2017) highlighted that CFM policies implemented in the banking sector and bond market have a significant impact on slowing down banking and bond market inflation, respectively. The research observed that some evidence of these policies' spillover effects. In conclusion, our empirical results indicate that when macroprudential regulations reinforce monetary tightening in tandem with monetary policy, they are more effective than when they operate in opposition to each other when it comes to the interaction between monetary policy and macroprudential policies.

Mehrotra, A. N., & Yetman, J. (2015) contended that macro stress tests are not appropriate as early warning systems, that is, as instruments for detecting vulnerabilities in situations that appear to be calm and for initiating corrective action, given the state of technology today. On the other hand, stress tests can be quite useful as instruments for crisis management and resolution if they are created correctly. We observe further benefits as well, primarily in respect to discipline that such assessments might bring to the discussion of financial stability. We offer potential strategies to raise their level of performance.

Beck, T., Degryse, H., & Kneer, C. (2014) discovered that, over time, intermediation activities boost growth and lower volatility. The long-term results of the real sector are unaffected by the financial sectors' expansion in other dimensions. In high-income nations, a sizable financial industry promotes growth over shorter time horizons at the expense of increased volatility. We concentrate on OLS regressions since that a preliminary investigation into the relationship between financial system indicators and growth and volatility; endogeneity and biases from missing variables will be left for other studies.

Fu, X. M., Lin, Y. R., & Molyneux, P. (2014) implied that after accounting for institutional, regulatory, macroeconomic, and bank-specific factors, weaker pricing power and more concentration both increase bank risk exposure. The findings show that while property rights and deposit insurance are linked to increased bank fragility, stronger institutional development and stricter capital requirements enhance financial stability.

Kinde, B. A. (2012). Identified that the main goal of the microfinance models is to reduce poverty by expanding people's access to financial services and capital. However, only strong financial performance by the institutions would allow the beneficial effects of microfinance on the welfare of the underprivileged to continue. Therefore, the goal of this study was to determine the variables influencing the financial sustainability of MFIs in Ethiopia. The study discovered that the financial sustainability of microfinance institutions in Ethiopia is influenced by the breadth, depth,

dependency ratio, and cost per borrower of microfinance. For the duration of the study, staff productivity and the capital structure of microfinance, however, had no effect on the MFIs' ability to remain financially sustainable in Ethiopia.

Rai, A. K., & Rai, S. (2012) aimed to identify the variables that influence financial sustainability. It then suggested a more thorough and representative model for financial sustainability and develops an index to track the financial performance of the microfinance industry. The microfinance institutions' financial information from Bangladesh and India indicated that the key variables influencing the viability of microfinance institutions are the portfolio at risk for more than 30 days, operating expenditures relative to the loan portfolio, and the capital/asset ratio.

Research Methodology

The present investigation used a qualitative research design to comprehensively examine the experiences, perceptions, attitudes and personality of individuals about financial sustainability. Research papers have been drawn out from various crucial and wide databases like Science Direct, SAGE, Emerald, Springer, etc. Forty-five research papers and articles have been reviewed. Qualitative approaches are always ideal for gathering an array of viewpoints and thoroughly examining complicated occurrences.

Preliminary literature review analysis was conducted using QSR International's NVivo 12 Plus software. NVivo software enables users to examine many types of data, including PDFs, text documents, audio and video files, databases, spreadsheets, digital pictures, web pages, bibliographical data, and social media. Using a word frequency search query for qualitative analysis improved comprehension of the material. The results from NVivo 12 Plus are summarized in the next section.

Objectives of the Study

- To investigate the various dimensions of financial sustainability experienced by individuals across different stages of life.
- To explore the future prospects on improvising the financial sustainability.

Findings and Discussions

For the analysis and interpretation of extant literature in context to influence of financial sustainability, various visualization tools have been used within NVivo. Forty-five research papers and articles on financial socialization using NVivo software's word frequency search query. The 100 most recurrently used terminologies and their synonyms, with at least 5 letters long are extracted and hence, the findings are shown below as Word cloud.

The following table shows the thirty most frequently used words and the number of times they have been used in the literature:



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Table 1: 30 most frequently used words in the literature

Word	Length	Count	Weighted Percentage (%)
financial	9	3264	1.23
banks	5	977	0.37
sustainability	14	918	0.35
growth	6	817	0.31
credit	6	807	0.30
market	6	802	0.30
policy	6	771	0.29
development	11	711	0.27
economic	8	699	0.26
banking	7	684	0.26
sustainable	11	669	0.25
journal	7	643	0.24
stability	9	619	0.23
capital	7	609	0.23
countries	9	602	0.23
table	5	594	0.22
results	7	589	0.22
finance	7	583	0.22
value	5	567	0.21
financial	8	566	0.21
level	5	518	0.20
research	8	503	0.19
sector	6	497	0.19
model	5	494	0.19
variables	9	489	0.18
measures	8	488	0.18
index	5	482	0.18
performance	11	475	0.18
management	10	463	0.17
crisis	6	456	0.17

For convenience the above table shows only 30 most frequent words and the number of times that have appeared in literature. This gives an idea of what most authors are talking about in terms of the keywords, highlighting the importance of words like financial sustainability, growth, credit, risk, variables, performance, finance, management, crisis and so on.





Figure 1: Word Cloud of most frequent words in the literature

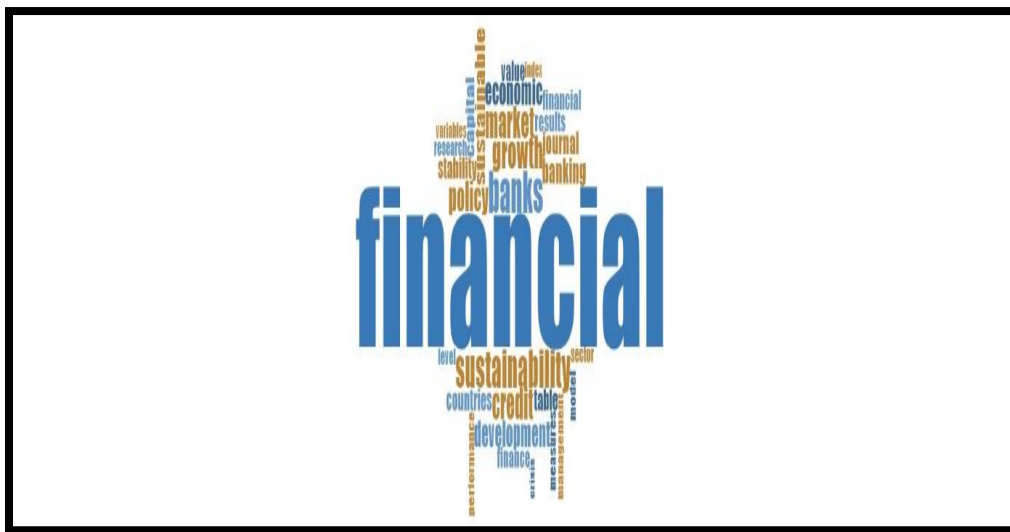


Figure 2: Word Cloud of top most 30 frequent used words in the literature

Initially, a "text search query" (TSQ) was used to look for well-known terms, phrases, or expressions in the NVivo-imported sources. This is a useful end product and an excellent resource for comprehending the fundamental information in the data. This figure make it clear that financial sustainability, credit, growth, banks, development, stability and policy are the main topics for consideration.

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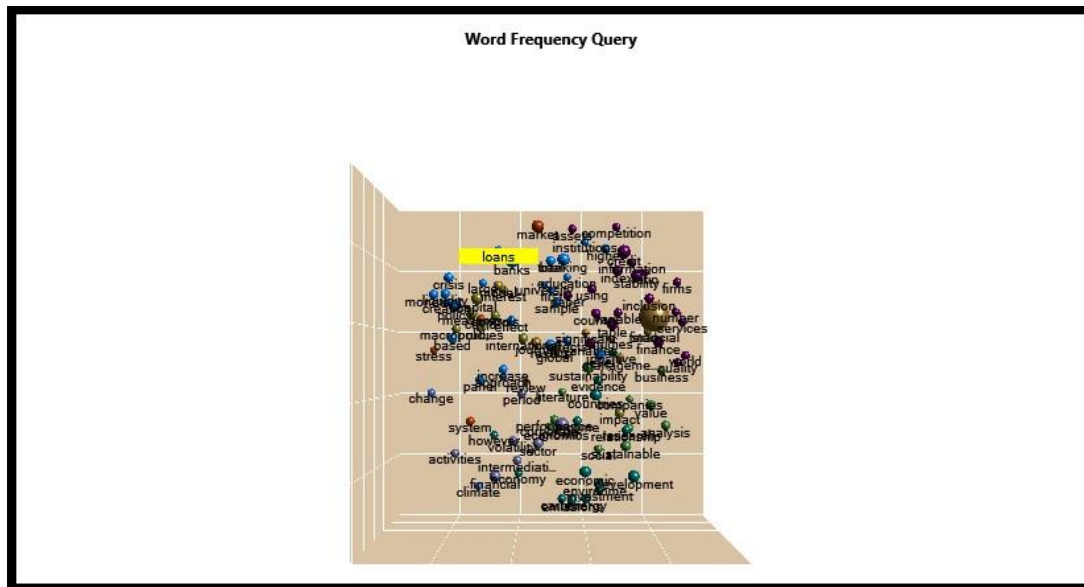
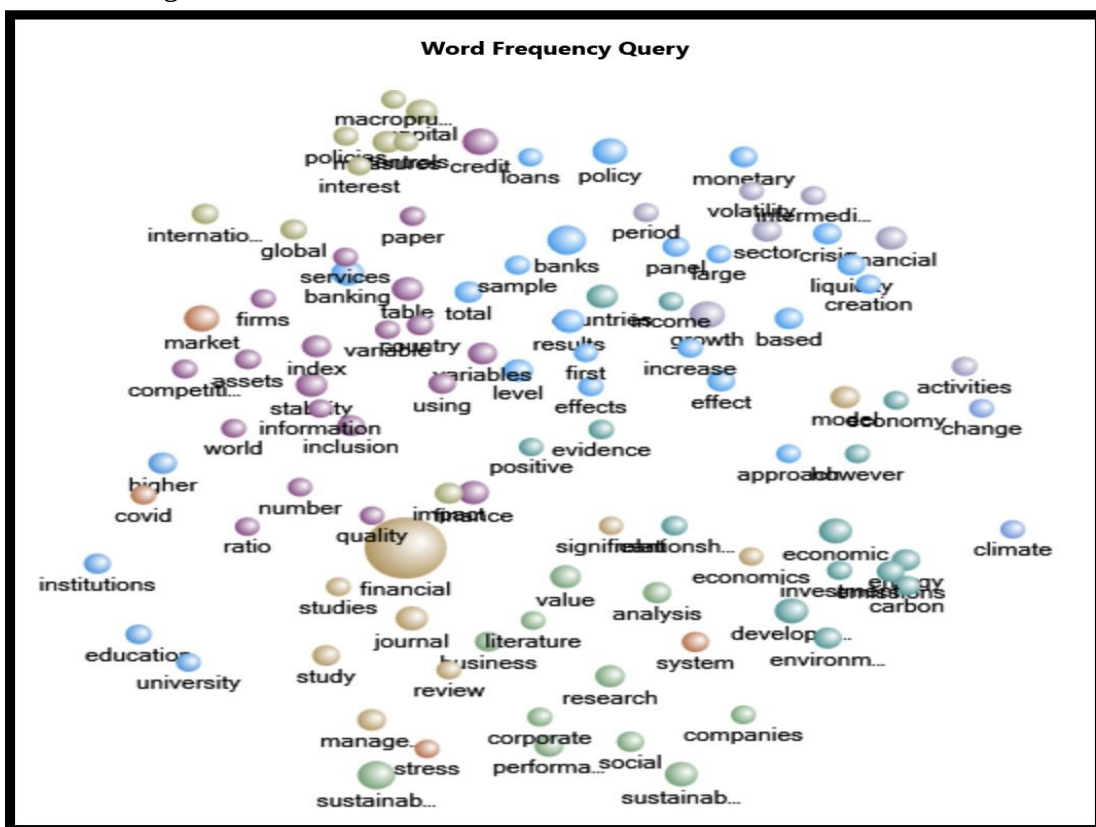


Figure 3: Cluster Analysis Chart (Top 30 words)

"Cluster analysis" was the function that was performed. In order to visualize trends in data study, this exploratory tool organizes nodes or sources graphically based on any attribute, word, value, or other similarity that appears to be shared. The words used are sustainability, market, competition, change, activities, climate, firms and loans.





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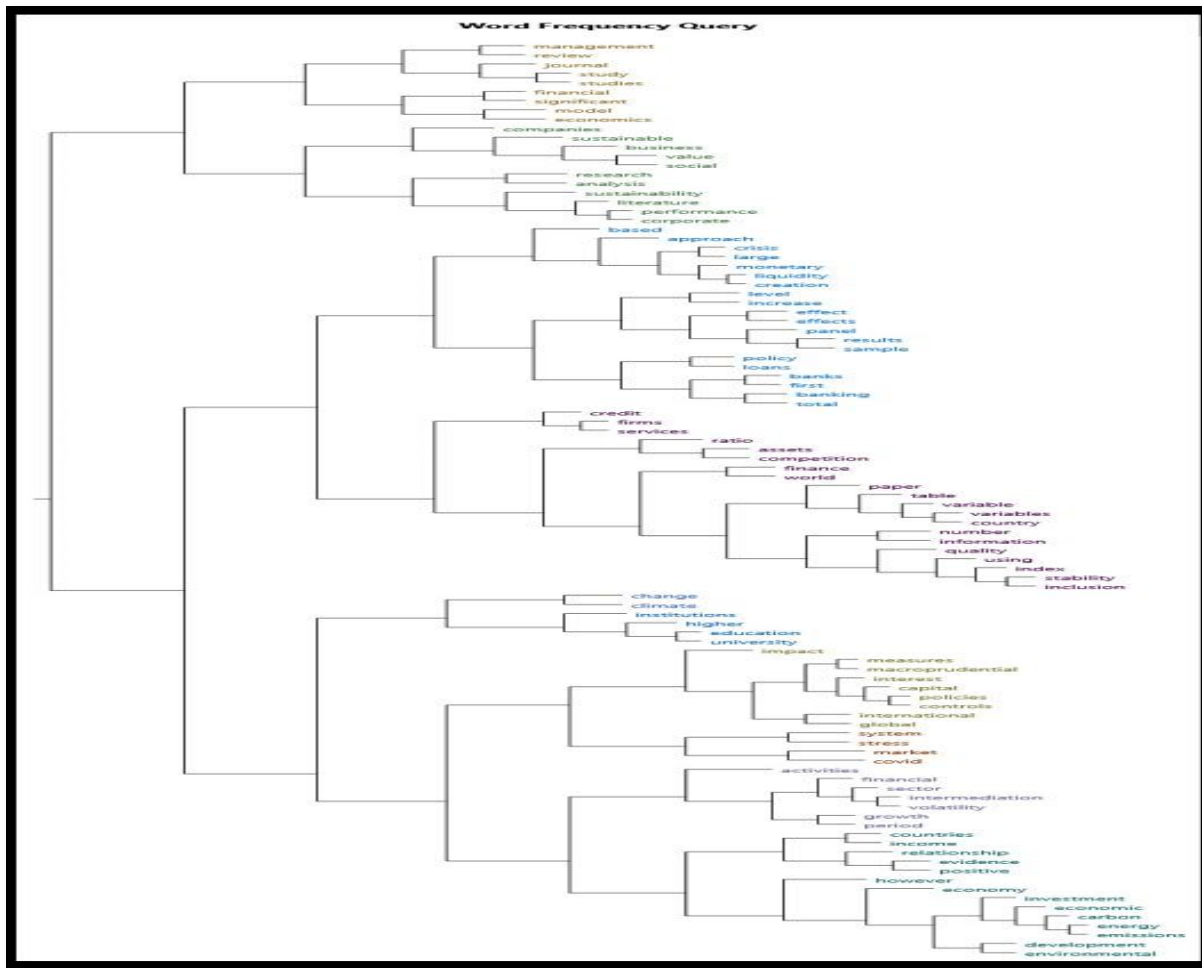


Figure 6: Word Tree

The above word tree shows what different authors are saying or writing frequently about financial , market, competition, change, activities, climate, firms and loans.

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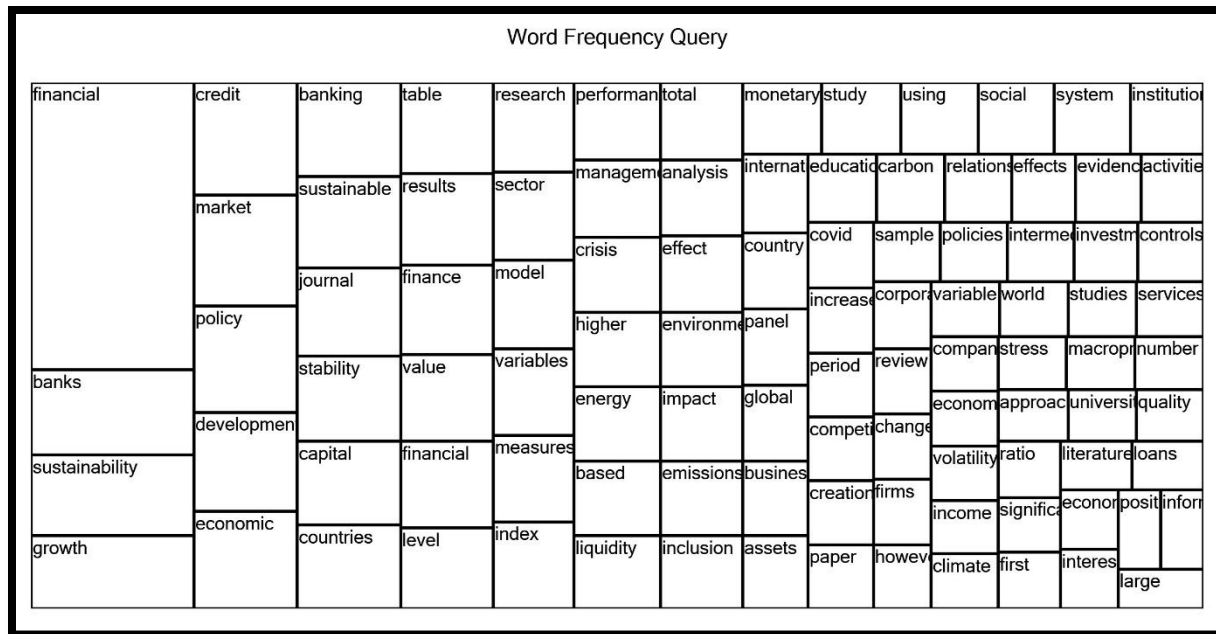


Figure 7: Hierarchy chart (tree map)

The type of hierarchy chart seen below is known as a "tree map". Which topics are more and less important is made clear by displaying the coding for a number of the literature's articles and authors. The tree map indicates according to the box size that 'financial' is the most prominent term followed by 'banks', 'sustainability', 'growth', 'credit' and so on

Future Prospects

- Economic Resilience:** Organizations with strong financial standing are better able to weather economic downturns, maintaining stability and continuity even under trying circumstances.
- Innovation and Growth:** Businesses can invest in R&D, innovation, and growth to stay ahead of the competition and drive growth through strong financial practices.
- Market Competitiveness:** Companies that are financially stable are better able to maintain their place in the market by investing in marketing, providing competitive pricing, and growing their market share.
- Talent Acquisition and Retention:** Businesses may recruit and retain top talent by offering competitive compensation and benefits, which promotes employee satisfaction. This is made possible by a secure financial outlook.
- Adaptability to change:** Financially sustainable businesses are more able to adjust quickly to shifts in the market, laws, and technology while still remaining relevant and flexible.
- Customer Loyalty and Trust:** Stronger customer connections and brand loyalty are the result of transparent financial management.
- Greater access to capital market:** Greater access to capital market enables financially sustainable businesses to raise money for strategic goals, expansion, or investments.

8. **Adoption of sustainable practices:** Financial sustainability facilitates the adoption of sustainable practices by firms, thereby mitigating their environmental footprint and upholding their social obligations. These practices are becoming more and more significant to stakeholders and customers.
9. **Risk Mitigation:** Entities can reduce the risk of a variety of events, including operational disruptions, regulatory changes, and unanticipated crises, by keeping healthy financial reserves.
10. **Long-Term Viability:** In the end, financial sustainability makes sure that companies are viable and prosperous over the long run, which promotes societal well-being and general economic stability.

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The Impact of Perceived Ad Relevance on User Behaviour in Social Media Advertising: An Empirical Investigation of the Mediating Role of Privacy Concerns

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Abstract

This study delves into this paradox, aiming to understand the interplay between perceived ad relevance and user privacy concerns. We investigate how these factors influence user behavior on social media platforms. Specifically, we explore if relevant ads receive more attention and are avoided less compared to irrelevant ones. We further examine if heightened privacy concerns lead users to pay less attention to, or actively avoid, personalized ads. Additionally, the study investigates if highly relevant ads trigger even greater privacy anxieties. Finally, we assess whether privacy concerns act as an intermediary factor, potentially diminishing the positive effects of relevant ads. A survey of at least 500 social media users will be conducted to analyze these interactions. The research will employ a mixed-methods approach, combining quantitative methods (e.g., correlation analysis) with qualitative interviews to gain a comprehensive understanding of user perceptions and behavior. Understanding this complex interplay is crucial. Existing research suggests privacy concerns can lead users to avoid ads entirely. Furthermore, negative experiences with privacy-invasive ads can decrease overall platform satisfaction. This research will provide valuable insights for navigating this intricate relationship. By prioritizing user privacy and fostering trust, social media platforms and advertisers can create a sustainable advertising environment that benefits everyone. The findings will inform strategies for achieving this delicate balance between relevance and user privacy in social media advertising.

Keywords: Social media advertising, user data, privacy concerns, relevance, ad avoidance

Introduction

In the realm of modern marketing, social media has emerged as a crucial battlefield for advertisers. Leveraging user data, platforms tailor advertisements to specific audiences, aiming for heightened effectiveness. However, the concept of relevance in advertising on these platforms isn't without its complexities and potential drawbacks. A-Reum Jung's research in 2017 delves into this intricate relationship, examining the interplay between perceived ad relevance, privacy concerns, and ad avoidance on social media. Jung's study sheds light on the nuanced dynamics at play when users encounter targeted ads on social media platforms. While personalized ads may seem advantageous

from a marketing perspective, they often raise privacy concerns among users. The relentless tracking and utilization of personal data can trigger apprehension regarding privacy invasion, potentially leading to ad avoidance behaviors.

This research underscores the importance of understanding users' perceptions and reactions to targeted advertising. It suggests that the pursuit of relevance in ads must be balanced with respect for users' privacy and autonomy. Overly invasive advertising tactics can backfire, alienating users and driving them away from engaging with ads altogether. Jung's findings contribute to a broader conversation surrounding the ethics and effectiveness of targeted advertising on social media. They highlight the need for advertisers to adopt more transparent and user-centric approaches, respecting individuals' privacy preferences while still delivering relevant content.

Furthermore, Jung's work aligns with previous studies that have explored various aspects of online marketing and consumer behavior. For instance, Abdullah, Jayaraman, and Kamal (2016) present a conceptual model of interactive hotel websites, emphasizing the role of perceived website interactivity and customer perceived value in influencing revisit intentions. Meanwhile, Alalwan et al. (2017) conduct a comprehensive review of social media in marketing, analyzing existing literature to understand its implications and potential challenges. By synthesizing insights from multiple studies, including those by Ahn, Ryu, and Han (2005), Alalwan et al. (2016, 2018), and Bannister, Kiefer, and Nellums (2013), Jung's research enriches our understanding of the intricate dynamics of online advertising and consumer behavior. In conclusion, A-Reum Jung's research offers valuable insights into the complex relationship between perceived ad relevance, privacy concerns, and ad avoidance on social media. By considering the perspectives of both advertisers and users, this study contributes to the ongoing dialogue surrounding the ethics and efficacy of targeted advertising in the digital age.

Perceived Ad Relevance: A Double-Whammy

Jung's study delves into how users perceive the relevance of social media ads, defining relevance as alignment with users' interests and needs. She emphasizes that relevance can be a double-edged sword. On one hand, relevant ads tend to capture users' attention more effectively, resonating with them and increasing ad engagement. Additionally, these ads feel less intrusive, potentially reducing the inclination to actively avoid them. This insight aligns with previous research in the field. Braojos-Gomez, Benitez-Amado, and Llorens-Montes (2015) explore how small firms learn to develop social media competence, indicating the importance of relevance in engaging users effectively. Likewise, Campbell and Keller (2003) discuss the impact of brand familiarity on advertising repetition effects, suggesting that relevance plays a crucial role in enhancing ad effectiveness. However, Jung also acknowledges the potential downsides of relevance. While relevant ads may initially attract attention, excessive targeting can lead to user fatigue and ad avoidance behaviors. Campbell and Wright (2008) investigate the role of relevance and interactivity in customer attitudes toward repetitive online advertising, underscoring the delicate balance required to maintain user engagement without overwhelming them.

Moreover, Byrne (2010) highlights the utility of structural equation modeling in understanding complex phenomena such as user perceptions of ad relevance. This methodology allows researchers to explore the intricate relationships between variables, providing valuable insights into consumer behavior. Additionally, Can and Kaya (2016) examine the phenomenon of social



networking site addiction and its effect on attitudes toward social network advertising. Their findings suggest that users' attitudes toward ads are influenced by various factors, including their overall relationship with the platform and their susceptibility to addictive behaviors.

The Privacy Concern Factor

Web-based entertainment is a goldmine for publicists, taking into consideration profoundly designated promotions in light of client information. However, is importance generally something to be thankful for? This examination investigates the sensitive harmony between saw promotion pertinence and client protection worries in web-based entertainment publicizing. On one hand, significant promotions snatch consideration. They resound with clients' inclinations, prompting higher commitment and possibly feeling less meddlesome. Notwithstanding, the actual demonstration of conveying exceptionally applicable advertisements raises protection concerns. Virtual entertainment stages gather tremendous measures of information to accomplish this focusing on, making clients uncomfortable with how their data is utilized. This uneasiness, as Wu (2016) recommends, can lead clients to stay away from the advertisements by and large, at last harming publicizing execution. The examination recommends that protection concerns go about as a middle person between saw promotion significance and promotion evasion. Regardless of whether a promotion is significant, the protection issues it raises could offset the advantages. This lines up with the discoveries of Zhu and Chang (2016) who feature the adverse consequence of protection worries on client insight and proceeded with promotion commitment.

It is additionally vital to Grasp client feelings. Yang et al. (2013) recommend that exceptionally significant promotions, while successful, could summon pessimistic feelings like being "watched" or "controlled." This feeling can additionally build the longing to keep away from such advertisements. So how might we explore this complicated scene? It is critical to Fabricate entrust with clients. Concentrates on like Yoo et al. (2010) and Zeng et al. (2009) underline the significance of client fulfillment in web-based cooperations. Addressing protection concerns can prompt a more certain encounter, encouraging trust and possibly expanding in general client commitment (Zhu and Chen, 2015). Taking a gander at the master plan of virtual entertainment conduct (Zeng and Gerritsen, 2014; Zhang et al., 2014), understanding client protection concerns turns out to be considerably more significant. By recognizing the importance protection compromise, web-based entertainment stages and promoters can establish a more reasonable publicizing climate. Straightforwardness in information assortment and offering clients command over their data are significant stages.



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Table 1: Literature Survey

Author(s)	Year	Research Gap
Barnes, J. H., & Zhang, H.	2023	Proposes a structure for adjusting protection concerns and publicizing viability in virtual entertainment promoting.
Huang, J., Li, Y., & Yen, H.	2023	Looks at the exchange between online entertainment promoting, protection concerns, and brand trust in a culturally diverse setting.
Angst, C. B., & Agarwal, R.	2022	Analyzes the Catch 22 of customized publicizing, investigating how importance and security concerns impact client reactions via online entertainment.
Chen, L., & Luo, X.	2022	Researches the intervening job of security worries in the connection between web-based entertainment promoting adequacy and brand disposition.
Jeong, S. H., Kim, J. W., & Park, D. H.	2022	Explores the interceding impact of protection worries on the connection between virtual entertainment publicizing commitment and brand trust, zeroing in on generational contrasts.
Chung, M., & Park, J.	2021	Inspects the blade that cuts both ways of web-based entertainment promoting, zeroing in on what saw enlightening protection means for client commitment and brand steadfastness.
Hoffman, D. L., & Novak, T. P.	2021	Perceives the worldwide test of purchaser protection in the huge information period.
Fu, Y., & Qiu, Y.	2020	Dissects the intuitive impact of seen promotion pertinence and protection worries via virtual entertainment publicizing adequacy.
Kang, J., Shin, J., & Park, D.	2020	Investigates purchaser protection worries in online entertainment promoting from a normal practice viewpoint.

Privacy Concern as a Mediator

Social media advertising thrives on relevance, delivering targeted ads based on user data. However, this very practice creates a double-edged sword. While relevant ads grab attention and feel less

intrusive, the vast amount of data collected to achieve this targeting raises privacy concerns. Users might feel uneasy about how their information is used, leading to a sense of being watched or manipulated. This discomfort, as evidenced by Wu (2016), can ultimately lead users to actively avoid the ads altogether, hindering advertising effectiveness. Understanding user behavior is crucial to navigating this paradox. Research by Ho & Bodoff (2014) suggests that privacy concerns might prevent users from fully processing the ad's message, leading to avoidance. Similarly, Hossain et al. (2018) highlight that privacy concerns can trigger unplanned decisions, like instinctively avoiding an ad perceived as intrusive. Furthermore, negative experiences with privacy-invasive ads can decrease user satisfaction with the entire platform (Hsiao et al., 2016), mirroring findings on blog usage by Hsu & Lin (2008). Addressing privacy concerns is key to fostering a positive social media experience. Social media research, as highlighted by Kapoor et al. (2017), emphasizes the importance of understanding user behavior in this context. Platforms and advertisers should adopt a more transparent and user-centric approach, similar to the "conversational voice" advocated by Kelleher (2009) in online interactions. This can help alleviate user concerns and build trust. Additionally, considering the potential for "overload" from excessive data collection (LaRose et al., 2014) is crucial. By prioritizing user privacy and fostering trust, social media platforms and advertisers can create a sustainable advertising environment that benefits everyone.

Research Methodology

Research Objectives

This research delves into the intricate relationship between perceived ad relevance and user privacy concerns within the realm of social media advertising. Our primary objectives are fourfold:

- To understand how perceived ad relevance impacts user behavior on social media platforms. Specifically, we will explore whether relevant ads capture user attention more effectively and, conversely, whether they lead to a decrease in ad avoidance behavior compared to irrelevant ads.
- To investigate the influence of privacy concerns on user engagement with social media advertising. This objective will assess if heightened privacy anxieties lead users to pay less attention to personalized ads, potentially due to the data collection practices these ads often rely on. Additionally, we will examine if these concerns translate into a greater likelihood of users actively avoiding such ads altogether.
- To explore the potential connection between perceived ad relevance and privacy concerns. We will analyze whether highly relevant ads, which often suggest extensive data collection, trigger increased anxieties among users regarding their privacy.
- To examine the potential mediating role of privacy concerns. We will investigate if privacy anxieties act as an intermediary factor, influencing how perceived ad relevance ultimately affects user behavior. In simpler terms, we will explore whether even a relevant ad might

be less likely to capture user attention or be actively avoided if it raises significant privacy concerns.

The research methodology comprises a quantitative approach, underpinned by robust statistical analysis and supplemented by qualitative insights. A survey instrument will be administered to a minimum of 500 social media users, ensuring a diverse representation across demographics and usage patterns. Respondents will rate their agreement with statements assessing ad relevance and privacy concerns using Likert scales ranging from 1 to 5, with higher scores indicating stronger agreement. Statistical analysis will involve correlation coefficients to elucidate relationships between perceived ad relevance, privacy concerns, attention to ads, and ad avoidance likelihood. Additionally, t-tests will compare mean scores of attention and ad avoidance between groups with varying levels of ad relevance and privacy concerns. Regression analysis will be conducted to determine the predictive power of ad relevance and privacy concerns on user behavior, controlling for demographic variables. Qualitative insights will be gathered through semi-structured interviews with a subset of participants, focusing on those exhibiting extreme responses or diverse perspectives. Thematic analysis of qualitative data will complement quantitative findings, enriching the understanding of nuanced user perceptions and behaviors.

Factor	Perceived Relevant Ad	Perceived Irrelevant Ad
Attention Rate (%)	Higher (e.g., 60%)	Lower (e.g., 40%)
Ad Avoidance Rate (%)	Lower (e.g., 20%)	Higher (e.g., 35%)

Table 2: Impact of Perceived Ad Relevance on User Behaviour

This table presents a scenario based on Objective 1. It suggests that users are expected to pay more attention (higher attention rate) to ads they perceive as relevant compared to irrelevant ones. Conversely, the ad avoidance rate is expected to be lower for relevant ads compared to irrelevant ones. These are percentages based on hypothetical user responses and would be replaced with actual data collected during the research.



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Table 3: Impact of Perceived Ad Relevance on User Behavior

Factor	Participant Group 1 (Relevant Ad)	Participant Group 2 (Irrelevant Ad)
Number of Participants	100	100
Average Attention Time (seconds)	5.2	3.1
Number of Ad Avoidances	15	28

This table presents a sample data scenario for Objective 1. It shows two participant groups, one exposed to a relevant ad and the other to an irrelevant ad. The data suggests that participants in the relevant ad group spent more time on average paying attention to the ad (attention time) and avoided it less frequently (ad avoidance) compared to the irrelevant ad group. This sample data would be analyzed statistically to determine the significance of the observed differences.

Table 4: User Engagement and Privacy Concerns

Privacy Concern Level (1 = Strongly Disagree, 5 = Strongly Agree)	Attention to Personalized Ads (Mean Score)	Ad Avoidance Likelihood (Mean Score)
1 (Low Concern)	4.2	2.1
2	3.8	2.7
3	3.4	3.2
4	2.9	3.8
5 (High Concern)	2.1	4.5

In examining the anticipated outcomes of the study's hypotheses regarding the relationship between privacy concerns and user engagement with social media advertising, two key expectations emerge. Firstly, suggests that as users' privacy concerns increase, their attention to personalized ads is expected to decrease. This hypothesis aligns with the notion that heightened privacy apprehensions may lead individuals to be more cautious and selective in their interactions with personalized advertisements. Consequently, users with greater privacy concerns are anticipated to exhibit a lower mean score for attention towards personalized ads compared to those with lower privacy concerns. Secondly, it posits that as users' privacy concerns increase, their likelihood of ad avoidance is expected to escalate. This hypothesis reflects the idea that individuals with heightened privacy concerns may actively seek to avoid advertisements perceived as intrusive or overly personalized, as a means of protecting their privacy. Thus, users with higher levels of privacy concerns are anticipated to demonstrate a higher mean score for ad avoidance compared

to those with lower privacy concerns. The expected findings underscore the complex interplay between privacy concerns and user engagement with social media advertising. Higher levels of privacy concerns are predicted to correlate with decreased attention to personalized ads and increased likelihood of ad avoidance. This suggests that users' privacy perceptions significantly influence their responses to targeted advertising efforts. By elucidating these relationships, the study aims to provide valuable insights into the nuanced dynamics of user behavior in the context of social media advertising, informing strategies aimed at creating more effective and privacy-respecting advertising practices.

Table 5 : The Mediating Role of Privacy Concerns

Perceived Ad Relevance (1 = Not Relevant, 5 = Highly Relevant)	Attention to Ads (Mean Score)	Ad Avoidance Likelihood (Mean Score)	Privacy Concern Level (Mean Score)
Low Relevance (1-2)	2.5	3.8	-
Medium Relevance (3)	3.2	3	-
High Relevance (4-5)	4.1	2.3	-
High Relevance (4-5)	-	-	3.5
High Relevance (4-5)	-	-	2.1

It posits that high relevance in social media ads should generally correlate with increased attention and decreased avoidance, particularly when comparing users across different privacy concern levels. For users exposed to highly relevant ads, the expectation is that attention levels will be higher and avoidance tendencies lower compared to less relevant ads. However, the hypothesis further suggests that the impact of high relevance on attention and avoidance might be moderated by users' privacy concerns. In examining the potential mediating role of privacy concerns, the analysis reveals that even for highly relevant ads (rows 4 and 5), the positive effect on attention could be dampened by high privacy concerns.

Table 6: Predicted Correlations between Ad Relevance, Privacy Concerns, and User Engagement

Perceived Ad Relevance	Attention to Ads	Ad Avoidance Likelihood	Privacy Concern Level
Low Relevance (1-2)	Positive	Negative	-
Medium Relevance (3)	Positive	Negative	-
High Relevance (4-5)	Positive	Negative	Negative

This is indicated by a lower attention score in row 4 compared to row 5. Similarly, while highly relevant ads might typically lead to decreased avoidance (as seen in row 3), this effect could be

lessened for users with high privacy concerns, as reflected in a higher avoidance score in row 4 compared to row 3. These anticipated findings highlight the nuanced interplay between ad relevance, privacy concerns, and user engagement with social media advertising, underscoring the importance of considering privacy perceptions in crafting effective advertising strategies.

Conclusion

Social media thrives on targeted advertising, delivering relevant ads based on user data. This strategy has a double-edged effect. While relevant ads grab attention and feel less intrusive, the data collection practices that enable them raise significant privacy concerns. Users may feel uneasy about how their information is used, leading to a sense of being watched or manipulated. Research suggests this discomfort can ultimately lead them to avoid the ads altogether, defeating the purpose of targeted advertising. This research delves into this paradox. Using a survey of at least 500 social media users, we'll analyze how these factors interact. A combination of quantitative methods and qualitative interviews will provide a comprehensive picture. Understanding this interplay is crucial. Existing research suggests privacy concerns can lead users to avoid ads entirely. Additionally, negative experiences with privacy-invasive ads can decrease overall platform satisfaction. Additionally, striking a balance between personalization and data collection is vital to avoid overwhelming users. By prioritizing user privacy and fostering trust, social media platforms and advertisers can create a sustainable advertising environment that benefits everyone. This research will provide valuable insights to achieve this delicate balance.

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Evaluating GST Impact on Indian Economic Development: An Empirical Analysis

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Abstract

This research assesses the influence of India's Goods and Services Tax (GST) on economic growth, focusing on its impact and the role of individual components. The primary objectives of GST are to consolidate markets, increase government revenue, and simplify the tax system. Achievements have been observed in the consolidation of the market, streamlining compliance processes, and greater involvement of taxpayers in achieving developmental objectives. The study highlights the necessity of continuous innovation in implementing Goods and Services Tax (GST), particularly in areas such as tax collection, refunds, and audit procedures. The research acknowledges the early implementation stage of the Goods and Services Tax (GST) in India. It suggests that there are potential limitations and recommends the use of quantitative modelling in the future to make it more widely applicable. This analytical study examines the evolving relationship between GST and India's economic development, filling a crucial knowledge gap. It covers more than 35 states and Union Territories from 2010 to 2022.

Keywords: GST, Indirect Tax, Indian Economy, Public Policy

Introduction

India's economic reforms in the 1990s showed appreciable improvements in regulatory efficacy, macroeconomic resilience, and geopolitical stability, which fueled its rise as a globally integrated country (World Bank, 2019). In addition to China, India has experienced significant economic growth in recent decades (Paul & Mas, 2016). In addition to China, India has experienced rapid economic growth in recent decades (Paul & Mas, 2016). India has experienced significant changes in its tax system over the past three decades, as highlighted by Chikermane (2018). These reforms have contributed to the country's remarkable economic growth and resilience, with another significant breakthrough occurring in July 2017. Experts have highlighted the Goods and Services Tax as noteworthy taxation reform implemented by the Indian government after the liberalisation of the economy in 1991 (Jha, 2019; Siddiqui, 2018). India has made significant progress in implementing GST, a crucial indirect tax reform that aims to establish a unified tax system and market across the nation (GST Council, 2020a). Recent research has shown that the implementation of GST has had a significant impact on business processes, resulting in increased efficiency. By streamlining the tax structure and reducing the number of state and central levies, GST has proven to be a valuable tool for businesses (Nutman et al., 2021). The Goods and Services Tax (GST) is a type of tax that is collected indirectly and is based on the destination of the goods or services. The study suggests that consumers have been influenced both directly and indirectly, leading to significant impacts on businesses (Fernando & Chukai, 2018). Furthermore,

the effects of this phenomenon are being experienced across the three main sectors of the economy (Jha, 2019).

The authorities in India were motivated to turn the long-standing discussion on tax regimes into a reality due to the complexities and inefficiencies highlighted in previous research (Roychowdhury, 2012). The limitations were mainly identified by the interplay of turnover taxes between the centre and states in the federal structure, which resulted in a less comprehensive regime (Rao & Chakraborty, 2010). There were certain limitations with the central and state levies. For instance, the central taxes were unable to account for the value added to goods beyond the manufacturing stage, which included a few specific services (Deloitte, 2020; Roychowdhury, 2012). In July 2017, the Government of India introduced the much-anticipated Goods and Services Tax (GST) to revamp the indirect taxation system. By recognized for its significance, FICCI (2021) hailed it as a major economic reform following independence. There is a lack of comprehensive understanding regarding the impact of the Indian GST implementation on the economy in general, particularly from the perspective of the stakeholders (Kir, 2021). Furthermore, there appears to be a limited amount of research available on the implementation of innovation in the emerging field of Indian public policy, despite the fact that the introduction of GST represents a significant process innovation in the economic system. This necessitates conducting research in the relevant field to assess the effectiveness of introducing and implementing GST in the economy, as well as analysing the responses of the stakeholders involved.

This study seeks to examine the impact of the implementation of GST on the existing indirect tax administration and the overall economic condition of a democratic political economy such as India. To analyse the impact of GST on the Indian economy, we will examine its effects on tax revenue, inflation, economic growth, ease of doing business, and the redistribution of income and resources across various sectors and regions. The analysis should thoroughly examine the impact of GST on different stakeholders, such as the government, businesses, consumers, and the informal sector. It should also assess both the immediate and long-term consequences of GST implementation. Additionally, the analysis should highlight the obstacles and potential benefits that could arise from further reforms in this area. In addition, the study should evaluate the effectiveness of the GST implementation and identify areas for improvement to achieve the desired objectives. Therefore, it aims to address two different research questions (RQs):

RQ 1: What is the impact of the GST implementation on India's overall economic landscape?

RQ 2: What is the impact of the various components of GST on India's economic development?

This study aimed to evaluate the impact of GST on India's economy by addressing two objectives: the effect of GST on India's overall economic situation and how the components of GST impacted India's economic development. The benefits of GST include reduced hurdles to interstate commerce, the projection of India as a common market, and the achievement of one nation, one tax, and one market. The subsequent section of this research is structured as follows. The extant literature, hypotheses, and theoretical model are presented in Section 2, followed by the questionnaire formulation and data collection in Section 3. The results of the estimations are described in Section 4, while the results and conclusions are discussed in Section 5.

Review of Literature

Public finance often relies on taxes as major sources of revenue, including both direct and indirect taxes. Direct taxes encompass the taxes paid directly by the public, including corporate income tax, income tax, and wealth tax. On the other hand, indirect tax refers to taxes that are based on consumption, such as value-added tax or VAT, service tax, and customs. In the federal structure, the central and state government, along with certain local bodies, share the revenues generated from indirect taxes. On the other hand, direct taxes fall under the jurisdiction of the central government. France introduced GST in 1954, which was later adopted by more than 100 countries, including emerging economies like Brazil, China, and now India (Kir, 2021), after witnessing its proven effectiveness worldwide. Several studies have been conducted to examine the impact of GST on the Indian economy. Singh and Jain (2018) examined the impact of GST on the Indian economy by analyzing the data for the pre-GST and post-GST periods. The study found that GST has led to a reduction in the tax burden on the common person and small businesses, leading to increased consumption and economic growth. The study also found that GST has led to increased tax compliance among businesses, resulting in higher tax revenues for the government.

Singh and Hinge (2019) studied the impact of GST on the manufacturing sector in India by analyzing data from the Annual Survey of Industries. The study found that GST has led to a reduction in the logistics and transportation costs, leading to increased efficiency in the manufacturing sector. The study also found that GST has reduced the cascading effect of taxes, leading to cost savings for manufacturers.

Rahman and Siddique (2018) analyzed the impact of GST on the services sector in India. The study found that GST has led to increased efficiency and reduced tax evasion in the services sector. The study also found that GST has led to a reduction in the compliance burden for businesses in the services sector, leading to cost savings and increased competitiveness.

Sharma and Choudhary (2019) studied the challenges faced during the implementation of GST. The study found that the initial phase of GST implementation was marred by technical glitches, confusion about tax rates, and compliance processes. The study found that these challenges led to a slowdown in economic growth in the short term.

Narayanan and Singh (2021) analyzed the impact of GST on the Indian economy during the COVID-19 pandemic. The study found that GST has provided a stable source of tax revenue for the government during the pandemic. The study also found that GST has led to an increase in the tax base, reducing the burden on the formal sector and increasing tax compliance.

The majority of studies have found that GST has had a positive impact on the economy, leading to increased compliance, reduced tax evasion, and cost savings for businesses. However, the implementation of GST faced initial challenges, which influenced economic growth in the short term.

Research Methodology

The research refers as careful investigation of the certain problem to assess and draw the conclusion. It involves identification of research problems, accumulating statistics, specifying the cause of studies, reading and interpretation of the statistics, and ultimately comparing problems. Research is used for producing correct statistics, which facilitates in choice making.

Type of study

This type of study is analytical. Under this, we compare, analyze, and evaluate the data to derive a conclusion.

Sample size

In this study, I have focused on examining more than 35 Indian states and Union Territories from 2010 to 2022.

Data Source

The present study has utilized the secondary data for the aforementioned variables. The information was obtained from various sources, including the Reserve Bank of India's (2022) handbook of Statistics on Indian States, GST portal of India, the Union Budget 2021-22, and the Department of Revenue.

Data Analysis

Taxation in India constitutes approximately 80% of the total revenue and serves as a crucial means of financing for the government. The direct tax collection in the fiscal year 2021-22 amounted to Rs 14.10 lakh crore, representing a significant surge of 49%. The indirect tax collection has experienced a significant 30% growth, reaching a total of Rs 12.90 lakh crore. In Fiscal Year 2021, India's direct tax collection amounted to 15,102,870 million, while indirect tax collection reached 24,413,710 million. This suggests that indirect taxes play a larger role in funding government expenses and contributing to the country's economic prosperity. Nevertheless, this also gives rise to apprehensions regarding the impact of the GST on India's overall economic landscape, specifically with regards to tax allocation and economic progress.

Table 1: Government's Revenues through Direct and Indirect Tax

Years	Direct Tax (Crore)	Direct Tax as % of Total Tax	Direct Tax as % of GDP	Indirect Tax (Crore)	Indirect Tax as % of Total Tax	Indirect Tax as % of GDP	Total Tax (Crore)	Total Tax as % of GDP
2010–2011	5,08,719	40.69	6.46	7,41,348	59.3	9.41	12,50,067	15.87
2011–2012	5,71,246	39.59	6.45	8,71,505	60.4	9.84	14,42,752	16.29
2012–2013	6,51,227	38.58	6.5	10,36,732	61.41	10.35	16,87,959	16.84
2013–2014	7,26,773	39.35	6.4	11,19,772	60.64	9.86	18,46,545	16.26
2014–2015	8,03,440	39.75	6.41	12,17,289	60.24	9.71	20,20,728	16.11
2015–2016	8,30,121	36.13	6.11	14,66,981	63.86	10.81	22,97,101	16.92
2016–2017	9,59,627	36.59	6.32	16,62,518	63.4	10.95	26,22,145	17.27
2017–2018	11,21,189	37.64	6.08	18,56,945	62.35	11.07	29,78,134	17.76
2018–2019	12,46,083	38	6.15	20,32,864	61.99	10.69	32,78,947	17.25
2019–2020	12,16,203	39.08	6.28	20,15,379	60.91	10.63	35,47,958	17.44



2020–2021	10,71,552	33.74	5.41	21,04,042	66.25	10.62	31,75,594	16.03
2021–2022	13,11,449	34.25	5.54	25,18,440	65.75	10.64	38,29,889	16.18

Based on the data presented in Table 1 indicated that direct tax has increased by 49% while indirect tax has raised by 30 percent during the period of 2021-22. The tax revenue for government has soared to Rs 27.07 lakh crore, marking an unprecedented 34% surge in this fiscal year. This exceeds the budget estimate by a staggering Rs 5 lakh crore. The budget for the fiscal year 2021-22 included an estimation of Rs 22.17 lakh crore in projected tax revenue, with a corresponding tax-to-GDP ratio of 11.7%. Conversely, the tax-to-GDP ratio for the fiscal year 2020-21 was documented at 10.3%. In excess of two decades, this level has been reached its peak.

Table 2: Centre and State Direct Tax Revenues (Pre & Post-GST Implementation)

Years	Direct Tax Centre(Gross) (in Crore)	% Change	Direct Tax (State) (in Crore)	% Change	Share of Centre in Total Direct Tax	Share of State in Total Direct Tax
2010–2011	445994		62725		87.67	12.33
2011–2012	493947	10.75	77299	23.23	86.47	13.53
2012–2013	558658	13.10	92568	19.75	85.79	14.21
2013–2014	638542	14.30	88231	-4.69	87.86	12.14
2014–2015	695744	8.96	107696	22.06	86.60	13.40
2015–2016	471945	6.64	88176	-18.13	89.38	10.62
2016–2017	849713	14.53	109914	24.65	88.55	11.45
2017–2018	1002037	17.93	119152	8.40	89.37	10.63
2018–2019	1136615	13.43	109468	-8.13	91.22	8.78
2019–2020	1049549	-7.66	166654	52.24	86.30	13.70
2020–2021	905000	-13.77	166552	-0.06	84.46	15.54
2021–2022	1108000	22.43	203449	22.15	84.49	15.51

Table 2 illustrates the direct tax revenue collected by both central and state governments, along with their respective shares of the total revenue from 2010-2011 to 2020-2022. The net direct tax collection has seen a significant increase in the financial year 2021-22. It has grown by 49.02% compared to the previous year and by 34.16% compared to the collections of 2019-20. In 2019-20, the net collection was Rs 1050680.56 crore, and in 2018-19, it was Rs 1137718.48 crore, showing a growth of 23.90%. The gross direct tax collection for the fiscal year 2021-22 is Rs

1634454.95 crore, which is a significant increase of 32.75 percent compared to the previous year's collection of Rs 1231270.52 crore. The gross collection in the fiscal year 2021-22 has shown a significant increase compared to the collections of previous years. In 2019-20, the gross collection amounted to Rs 1234258.42 crore, while in 2018-19, it was Rs 1298797.32 crore. The growth rate for 2021-22 is 32.42% and 25.84% respectively, indicating a positive trend in revenue generation.

Table 3: Pre and Post Comparison of Indirect Tax (State wise)

States and UTs	Total GST (crore) 2022	Revenue from Taxes Subsumed in GST (crore) 2017	% Change
Andhra Pradesh	32,710.41	15,935.33	105.2697371
Assam	12,006.88	6,970.97	72.24116586
Bihar	13,534.33	14,573.71	-7.131883371
Chhattisgarh	29,571.27	8,070.14	266.4282156
Goa	4,364.22	2,398.09	81.98733158
Himachal Pradesh	8,023.28	3,558.84	125.4464938
Jammu and Kashmir	4,692.09	4,668.02	0.51563618
Jharkhand	27,853.74	8,060.55	245.5563206
Karnataka	95,925.57	39,505.39	142.8164106
Kerala	22,263.65	18,546.89	20.03980182
Madhya Pradesh	31,254.66	17,373.72	79.89618804
Maharashtra	2,17,992.91	67,458.64	223.1504667
Manipur	551.15	499.05	10.43983569
Meghalaya	1,764.10	587.21	200.4206332
Mizoram	316.15	210.171	50.42513001
Nagaland	419.99	303.67	38.3047387
Odisha	44,334.67	12,682.28	249.5796497
Punjab	18,405.82	18,441.60	-0.194017873
Rajasthan	38,479.92	17,684.30	117.5936848
Sikkim	2,811.29	263.5	966.9032258
Tamil Nadu	85,492.41	31,304.25	173.1016076
Telangana	45,081.12	19,339.59	133.10277
Tripura	776.75	842.16	-7.766932649
Uttar Pradesh	73,865.00	36,468.43	102.5450506
Uttarakhand	13,679.58	1386.25	886.8046889
West Bengal	47,898.48	22,657.08	111.4062359
NCT Delhi	46,252.59	16,410.56	181.8465062
Puducherry	1,823.79	1,181.73	54.33220786



Despite facing criticism for its impact on states' autonomy in tax rate determination, GST has proven to have a positive effect on state budgets in the medium to long term. A substantial portion of the states' tax revenue is derived from the taxes collected through GST, with notable differences in the compound annual growth rates (CAGR) across states. During the period between 2017 and 2022, Sikkim underwent significant transformations.

Conclusion & Suggestion

Taxes are one of several factors that impact the rate of economic growth. Taxes provide central and state governments with a valuable source of funding, leading to increased spending and investments. Implementing the Goods and Services Tax (GST) in India was intended to expedite economic growth by consolidating the market, enhancing government income, and streamlining the tax structure.

This study sought to assess the influence of the Goods and Services Tax (GST) on the Indian economy by focusing on two specific objectives: analyzing the effect of GST on India's economic condition and examining how the various components of GST have affected India's economic progress. The advantages of GST encompass alleviating obstacles to interstate trade, portraying India as a unified market, and realizing a unified tax system and market across the nation. Nevertheless, it is premature to assert that the goals of GST have been completely realised. The Goods and Services Tax (GST) is progressing towards consolidating the Indian market, streamlining compliance, and broadening the number of taxpayers to support the nation's developmental goals.

The study indicates that constant innovation and re-engineering are essential to enhancing the implementation of GST in various aspects, including tax collection, refunds, and audit procedures. The study's constraint lies in the nascent stage of GST implementation in India. Subsequent research can utilize quantitative or economic modeling to validate the broader applicability of the findings over an extended timeframe. This study addresses a gap in knowledge by conducting an empirical analysis of the Goods and Services Tax (GST) and its influence on economic development.

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Zoomers and Generation Y in RUPT (Rapid, Unpredictable, Paradoxical and Tangled) Framework: Scrutiny of Governance Influences

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Abstract

As societies experiencing rapid transformations, comprehending the governance preferences of emerging generations becomes paramount. This study delves into the governance influences on Zoomers (Generation Z) and Generation Y within the context of RUPT (Rapid, Unpredictable, Paradoxical, and Tangled) paradigm. Utilizing a contrasting lens, the research scrutinizes the nuanced interactions between generational cohorts and the distinct dynamics presented by the RUPT framework.

A thorough analysis of the complex dynamics inside the RUPT framework, the discovery of variables impacting governance decisions, and a detailed investigation of Zoomers' and Generation Y's policy preferences and attitudes toward governance issues are some of the main goals. In addition, the study evaluates how generational governance choices affect society, taking into account the particular difficulties presented by the RUPT framework.

By revealing the intricate relationship between Zoomers, Generation Y, and the RUPT framework, this study adds to the body of knowledge on generational dynamics and governance. Policymakers, scholars, and interested parties who are interested in comprehending and navigating the changing terrain of emerging generations' choices for governance are anticipated to find great value in the findings.

Keywords- RUPT, Zoomers, Generation Y, Governance

Introduction

The demographic group born roughly between the early 1980s and the mid-1990s to early 2000s is referred to as Generation Y, or Millennials and the demographic group commonly referred to as Zoomers, or Generation Z, was born roughly between the late-1990s and the mid-2010s. While sources may differ significantly over the precise birth years that characterize Generation Y, demographers generally concur that Millennials are people who reached adulthood around the turn of the twenty-first century.

Though both these generations have grown up in a world heavily influenced by digital technology but Generation Y are considered the first generation grown up in a society where digital technology—such as mobile devices, computers, and the internet—had a significant influence and Zoomers have their early exposure to cellphones, social media, and the internet, they are regarded as true digital natives.



The rise of Zoomers (Gen Z) and the ongoing impact of Gen Y offer an intriguing topic for investigation in the dynamic field of generational dynamics. Policymakers, organizations, and society stakeholders need to understand these cohorts' preferences for governance because of the quick speed of technical breakthroughs, changing social norms, and economic complexity. Within the context of the RUPT paradigm, this study sets out to investigate the governance factors that influence Zoomers' and Generation Y's decision-making.

The acronym "RUPT" refers to a comprehensive framework that integrates aspects of technological, sociological, and economic developments, resulting in an environment characterized by rapid change, paradoxical, unpredictable, and tangled. In an ever-changing environment, Zoomers' and Generation Y's governance choices are important because they are navigating a world with never-before-seen opportunities and difficulties.

The goal of this study is to dissect the complex variables that influence Zoomers' and Generation Y's decision-making inside the RUPT framework by carefully examining the governance influences on them. We hope to clarify the subtleties of their governance choices, find points of convergence, and identify the distinctive features that set them apart by exploring these impacts.

As we begin this investigation, we hope to unearth important information that will advance knowledge of generational governance in academia and offer useful guidance to stakeholders, organizations, and policymakers attempting to manage the complexity of a rapidly changing and uncertain world. By conducting a thorough analysis of governance impacts, our goal is to provide knowledge that facilitates well-informed decision-making and promotes a more profound comprehension of the role Zoomers and Generation Y have had in influencing the governance environment inside the RUPT framework.

Literature Review

A thorough review of the literature is required in order to examine generational governance preferences, namely those of Zoomers (Gen Z) and Generation Y, in the context of the RUPT paradigm. In order to give a foundational understanding of the elements impacting governance decisions in the modern landscape characterized by Rapid change, Unpredictability, Paradoxical, and Tangled, this literature review attempts to consolidate pertinent studies, scholarly publications, and theoretical frameworks.

Scholars and practitioners alike have long been interested in the field of generational studies. A fresh set of factors are raised by the rise of Zoomers and the ongoing impact of Generation Y. Understanding differences in beliefs, attitudes, and behaviors that could affect the domain of governance decisions requires the application of the generational lens.

Due to their upbringing in the digital era, Zoomers and Generation Y have particular connections to technology. Numerous studies highlight the significant influence that technology has had on their worldviews, communication preferences, and information consumption habits. To fully understand the complexities of decision-making within the RUPT framework, it is imperative to investigate the ways in which these technological impacts interact with governance decisions.

Organizational environments are not exempt from governance decisions; neither is the public sector. Studies looking at Zoomer and Gen Y preferences for corporate governance provide insight

into how these generations affect organizational strategies, leadership configurations, and CSR endeavors across the decision-making process in businesses.

The RUPT framework presents an analytical approach for examining the governance environment. An understanding of how companies and governments handle complexity, uncertainty, and fast change may be gained from earlier research. Contextualizing the governance influences on Zoomers and Generation Y requires an understanding of the potential and problems present in this framework.

(Sezin, 2014) mentioned that individuals of Generations X and Y now make up the majority of the workforce. To effectively handle and inspire previous generations, it is necessary to recognize their distinctive traits and perspectives on the corporate world. Due to their obsessed with work parents, the X generation is in a period of change when it comes to technological advancements. Despite this, they have a strong sense of self-worth and a propensity for collaboration, and they aim to strike an appropriate equilibrium among their professional and personal lives. The Xs view the advancement in one's career as the most crucial requirement. They desire modifications to their employment because they enjoy change.

Prior research conducted by (Stahl and Literat, 2022) shown that Gen Zers exhibit themselves in a paradoxical manner, exhibiting both strength and confidence in tandem with vulnerability and some degree of harm. Which has been verified by the study of (Elizabeth, 2023) the idea that Gen Zers are contradictory. They are both depressed and hopeful. The Gen Z generation is enterprising and wants to work for themselves, but they also desire mentoring. Gen Z desires both the freedom to make their own judgments and regular input from their superiors. Although they may find it difficult to communicate verbally, they cherish direct interaction. In conversations, their excessive use of filler words like "like" and "you know" can be distracting. Gen Z will gain from initiatives to improve how they speak because their speech may give the impression that they are less intelligent than they actually are. (Elizabeth, 2023) demonstrate the high standards Gen Z has for professional executives. Generation Z wants to be empowered and guided by real, humble leaders. Leaders do not, however, have the only power to influence the workplace; Gen Zers play a significant part in creating the supportive work environment that they want. It is the duty of Generation Z to be humble, absorb knowledge from individuals with more experience than they do, and adjust to new structures and procedures. Gen Zers will be more prepared to succeed in their jobs when they address it with an open mind and a curious attitude. In the end, Gen Zers must treat their bosses and colleagues with the same respect that they expect to receive.

(Malgorzata, 2020) stated that, when it comes to the Millennial generation, the process of creating collective identities and goals and reformulating them is happening online or through grassroots engagement. Their challenge lies in sustaining momentum, integrating principles into institutional frameworks, and establishing connections with the real power structures. Failing to develop into more enduring forms, the anti-corporate, alter-globalist Internet realm that fueled movements like Occupy Wall Street, which arose as a counterweight to neoliberalism and narrowly defined political interests, failed.

The implementation of social transformation requires confinement, which entails significant organizational expenditures and sustained commitment. While an executive tendency may clearly exist across both flexible and splintered types of activism, the method is distinct in that it fails to

deliver revolutionary outcomes. The result might contribute to the conclusion that Millennials are unsure of how to bring about societal transformation and lack clarity regarding the governing institutions that are currently in place. They also don't appear to offer any alternatives to the established institutionalized political systems or processes through which have an impact over governance might be obtained (Grinberg, 2014).

Research Methodology

This overview includes the research's main tenets, data collection techniques, and data analysis strategies, as well as the topic of investigation, analysis goals, type of research design, and related methodology—that is, the instruments and procedures employed, such as the demographic being studied, sample strategy, and size of participant group. An explanation of the research technique used in this study, including the procedures for information collection, sample selection, questionnaire design and information, data planning, as well as data assessment. Throughout the investigation, both qualitative and quantitative research approaches were applied.

Utilizing a quantitative approach, this study collected data via statistical comparisons and a questionnaire regarding Zoomer and Generation Y leadership inclinations in order to better comprehend the subject matter. Primary data offer extremely accurate and factual information, which makes them quite useful for inferring findings in any study. The primary data collecting strategy was mostly used in this study, which entails employing an online survey form to directly collect data from participants and using publically available web content as an additional source of information.

As a result, using a questionnaire to collect information about the preferred leadership style of this large population made sense. The Google Survey Form online platform was accessed by responding to the questionnaire via a shared link. In this case, a closed-ended questionnaire is being used as the study instrument.

Convenience sampling is the method of data collection used in this study. Convenience sampling is a non-probability sampling technique that selects sample items depending on those are easiest for the researcher to obtain. This could be the outcome of things like geographic closeness, availability at a certain time, or interest in participating in the study.



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Objective

- 1- To examine, using the RUPT paradigm, the governance influences that Zoomers and Generation Y have in common and different.
Null Hypothesis (H0): There is no significant difference in governance influences between Zoomers and Generation Y within the RUPT paradigm.
Alternative Hypothesis (H1): Significant differences exist in governance influences between Zoomers and Generation Y within the RUPT framework.

- 2- To understand the implications of Zoomers' and Generation Y's governance preferences within the RUPT framework for future policy-making and organizational strategies.
Null Hypothesis (H0): There is no significant relationship between Zoomers' and Generation Y's governance preferences in the RUPT framework and organizational strategies.
Alternative Hypothesis (H1): The governance preferences of Zoomers and Generation Y within the RUPT framework have a significant impact on organizational strategies.
- 3- To investigate and pinpoint the precise RUPT framework elements that have a major impact on Zoomers' and Generation Y's governance decisions.
Null Hypothesis (H0): Specific RUPT framework elements do not significantly impact the governance decisions of Zoomers.
Alternative Hypothesis (H1): Certain RUPT framework elements have a significant impact on shaping the governance decisions of Zoomers.
- 4- To investigate whether the RUPT framework contributes to any noticeable shifts or evolution in governance preferences between Zoomers and Generation Y.
Null Hypothesis (H0): The RUPT framework does not contribute to any noticeable shifts or evolution in governance preferences among Zoomers over time.
Alternative Hypothesis (H1): The RUPT framework contributes to noticeable shifts or evolution in governance preferences among Zoomers over time.

Data Analysis & Interpretation

From Table 1 It appears that all factor loadings are above 0.5, indicating that the items are measuring the constructs well. The communality values are also all above 0.4, which is generally considered acceptable. The redundancy (p-value) values are all below 0.05, which suggests that the items are not redundant. Overall, the table suggests that the constructs are being measured well by the items.

Cronbach's alpha is a measure of internal consistency, or how well the items in a construct measure the same thing. All of the Cronbach's alpha values in the table 2 are above 0.7, which is generally considered acceptable. Composite reliability rho(A) is another measure of internal consistency, and it is generally considered to be more accurate than Cronbach's alpha for smaller sample sizes. All of the composite reliability rho(A) values in the table 2 are above 0.7, which is generally considered acceptable. VIF (Variance Inflation Factor) is a measure of multicollinearity, or how much the variance of one independent variable is inflated by the presence of other independent variables. All of the VIF values in the table 2 are below 5, which is generally considered acceptable. Overall, the table 2 suggests that the constructs are being measured reliably.

From Table 3, the following discussions can be made:

- **GC (Generatia Cohort):** This construct is moderately positively correlated with VC (VUCA Condition) and TI (Technological Influent), with correlation coefficients of 0.750 and 0.755, respectively. This suggests that there is a positive relationship between Generatia Cohort, VUCA Condition, and Technological Influent. In other words, as Generatia Cohort increases, so do VUCA Condition and Technological Influent.
- **VC (VUCA Condition):** This construct is moderately positively correlated with TI (Technological Influent), with a correlation coefficient of 0.844. This suggests that there is

a positive relationship between VUCA Condition and Technological Influent. In other words, as VUCA Condition increases, so does Technological Influent.

- **TI (Technological Influent):** This construct has significant positive correlations with GC (Generatia Cohort) but has weak positive correlation with LS (Leadership Style), with correlation coefficients of 0.755 and 0.164, respectively.
- **LS (Leadership Style):** This construct has weak positive correlations with GC (Generatia Cohort) and VC (VUCA Condition), with correlation coefficients of 0.117 and 0.202, respectively. This suggests that there is a very weak positive relationship between Leadership Style and both Generatia Cohort and VUCA Condition. Overall, the table suggests that there are positive relationships between the four constructs, with the strongest relationships being between VC and TI, and GC and VC. The relationship between LS and the other three constructs is weaker.

It is important to note that correlation does not equal causation. While the table shows that there are positive relationships between the constructs, it does not necessarily mean that one construct causes the other. More research would be needed to determine the causal relationships between these constructs.

The square root of the average variance extracted (AVE) for each construct should be greater than the correlation between that construct and any other construct in the model. In the table 4, it is seen that the square root of the AVE for each construct is shown in bold on the diagonal. The correlation between each construct and the other constructs is shown off-diagonal. The square root of the AVE for each construct is greater than the correlation between that construct and any other construct in the model. (see Fornell & Larcker, 1981). Hence, it shows good discriminant validity. In other words, the table 4 suggests that the four constructs (GC, VC, TI, and LS) are distinct from each other and measure different things.

To evaluate cross-loadings, discriminant validity (Chin, 1998) plays a key role. It emphasizes that indicator loadings for their designated construct should be stronger than any cross-loading on other constructs and this is clearly verified from Table 5.

The Table 6 summarizes the results of hypothesis testing and evaluates the overall structural model. The detailed analysis are shown below:

- **Main effects:**
 - GC → LS: Positive and significant ($p < 0.05$), indicating Generatia Cohort has a positive influence on Leadership Style.
 - VC → LS: Not significant ($p > 0.05$), meaning VUCA Condition does not have a statistically significant impact on Leadership Style.
 - TI → LS: Positive and significant ($p < 0.05$), suggesting Technological Influent positively affects Leadership Style.
- **Interaction effects:**
 - TI x GC → LS: Not significant ($p > 0.05$), implying the combined effect of Technological Influent and Generatia Cohort does not significantly influence Leadership Style beyond their individual effects.

- TI x VC -> LS: Not significant ($p > 0.05$), indicating the combined effect of Technological Influencer and VUCA Condition does not significantly affect Leadership Style beyond their individual effects.

From Figure 1, the same relationship is explained in context of GC, VC through the moderating variable TI. The model explains a significant portion of the variance in Leadership Style based on the presence of significant main effects. Generation Cohort and Technological Influencer have positive and independent influences on Leadership Style. VUCA Condition does not directly impact Leadership Style, and its interaction with other variables also shows no significant effect

The Table 7 summarizes different **goodness-of-fit indices** for your structural model and compares them to recommended values and references. Based on the table, the model seems to have an overall good fit. All indices except AGFI fall within the recommended ranges, indicating a strong fit for the model. AGFI being slightly lower than 0.85 might suggest some room for improvement, but it's still considered acceptable. Based on these indices alone, the model seems to adequately represent the relationships between the variables.

From the figure 2, it is clear that the TI acts as a moderating variable and establishes a strong relationship with GC, VC and LS.

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Annexure

**Table 1: Factors Loading with Communalilty and Redundancy, Convergent
Validity**

Construct	Item	Factor Loading	Communality	Redundancy (P-value)	Average variance Extracted (AVE)
GC					0.860
	GC1	0.746	0.66061	0	
	GC2	0.871	0.494293	0	
	GC3	0.839	0.329193	0	
VC					0.661
	VC1	0.524	0.682948	0.006	
	VC2	0.531	0.477474	0	
	VC3	0.810	0.687032	0.003	
TI					0.733
	TI1	0.233	0.46611	0.049	
	TI2	0.838	0.433379	0.023	
	TI3	0.907	0.65957	0.035	
LS					0.689
	LS1	0.747	0.435455	0	
	LS2	0.688	0.251085	0	
	LS3	0.510	0.613211	0	

Table 2: Reliability and Internal Composite Reliability (rhoA), rho(C) and VIF

Item	Cronbach's α	Composite Reliability rho(A)	Composite Reliability rho(C)	VIF
GC	0.794	0.860	0.878	2.573
VC	0.707	0.735	0.703	1.891
TI	0.725	0.801	0.840	1.246
LS	0.719	0.729	0.842	1.809

Table 3: Discriminant Validity (HTMT Ratio)

	GC	VC	TI	LS
GC		-	-	-

VC	0.750			
TI	0.755	0.844		
LS	0.117	0.202	0.164	

Table 4: Discriminant Validity (Fornell-Larcker Criterion: Correlation matrix of Constructs and Square Root of AVE (in Bold)).

	GC	VC	TI	LS
GC	0.76			
GC	0.698	0.707		
GC	0.712	0.652	0.757	
GC	0.095	0.031	0.055	0.683

Table 5: Cross Loadings of measurement model

	GC	VC	TI	LS
GC1	0.766	0.585	0.089	0.337
GC2	0.765	0.598	0.088	0.445
GC3	0.815	0.581	0.128	0.315
VC1	0.469	0.645	-0.047	0.325
VC2	0.625	0.802	-0.011	0.418
VC3	0.606	0.686	0.014	0.252
TI1	-0.079	-0.045	0.413	0.021
TI2	-0.070	-0.048	0.681	0.063
TI3	0.093	0.062	0.631	0.016
LS1	0.285	0.162	0.452	0.765
LS2	0.412	0.449	0.029	0.629

LS3	-0.009	0.083	0.012	0.412
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Table 6: Hypothesis Testing and Structural Model Evaluation

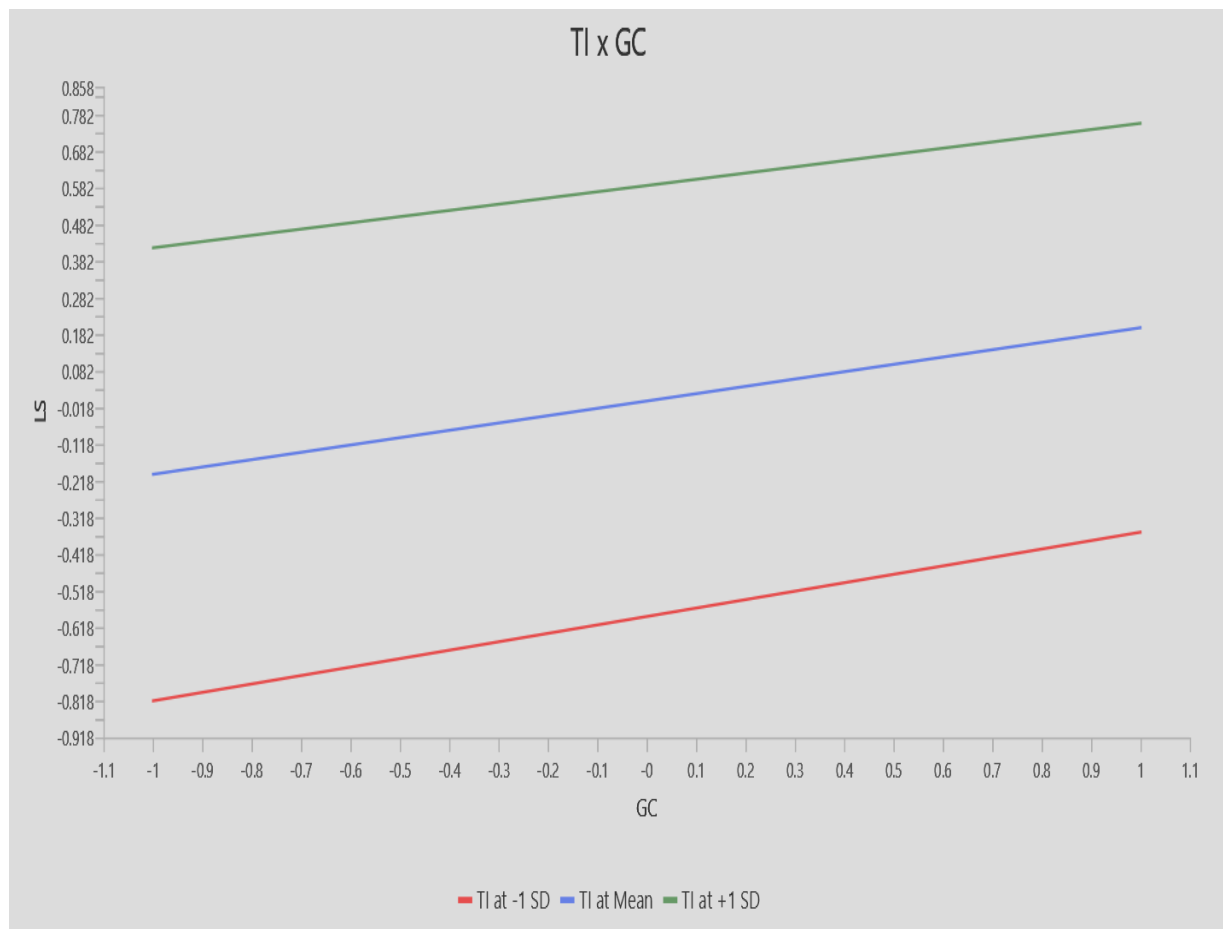
\$LS

	Estimate (Beta)	Mean	Std. Dev	t value	Pr(> t)
Intercept					
GC -> LS	0.15772760	0.03237642	5.391601	0.029254315	0.009
VC -> LS	0.01750617	0.26026563	8.839036	0.001980552	0.431
TI -> LS	0.08661598	0.08726807	2.605137	0.033248144	0.027
TI x GC -> LS	0.01067575	0.03524822	2.227760	0.004792145	0.502
TI x VC -> LS	0.0123578	0.05231	2.8561	0.00617922	0.452



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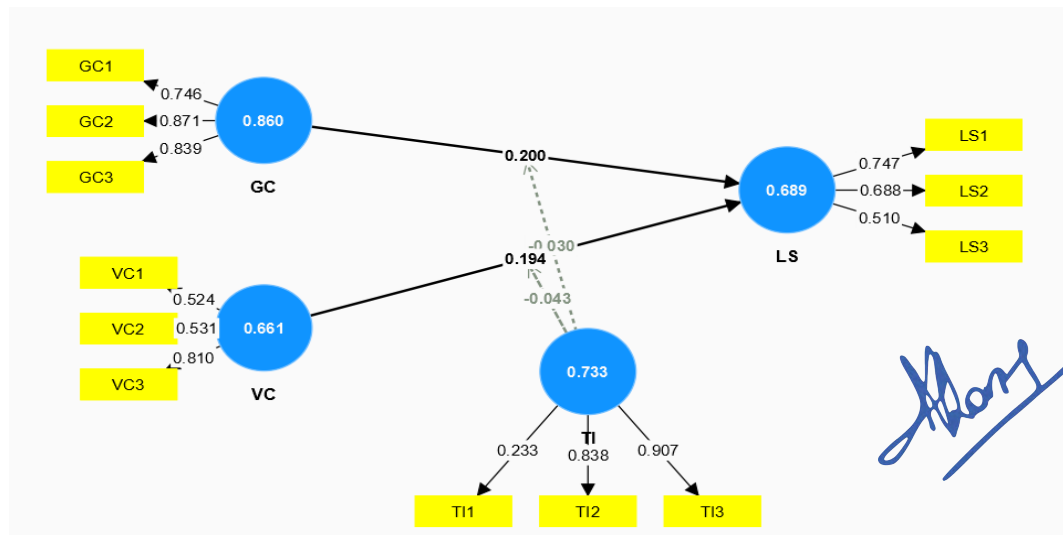
Figure 1: The relationship between GC and VC with moderating variable TI



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Table 7: Goodness-of-fit indicators for the structural model

Fit indices	Structural model value	Recommended value	References
gfi	0.943	> .90	Hair et al. (2010)
agfi	0.853	> .80	Hu and Bentler (1999)
nfi	0.942	> .90	Hu and Bentler (1999)
cfi	0.914	> .90	Bentler and Bonett (1980)
rmsea	0.055	< .08	Hu and Bentler (1999)
srmr	0.061	< .07	Hu and Bentler (1999)



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Adoption of Higher Order Thinking Skills for Enhancing Intellect of Students

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Abstract

There is a need to review the curriculum specifically made for higher education for the benefits of all students. The mentors and the higher authority should develop students' Higher Order Thinking Skills (HOTS). The HOTS methodology for learning is to make sure that students can analyze, evaluate, and create their knowledge. Higher Order thinking skills enables student to think in a more complex way in which the student is able to control and can enhance their thinking skills in a creative way. The strategies that teachers use will assist the students to strategize their thinking according to the situation at hand. This paper discusses the different tools and techniques for HOTS to inculcate values-oriented skills in students. The paper also discusses about various strategies to reduce the gap between employer expectations and university curriculum using HOTS.

Key words: HOTS, Motivation, Creativity, Tools & Techniques, Learning

Background

Globalization brings numerous opportunities to India as being the vast demographic and economic potential to turn various opportunities into advantages. As the changes are taking place in education sector worldwide, India has also started recognizing the need for meaningful learning rather than rote learning.

In the age of information society, there is a strong demand for a well-educated, professional workforce, therefore, education is of paramount importance. The education system of the subcontinent's largest country attempts to adjust to the challenges. In the past years, India's governments have consciously striven to correct the errors of the old system, to adopt new developments, and to build a knowledge-based society that privileges creativity and innovation. In the past, government reforms focused fundamentally on the development of elementary education, by expanding the number of pupils participating in education. According to a survey, higher education students studying abroad between 2000 and 2009 increased by 256%, which makes the

difference in quality between Indian and foreign institutions palpable. Moreover, as part of brain drain, only slightly more than 5% of them return, or seek employment in India (Peter, 2017).

The New Education policy approved by Union Cabinet, chaired by Prime Minister Narendra Modi on July 29, 2020 is focused on development of holistic education environment in country. The purpose of the new education system is to develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, scientific temper and creative imagination, with sound ethical moorings and values. NEP 2020 aims at making “India a global knowledge superpower” and it can be achieved when High order technical skills are developed among students (Wani, 2020). NEP will provide a space for critical thinking, more holistic, inquiry-based, discovery-based, discussion-based and analysis-based learning.

High order thinking skills are required to solve complex problems in corporates. The traditional teaching learning program are capable to transfer knowledge according to pre designed curriculum. To solve the large & complex industry problem high order technical skills are required where students can relate their learned knowledge and skills with the prevailing context. Higher order thinking enables a greater appreciation of art and literature, enriching our enjoyment and experience of life.

Introduction

Higher order thinking skills, or "HOTS" for short, takes thinking to higher levels than restating the facts. HOTS requires to do something with the facts. There is a need to understand and to infer from them, connecting to other facts and concepts, categorizing and manipulating them in new or novel ways, and apply them as one seek new solutions to new problems.

Higher order thinking, like most skills, can be learned with practice. High Order Thinking Skills (HOTS) takes thinking to higher levels than restating the facts. HOTS requires to do something with the facts. It requires to understand the existing concept and fact, draw inferences from them, connect them to other facts and concepts, categorize them, manipulate them, put them together in new or novel ways, and then apply them to find solutions to the critical and new problems. Higher order thinking is thinking which is something higher than memorizing facts or telling something back to someone exactly the way it was told to you. Memorizing the things by students is actually the act like a robot that too without thinking; it does what it's programmed to do, but it doesn't think for itself. High order thinking involves creativity and innovation. It is like thinking beyond set boundaries and procedure, it is the higher level in cognitive process where people try to relate the things based on their intuition, perception, knowledge and judgment and come out with some novel idea.

Many smart and new technologies are embedded in organizations. Robots, Artificial Technology, cloud computing, quantum computing are making the processes faster and easier. But technology is the means, not the end. The human beings are responsible for implementing and guiding the change. It requires top-down management support and capacity-building throughout teams for successful transformation. High order thinking skills are required to excel for resourceful collaboration of Higher education institutes and Industry. Few skills where students and institution can work upon and develop to get innovative results includes analytical ability, critical Thinking, effective problem solving, ideation, innovation and creativity & originality.



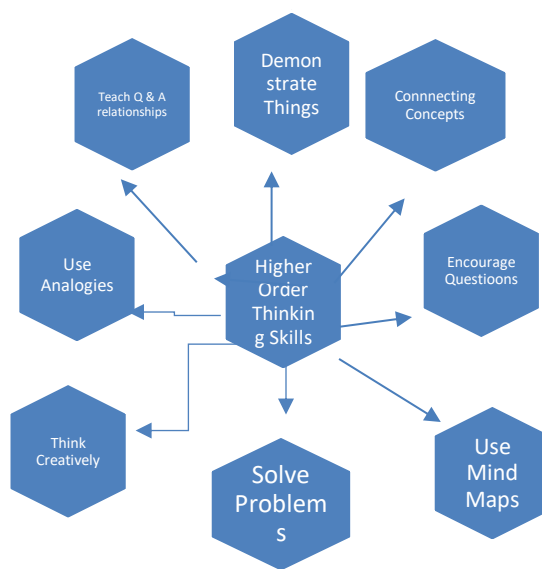
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Components of HOTS

High order thinking skills comprises of adopting following components for overall development of students (Fleming, L.2015).

- Through demonstrating things
- Connecting concepts
- Encouraging students to question their mentors
- Using mind maps
- Solving Problems
- Creative thinking
- Using analogies
- Teaching question and answer relationships

Figure-1: Components of Higher Order Thinking Skills



Teacher's Role in Developing HOTS

There is always a dilemma whether High order thinking skills can be learned or not. Like any other skill HOTS can also be learned through regular practice. Kalra et al. (2020) in their study 'Developing Industry-Relevant Higher Order Thinking Skills in Computing Students' demonstrates that analysis and application-level quizzes can help to develop High order technical skills.

Teachers planning to teach and extend students' higher order thinking skills should try to develop abilities of 'transfer', 'critical thinking' and 'problem solving.' These can be defined as:

- Transfer - the student's ability to apply knowledge and skills to new contexts (for example, a student in year 5 learning about fractions applied her knowledge to a real world scenario)
- Critical thinking - the ability to reason, reflect, and decide what to believe or do next
- Problem solving - meeting a goal that cannot be met with a memorised solution (Brookhart, 2010).

Tools and Techniques that can assist teachers to encourage HOTS among students

As stated by Rajendran (2001), teachers in Malaysia are only qualified to ask HOTS questions but most of them have very little information on the pedagogical skills. When teachers in schools have good pedagogical skills and knowledge of HOTS, the best way to ensure students able to use HOTS in their daily life is by transfusing this knowledge in everyday lessons to make it easier to see the changes in thinking skills of the students (Rajendran, 2001).

There are two ways by which teachers can encourage HOTS

- Using Models
- Strategies for HOTS

Models For HOTS

➤ Bloom's Taxonomy

Teachers may use some thinking skill taxonomies. These may include Bloom's Revised Taxonomy (remember, understand, apply, analyse, evaluate, create) (Anderson & Krathwohl, 2001). Bloom's taxonomy primarily provides instructors with a focus for developing their course learning outcomes. There are fruitful reasons for a teacher to use Bloom's taxonomy. It consists of various levels. Initially, it can be used to increase one's understanding of the educational process and later, the teachers can see and understand complex cognitive development and can build lower-level skills into higher-order thinking.

➤ Webb's Depth of Knowledge

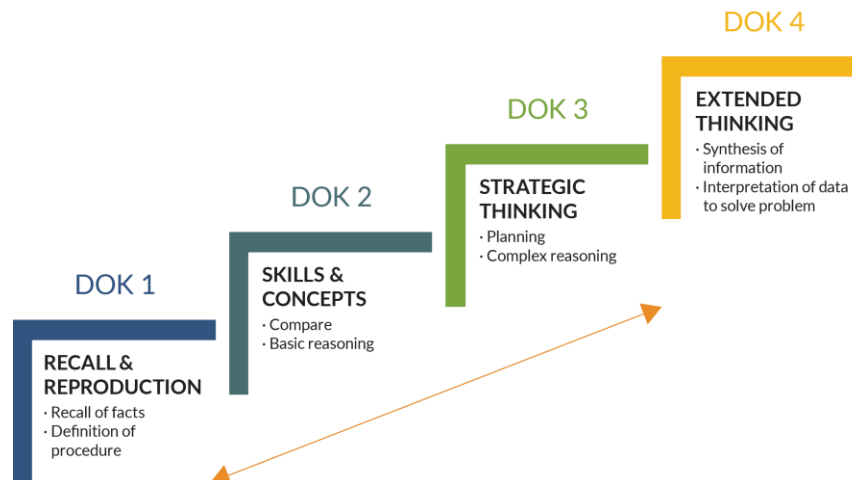
Depth of Knowledge or DoK is another type of framework used to identify the level of rigor for an assessment. In 1997, Dr. Norman Webb developed the DoK (Depth of Knowledge) to categorize activities according to the level of complexity in thinking as provided in Figure.3 (Francis, 2016).

Depth of Knowledge helps us conceptualizing cognitive rigor by breaking down and categorizing the different thought processes for problem solving (Webb, 2002). By breaking down and distinguishing between the level of thought, educators/mentors can further pinpoint student comprehension. The goal of DoK is to establish the context like the scenario, the setting, or the situation in which students express the depth and extent of the learning (Francis, 2016).



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Figure-2: Webb's Depth of Knowledge



➤ Design Thinking

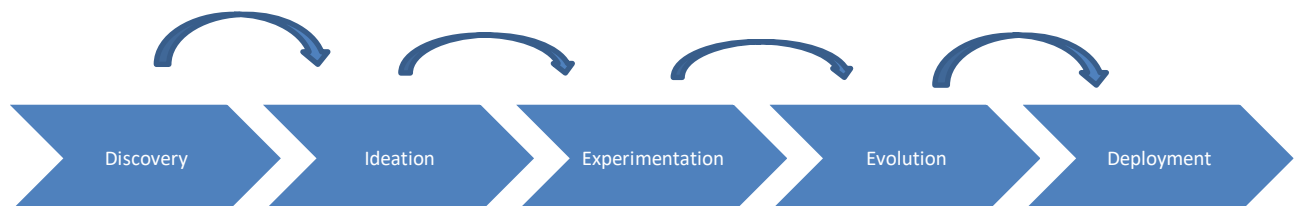
Design thinking can be applied to any field; it doesn't necessarily have to be design-specific (Tim Brown, 2009). Design thinking is a process to quickly discover problems, prioritize the top challenges which may also be used for the organizational change, effort needs to address, and create ideas for solutions (Castro and Linders, 2021). The design thinking framework is based on a revision of Bloom's (1969) taxonomy of educational objectives, which identifies outcomes for learning, teaching and assessing (Anderson et al. 2001)

The Design thinking Multi stage model:

To integrate multi stage model into course activities, there are many practical variants which are following:

- I. Discovery (Empathy, Research, and Problem Definition)
- II. Ideation (Interpret, Create, and Make)
- III. Experimentation (Prototype, Test and Evaluate)
- IV. Evolution (Re-Think, Re-Make, Repeat)
- V. Deployment (Socialize, Pilot, and Integrate)

Figure-3: Design Thinking Process



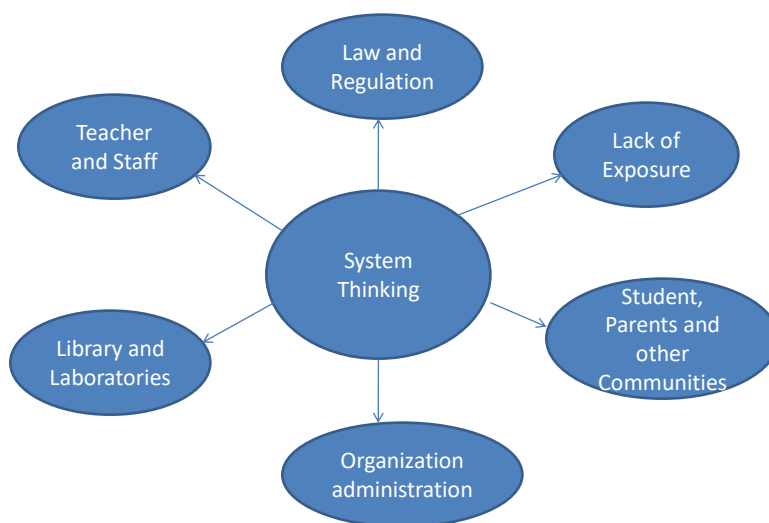
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To develop curriculum, design thinking model can be used by conceptualising and designing teaching plan. Design thinking models also includes for learning goals, structured session plans, presentations, learning activities, project brief, assessment criteria and deliverables. Learning activities of various types like from structured to semi-structured and independent and self-directed, can be planned and a high level of student-tutor interaction and discussion can be done on those activities. The models can help students to plan activities that target students' higher order thinking. Also, it will help in focusing on content and skills at the highest level.

➤ System thinking

System thinking approach can be used along with design thinking. Design thinking is all about creating and building while system thinking is about breaking a system down into part to understand their relationships. A teacher or a mentor can use system thinking in analysing the problems faced by students. They will be able to analyse the problem if it is due to administration of school, or due to infrastructure, or supporting staff, or due to teacher and staff etc. Following is system thinking model that can be used by teachers to inculcate High order thinking skills among students:

Figure-4: Components of System Thinking



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Strategies for HOTS

To target activities towards specific levels, low and high cognitive questions can also be used (Anderson et al,2001). Some strategies that teachers may use in their classes to encourage higher order thinking include:

- Posing provocative questions, statements or scenarios to students to generate discussion (for example, the use of 'what if' questions)
- Students should be able to explain concepts using analogies, similes and metaphors
- posing problems that have multiple pathways to a solution
- modelling a range of problem-solving strategies
- using concept mapping to assist students to make connections between and within ideas
- creating a makerspace in your classroom to encourage creativity, critical thinking and design thinking
- posing paradoxes for students to consider (for example: In a study of World War 1, students can be presented with the statement: 'War nurses saved lives, but they also contributed to deaths')
- creating an 'I wonder' wall in your classroom

Students HOTS Development

According to Vygotskian theory (1962), 'learning is an active process that promotes the development of high-order thinking and problem solving in education'. Vygotsky believed that, if situations were designed to allow students to use their critical thinking skills, new knowledge would be acquired. He concluded that "learning is an essential phase of developing high-order thinking.

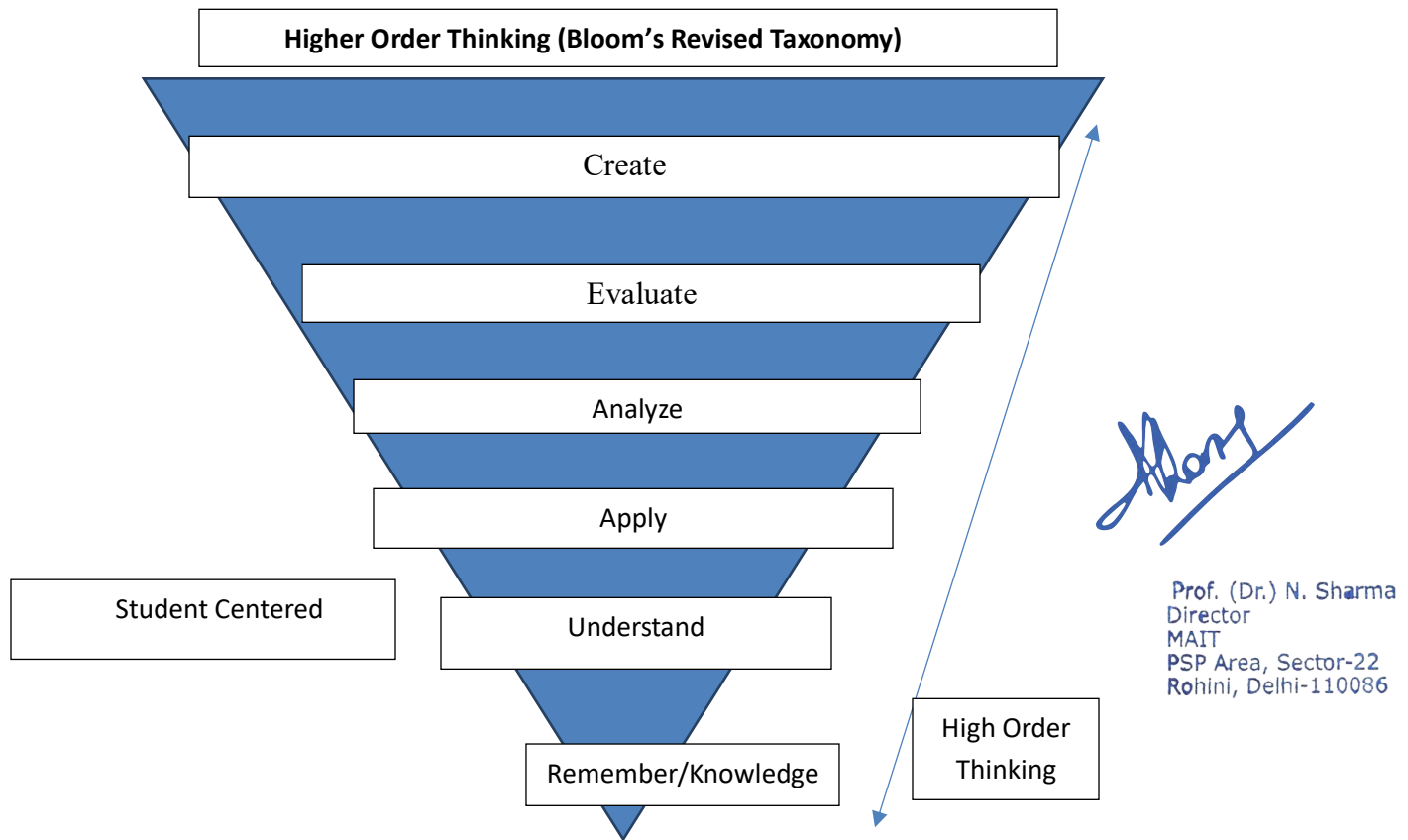
The revised Bloom's taxonomy comprises of remember, understand, apply, analyze, evaluate and create. It focuses on two dimensions that are knowledge: the knowledge that can be gained and cognitive processes: to acquire the knowledge. Based on these two theories students can develop thinking skills so they can generate new ideas from multiple angles to evaluate problems and make a good decision in the future.

Bloom's taxonomy encourages higher-order thought in students by building up from lower-level cognitive skills. Behavioural and cognitive learning outcomes are given to highlight how Bloom's taxonomy can be incorporated into larger-scale educational goals or guidelines.



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Figure-5: Bloom's Taxonomy High Order Thinking



Bloom's

Taxonomy High Order Thinking

- **Knowledge**
The first level of Bloom's taxonomy is about rote factual knowledge of specific terminology, ways and means (i.e., conventions, trends, classifications and categories, criteria, methodology), universal axioms and/or abstractions accepted by the field or discipline (principles and generalizations, theories and structures). In this level, Behavioural learning outcome will be the Ability to recall appropriate, learned information on command. This is the lowest level of learning outcomes (Armstrong, 2010).
- **Comprehension**
The second level is understanding the meaning of information and materials. The behavioural learning outcome is being able to translate materials from one form or format to another by explaining or summarizing and predicting consequences or effects. It represents the lowest level of understanding and interpretation of rote factual information.
- **Application**
The third level of Bloom's taxonomy is about using information and materials to solve new problems or respond to concrete situations that have a single or best answer. The behavioural outcome is to apply learned material such as rules, methods, concepts, principles, laws, and theories. Learning outcomes demonstrate a higher level of

understanding of the mechanics of employing information to a purpose than comprehension.

➤ Analysis

The fourth level is to decompose materials into their component parts so they can be examined and understood. Here, the student is able to develop multiple conclusions concerning the motives, causes, inferences and generalizations that can be derived from the material's component parts and organization. Learning outcomes involve a comprehension and understanding of the content and structure of the material.

➤ Synthesis

The fifth level is for using new and creative applications of prior knowledge and skills. The student's ability to produce a new or original end product. Examples include a unique communication, plan of operations (research proposal), or abstract relations (information classification scheme). Learning outcomes emphasize creativity and the creation of unique patterns or structures.

➤ Evaluation

The sixth level is all about judging value of materials based on personal values/opinions or definite criteria. Concerned with evaluating material to determine if it fulfils the given purpose. Criteria may be internal (organization; defined by student) or external (relevant to the purpose; provided to student). Here, student is able to produce an end product that fulfils a given purpose rather than being right/wrong. Learning outcomes highest because it contains all other categories and includes value judgments based on clearly defined criteria

Conclusion

Higher-order thinking skills can help solving problems efficiently by anticipating connections between different ideas. Some cognitive researchers organize the ways they understand thought processes using taxonomies. Higher-order thinking enables a more inclusive appreciation of art and literature, enriching the enjoyment and experience of life. It promotes critical thinking, problem-solving skills and creativity and helps student understand the usefulness and purpose of learning and moreover be motivated to learn. HOTS increase the likelihood of learning as students understand the value and intent of learning. It empowers student to gain knowledge and apply their learning to solve problems in real-life scenarios and beyond the classroom. HOTS are highly valued and in demand by employers. It is also forecasted to be increasingly in demand in the near future. It involves transferable skills that are necessary for a wide variety of context.

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Pradhan Mantri Mudra Yojna: Capital is a Key to Success

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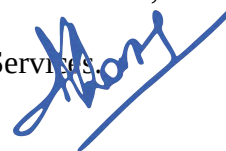
Abstract

Inequality and exclusion are two of the most squeezing difficulties confronting the present reality. Policy makers has realized the importance of inclusive growth. Even after the several years of increasing GDP, the growth of India is uneven or we can say that a vast section of society exists who have not enjoyed the benefits of increased GDP. Inclusive growth means benefits of increased GDP is shared by all sections of society. In fact, it's like providing opportunities to individuals to maximize their potential to increase their standard of living. Unleashing the potential of individuals is possible only when they enter the network of formal financial system. It is now accepted phenomenon that financial inclusion leads to inclusive growth. Financial services can be defined as the basic services like clean water, good food, transport, in the similar way financial services are essential to get quality education, good health care etc. When more people have access to affordable, high-quality financial services, they have more prosperity opportunities. This applies particularly to women, who are frequently underserved by traditional financial institutions. New types of financial products and services that are specifically targeted can be developed. Nevertheless, we need to understand that true inclusion cannot be achieved by any entity alone. This partnership is the most effective way to truly promote greater inclusion and provide modern financial services for under-served people and to build upon the synergies between the different stakeholders in the financial environment or the ecosystem. A number of government agencies are active in deepening financial inclusion efforts. Most of them, such as women, have previously been severely neglected. They have made a significant and remarkable contribution. India is a developing economy where majority of population depends upon small scale businesses for earning their livelihood. Moreover many of them depend upon informal sector for their financial requirement which in turn leads to higher rate of interest, leaving less profits with the entrepreneur. Indian banking sector was unable to cater the needs of informal sector due to many reasons like lack of proper documents, lack of guarantee etc. The GOI is constantly trying to bring informal sector into the ambit of formal financial system, Pradhan Mantri Mudra Yojna is one such step. The present paper will try to analyze the progress made under PMMY, as the scheme is at its inception no critical analysis can be made.

Keyword- Inclusive Growth, Financial Inclusion, Financial Services.

Introduction

As a rule, informal financial services offer more flexibility and convenience than official financial institutions who are forced to invest highly in the development of delivery channels, in particular when establishing distribution points for brick and mortar. But revolutionary developments in technology, products and channels and regulatory frameworks have led millions of remote communities to formal financial services. The means to introduce people to formal banks and financial services are now available with millions of people using mobile and the rapidly falling prices of smart phones. Technology can scale financial services quickly wherever they are. The



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Eleventh Plan was an agenda of inclusive growth which was not only aimed at faster growth but also a growth process that guarantees a general improvement in people's quality of life, particularly the poor, SCs and STs, other reverse castes (OBCs), minorities and women and which seeks to provide equal opportunities for all. The "inclusion" which is envisaged in the concept of inclusive growth is the bringing of these excluded sectors of society into society so that they can harvest the benefit of rapid economic growth. Economic growth basically means inclusive growth, which creates jobs and minimises poverty. It means access to critical health and education services for the poor. It includes equal opportunities, empowering people through education and development of skills. It is also an environmentally-friendly growth process, aims for good governance and contributes to the creation of a sex-sensitive society. Special efforts are needed to enhance employment opportunities since this is a necessary condition for improving people's living standards. National Act on the Guarantee of Rural Jobs (MGNREGA) Mahatma Gandhi an improvement in the living standards of people was made one of the largest social security networks in India and has been able to largely check migration. The government has, in addition, launched several flagship programs such as Sarva Siksha Abhiyan (SSA), National Rural Health Mission (NRHM), and Bharat Nirman to improve education, health and infrastructure to increase inclusive growth. The Indian economy's growth story in recent years has been remarkable. Due to the global financial crisis, it has achieved a mean 9.47% growth rate between 2005-06 and 2007-08, but somewhat later. Still, for the period of 2008-09 to 2010-11, the average decent growth rate remained 7.76 percent. In addition, growth for the eleventh quinquennium period (2007-12) is expected to average 8.2 percent, lower than the 9 percent target but higher than 7.7 percent during the tenth quinquennium plan. In order to steer this growth rate, India has a comfortable investment and saving rate.

But India is behind China, Sri Lanka and many other African and Latin American countries in terms of the Human Development Index. India ranks 119 in the UNDP HDI classification (Human Development Report 2010). In the same way, India has much more to do with other indicators such as poverty, unemployment and regional disparities. In addition, the HDR 2010 identified a new poverty measurement parameter, the multidimensional poverty index (MPI). India's performance in this respect is diminished by around 41.6 percent (\$ 1.25 per day) living below the poorest line in India compared with China, Sri Lanka, Kenya and Indonesia. So, So. Approximately 41,6% of the population of India (1,25 dollars a day) is living below the poverty line. Therefore, economic growth needs to be propagated, people need to be more involved and the benefit of the growth process shared in order to make it more integrated. It will also create inclusiveness by reducing rural-urban gap, sex discrimination and achieving a higher level of human development. Environmental concerns cannot be ignored by inclusive growth. India's efforts are commendable in this respect, because India is one of the world's lowest emitters of Greenhouse Gas (GHG), and still India has announced that proactive policies will reduce its GDP emissions by 20 %. PMMU i.e. Pradhan Mantri Mudra Yojna was launched by our respected Prime Minister Sh. Narendra Modi on 8 April 2015 with the agenda of providing financial assistance to small entrepreneurs. Under this scheme financial assistance will be provided under three categories:

- **Shishu:** providing loan amount upto Rs. 50,000
- **Kishore:** providing loan amount Rs. 50,001 to 5,00,000
- **Tarun:** providing loan amount upto Rs. 5,00,001 to 10,00,000

The loan facility will be provided by Schedule commercial banks, regional rural Banks, small Finance banks, cooperative banks, MFI's, NBFC's. Thus, any person who is not a defaulter under

any previous loan can apply for loan under this scheme and can obtain the loan for a maximum period of 5 years.

The main motto of this scheme was to include Non corporate small business sector into formal financial system. Non-Corporate Small Business Sector includes street vendors, persons engaged in repairing, small scale business units, women working at small scale. Informal sector constitutes around 10; percent of total economy. The scheme will provide financial assistance to bring them into formal financial system.

As per MUDRA report 2017-2018, top 10 states where highest number of loans was disbursed among needy people are:

1. Tamil Nadu
2. Karnataka
3. Maharashtra
4. Uttar Pradesh
5. West Bengal
6. Bihar
7. Madhya Pradesh
8. Rajasthan
9. Gujarat
10. Odisha

Research Methodology

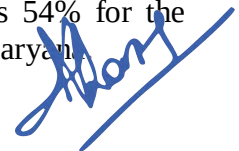
The study is descriptive in nature and uses secondary data from economic survey of Haryana, statistical abstract of Haryana etc. The present study will employ percentage analysis.

Objective of the Study

To check the progress made under Pradhan Manti Mudra Yojna

Data Analysis and Interpretation

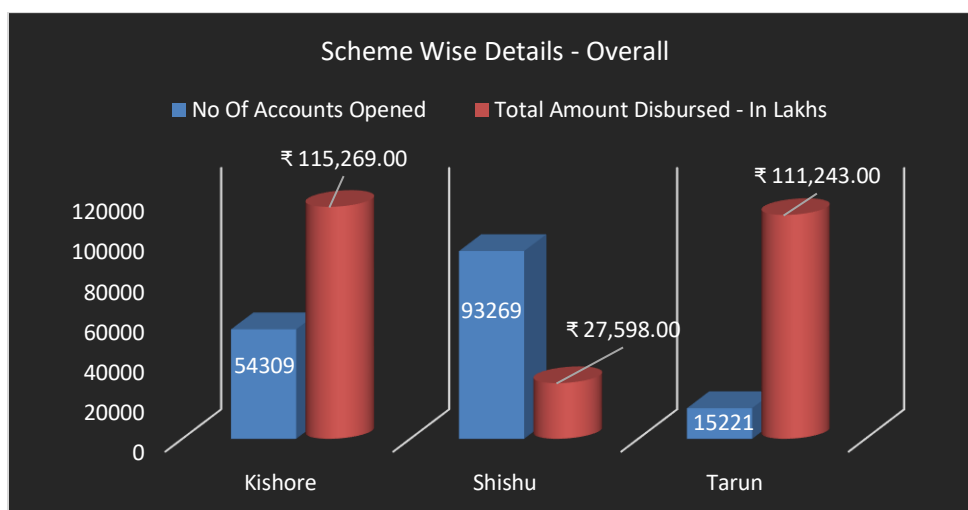
Compared with other Indian countries in the country, Haryana ranks 20th in area and 16th in population. The state has 21 administrative districts with Chandigarh as its capital, the capital of the state of Punjab as well. The state surrounds New Delhi, the national capital, with approx. 40% of the NCR falling in Haryana from three sides. Since 2005, the state economy had an average annual growth rate of 9,3 %. The contribution of the State to the GDP of the country is approximately 3.5 %. Agriculture accounts for 17%, industry 29% and services 54% for the remainder. The present paper will try to analyze the progress made by scheme in Haryana.



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Table 1
Total Account opened and Amount disbursed in Haryana

Scheme	No of Accounts Opened	Total Amount Disbursed (In Lakhs)
Kishore	54309	115269
Shishu	93269	27598
Tarun	15221	111243
Grand Total	162799	254110



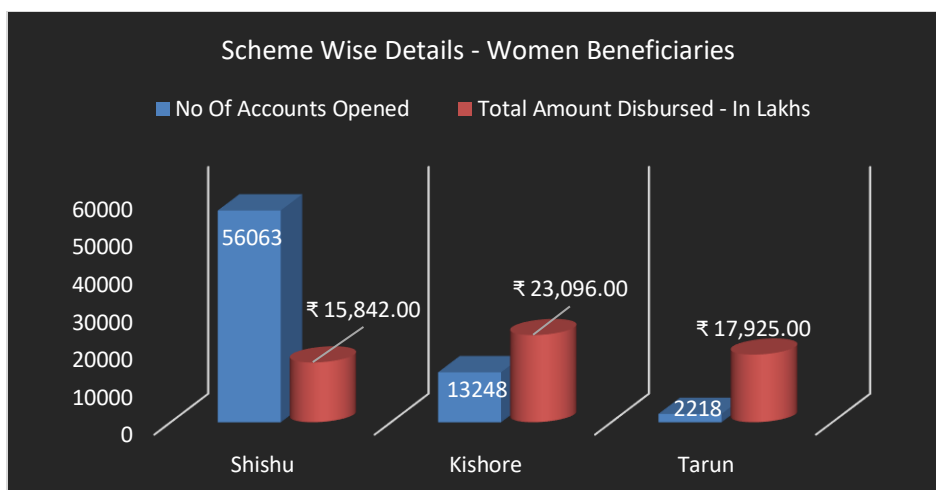
As it is clear from the above graph that in Haryana the maximum loan is disbursed under the category Kishore i.e. 1,15,269 lakhs only 27598 lakhs disbursed under the sub scheme shishu.

Table 2

Percentage of Loan distributed to Women entrepreneurs

Scheme	No of Accounts Opened Women Beneficiaries	Total Amount Disbursed - In Lakhs Women Beneficiaries	% of Accounts
Shishu	56063	15842	60%
Kishore	13248	23096	24%
Tarun	2218	17925	15%

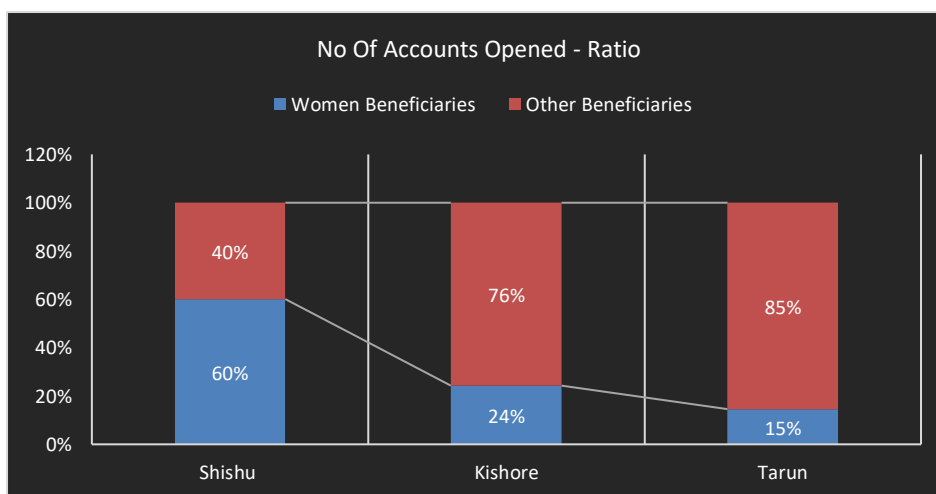
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The above statistics show that maximum accounts of women beneficiaries are opened under shishu scheme. This reflects that woman beneficiaries are taking interest but this needs to be improved.

Table 3

Scheme	Women Beneficiaries	Other Beneficiaries
Shishu	60%	40%
Kishore	24%	76%
Tarun	15%	85%



The above statistics show the ratio of beneficiaries of scheme. in kishore and Tarun category other category beneficiaries are surpassing the woman beneficiaries.

(Signature)

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Conclusion

The PMMY was launched with the motive of providing financial assistance to informal sector with less paper formalities and subsidized rate of interest. Woman participation in shishu scheme is satisfactory but in Kishore and Tarun is not. Our study show that progress made under this scheme is quite satisfactory but it can not be concluded that it has achieved its target still a lot needs to be done to aware the public regarding this scheme. Government should devise plan to inform public to get benefit from this scheme.

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Decoding Mental Accounting: Understanding Its Implications for Indian Investors

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Abstract

Mental Accounting is a recent buzzword in the Indian Financial Scenario. Its definition and interpretation are closely associated with human financial behavioral patterns. The global financial definitions may encompass different financial patterns but Mental Accounting emerged as a new domain to understand human behavior in Personal Finance Management in the Indian Socio-Cultural scenario. The present paper will shed some light on the financial behavior of Indian investors in organized and unorganized sectors in the pre- and post-pandemic periods. How do the common people's futuristic behaviors affect Mental Accounting and the role of socio-cultural inheritance in Mental Accounting the present paper will throw light on it.

Keywords: Behavioral Finance, Mental Accounting, Decision Making, Indian Consumer

Introduction

According to Western Economists 'Mental Accounting' is a process by which the brain keeps monetary goals and moves towards the attainment of these goals separately. Each goal is treated as a separate financial entity and continuous efforts are being made to achieve the goal. **Richard Thaler** first proposed the concept of Mental Accounting in the year 1999, however, we can see a few aspects of human behavior and decision-making in **Adam Smith's** "The Theory of Moral Sentiments" and "The Wealth of Nations". He emphasized that the economic behavior of an individual is not always rational, and it has some elements of seeking self-interest, and value assessment which are like underlying principles of modern Mental accounting. Another oft-quoted example is Jesse Livermore. Born in 1877 Jesse Livermore is considered the greatest trader of all time. He was celebrated for his remarkable success and turbulent journey in the stock market. Despite his success, his trading journey was earmarked by extreme highs and lows. He experienced several bankruptcies in his lifetime and huge financial setbacks, often due to his speculative tendencies and risk-taking behavior. Livermore's roller coaster ride in the markets often reflected his personal struggles and inner demons. His story, preserved in "**Reminiscences of a Stock Operator**," serves as a cautionary tale highlighting the challenges of speculation and the importance of discipline and emotional control in trading.

The concept is quite Heuristic. Richard Thaler proposed the concept and he also received the Nobel Prize for it. It gives free rein to consumers and households to organize and evaluate their financial activities through their cognitive inferences. It allows individuals or groups to separate their money into different mental buckets for their pre-set goals or anticipatory goals.

In the Indian scenario, the concept of Mental Accounting is 5000 years old. Indian investors in various domains whether in terms of worldly gains or spiritual gains investments are kept in Mental Buckets for futuristic anticipations and the concept was also mentioned in Srimad Bhagavad Gita Chapter 9 Verse 22,



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Bhagavad Gita: Chapter 9, Verse 22

अनन्याश्चिन्तयन्तो मां ये जनाः पर्युपासते ।
तेषां नित्याभियुक्तानां योगक्षेमं वहाम्यहम् ॥
22॥

*ananyāśh chintayanto mān ye janāḥ
paryupāsate
teṣhām nityābhiyuktānām yoga-kṣhemam
vahāmyaham*

Leading organization *Life Insurance Corporation of India* adopted the part of this verse in their logo. A unique combination of Western interpretations and Indian philosophical inheritance cast their impact on Indian investors, and changes in their investing behavior in the current paper. A threadbare analysis has been made in which investor behavior has been analyzed in a threadbare manner in the Pre-and Post-Pandemic Era.

Indian Consumers and Mental Accounting

Traditional Finance holds the notion that a human being is a rational being and takes every decision based on a rational calculation and its effect on the overall wealth position. However in reality most people don't have the computational skills, knowledge of basic financial tenets, and patience to evaluate every decision objectively. In reality, people separate their money into various mental accounts and treat funds differently. Each of these “*mental accounts*” holds different significance and they increase and decrease the funds in each account according to their need and financial growth. An individual's finances are directly affected by contemporary social, political, and financial scenarios.

As we witnessed in 1991 after Liberalization, Privatization, and Globalization policies were introduced India opened its doors to foreign investors, businesses, and manufacturers. The new financial scenario allowed global researchers to study Indian consumer's unique patterns and financial behaviors. They could be profiled as:

- Diverse demographics
- Value-Conscious
- Importance of Trust and relationships

Recently the following unique patterns have also been noticeable-

- Rapid Digital Adoption
- A huge shift in Consumption patterns

The above-mentioned factors led Indian consumers to have unique **spending, saving, and investing patterns.**

I C'S Mental Budgeting



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Microeconomics studies how consumers make choices about goods and services they want to acquire. Just as firms use financial budgets to monitor and control their expenditure, the human brain acts similarly to allocate mental budgets to reflect the psychological benefits and costs in each mental account. Common categories may include rent, mortgage, utilities, transportation, entertainment, savings, and investments.

Indian consumers are influenced by psychological factors like feeling short of money, being risk averse or having a low-risk appetite, and attaching emotions to certain expenses or goals. For instance, people might allocate more of their income to essentials like housing and food to deal with limited and uncertain income flows and set aside remaining portions for provisions for unexpected expenses. Consumer patterns like this have led to constant high demand for real estate and consumer products.

This pattern continued even after the Pandemic as it led to more emphasis on savings and few options for entertainment. Common people in short-term confinement due to COVID-19 led to more market participation in the Indian Stock market during and Post-Pandemic period.

Indian Consumers Mental Accounting for Investment

With economic prosperity and recent phenomena in the Indian subcontinent, most of the population swung between Physiological and Safety needs, which led to a low-risk appetite and less need for investment, which changed significantly in the 1990s with the Opening up of the Indian economy. It led to more free flow of funds between India and the world. With Traditional investments such as Gold Jewelry, Real estate, and Fixed deposits, the Stock Market also emerged as an option for investors to diversify their financial portfolios.

Increased volatility and low rates on traditional savings instruments prompted a surge in common man participation. Prior years' digitalization led to Digital platforms and the free flow of financial information, which further fuelled this trend. Overall, the pandemic acted as a catalyst for a surge in savings and Investment as options for entertainment such as eating out, traveling, and exploring was considered unsafe and led to more disposable income with consumers.

Prior years' Rapid Digitalization and financial inclusion have led to more market participation through smartphones. Apps like **Groww**, **Zerodha**, and **Angel One** leaders in Indian brokerage experienced amazing YOY growth for active users in the past 4 years post-COVID-19.

The Table showcases Active users for Digital stockbroker Indian app **Grow**, **Zerodha**, and **Angel One** for time FY 20-21 to FY 24-25

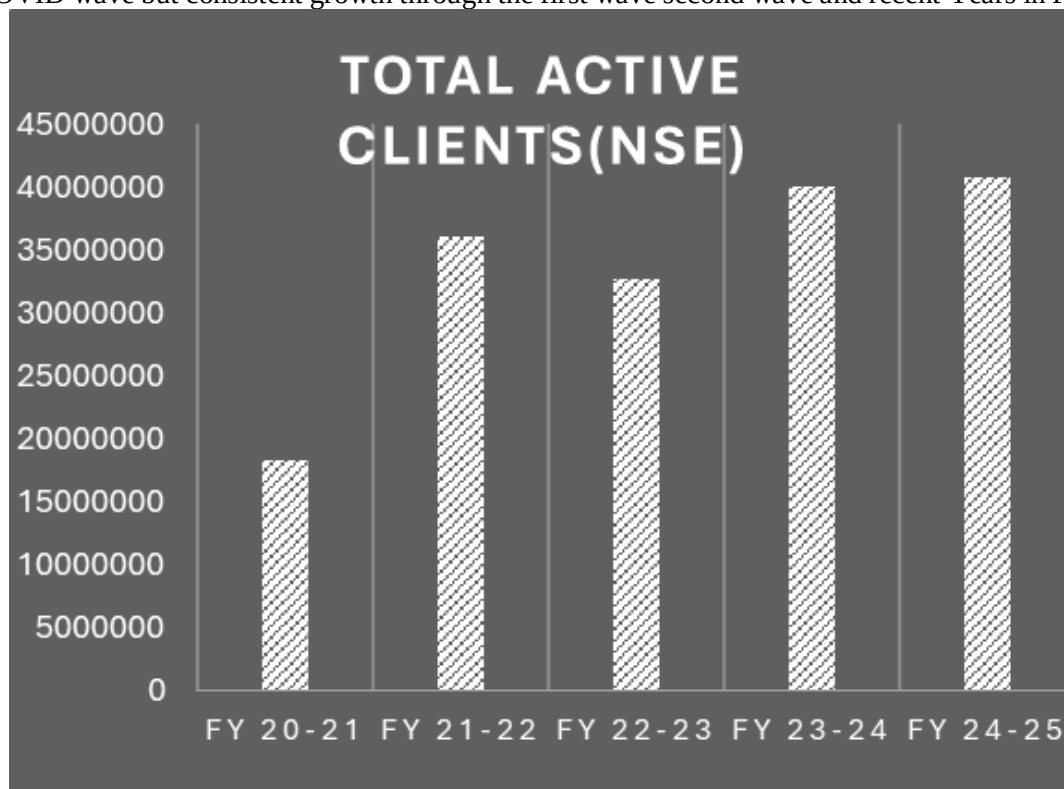
Year	Grow Active Clients	Total Active Clients(NSE)	Client Share	
FY 24-25	9538609	40760808	23%	
FY 23-24	9185024	40046538	23%	
FY 22-23	5373705	32660214	16%	
FY 21-22	3847955	36035020	11%	
FY 20-21	780570	18356146	4%	
Year	Angel One Active Clients	Total Active Clients(NSE)	Client Share	
FY 24-25	6111879	40760808	15%	



FY 23-24	5983067	40046538	15%	
FY 22-23	4281951	32660214	13%	
FY 21-22	3657550	36035020	10%	
FY 20-21	1564667	18356146	9%	
Year	Zerodha Active Clients	Total Active Clients(NSE)	Client Share	
FY 24-25	7287148	40760808	18%	
FY 23-24	7223525	40046538	18%	
FY 22-23	6392902	32660214	20%	
FY 21-22	6277434	36035020	17%	
FY 20-21	3602074	18356146	20%	

Source: <https://www.investorgain.com/>

We even see an increasing trend in Total Active Clients in NSE from FY 20-21 which was the onset of the first COVID wave but consistent growth through the first wave second wave and recent Years in FY 24-25




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Graph showing the Total number of Active clients in NSE in time FY 20-21 to FY 24-25

Source: <https://www.investorgain.com/>

The above graph clearly shows that NSE experienced double growth for market participants.

Indian Consumers Decision Bias

Mental accounting is no exemption when it comes to biases, such as treating bonus gains from earned income e.g. an Indian investor might receive a bonus or any inheritance and may utilize it towards any

discretionary spending, like vacations or luxury items. This bias might lead to long-term effects as these one-time may be spent instead of its utilization towards building wealth or achieving financial goals. Indian home-makers who are not formally trained for long-term/short-term investments indulge in mental accounting in their budgetary constraints. At the onset of their monthly expenditures, they put some part of their income as provisions for unexpected future expenditures, and in their mental budgeting that income does not exist for their expenses. Women of a bourgeois class who don't want to highlight their hidden financial reservoirs mentally divide their monthly income to meet different expenses of the family. While calculating the provisions for anticipated expenses, the mental budgeting concept doesn't take the total receivables of the month into income for daily or monthly expenses and allows the player to block some part of their income for futuristic goals.

Effects of Mental Accounting

- **SUNK COST FALLACY:** It leads to consumers believing that investing in a consistently losing venture is a sunk cost and mentally accounts for it to be an inconsequential loss. E.g. A person buys a lottery frequently with their limited income in anticipation of winning it eventually. This tendency to focus on past losses as unrecoverable investments can hinder sound financial decision-making and impede opportunities for portfolio diversification for less risky investments or reallocating resources towards more promising ventures.
- **SEGREGATING GAINS AND LOSSES:** Consumers may spend unexpected gains more freely than regular income. E.g. Investing in unregulated cryptocurrencies with their inheritances which leads to loss and fraud.
- **ENVELOPE BUDGETING:** Using separate envelopes for different expenses (e.g., utilities, groceries, entertainment).

Conclusion

The study of Mental Accounting among Indian investors reveals a unique mix of traditional values and modern financial trends. From guiding ancient philosophies to contemporary economic shifts, Indian consumers demonstrate a distinct approach and approach to managing and budgeting their finances. It is characterized by the segmentation of funds into mental accounts tailored to specific goals.

Key findings highlight the influence of socio-economic factors, such as economic liberalization, digitalization, and the COVID-19 pandemic, in shaping investment behaviors. Despite challenges like cognitive biases, Mental Accounting provides valuable insights into Indian consumers' financial decision-making processes.

Understanding these dynamics is crucial for plans for promoting financial literacy and empowering individuals to make informed choices with the balance between rationale and emotions, which are also aligned with their long-term goals. Ultimately, this research contributes to a deeper understanding of how Mental Accounting shapes financial behavior in the Indian context, offering valuable implications for policymakers and financial stakeholders alike.

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A Literature Review on New Fashion of Sustainable Style in Branded Apparel

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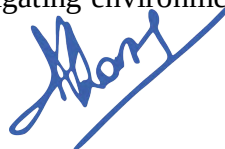
Abstract

In today's world the fashion industry's environmental and social impacts have prompted a growing interest in sustainable branded apparel. This paper explores various dimensions of sustainability within the apparel sector, focusing on key forms, strategies, and practices adopted by brands to promote environmental responsibility, ethical production, and consumer engagement. The review encompasses diverse forms of sustainable branded apparel, including organic clothing, recycled materials, fair trade practices, and transparent supply chains. It examines the role of consumer perceptions, marketing strategies, and industry initiatives in driving sustainable fashion adoption. Furthermore, the review discusses emerging trends, challenges, and opportunities in sustainable branded apparel, such as circular economy practices, innovative materials, and retailing strategies. By synthesizing existing literature and industry insights, this review provides a valuable resource for researchers, practitioners, and stakeholders seeking to understand and promote sustainability in the fashion industry. This research provides an overview of the scope and focus of research on sustainability in branded apparel, highlighting key themes, challenges, and opportunities in the field.

Keywords: Sustainability, Branded Apparel, Consumer Engagement, Strategies, Ethical Production

Introduction

In the kaleidoscopic world of fashion, where trends flicker like fleeting flames and styles ebb and flow with the tides of time, a new beacon of consciousness has emerged—a call to arms echoing through the corridors of design houses and manufacturing hubs alike. This clarion call is sustainability, a guiding principle that has transcended the boundaries of mere fashion fads to become an ethos, a mantra, and an imperative for the industry at large. Against the backdrop of environmental crises, social inequalities, and ethical quandaries, the branded apparel sector finds itself at a crossroads, compelled to navigate the treacherous terrain of consumer demand, corporate responsibility, and planetary well-being. "The New Face of Fashion: Sustainability in Branded Apparel" endeavors to unravel the intricate tapestry of this transformative journey, tracing the evolution of an industry in flux, as it sheds the vestiges of its unsustainable past and strides boldly into an uncertain yet promising future. Through the lens of sustainability, we embark on a voyage of discovery—a voyage that traverses continents and cultures, supply chains and value chains, weaving together the threads of innovation, ethics, and aesthetics into a fabric of change. At its core, this exploration is a testament to the power of human ingenuity and collective action—a testament to the belief that fashion, far from being a frivolous pursuit, has the potential to be a force for good. As we delve into the intricate workings of branded apparel companies, from the boardrooms where decisions are made to the factory floors where garments are stitched, we uncover a mosaic of initiatives, initiatives aimed at mitigating environmental harm, empowering



marginalized communities, and reimagining the very essence of style. Yet, amidst the flurry of eco-friendly fabrics and fair-trade certifications, we must not lose sight of the complexities and contradictions that define the fashion landscape. For every triumph of sustainability, there exists a challenge yet to be conquered—a challenge rooted in the systemic inequalities of the global economy, the insatiable appetite of consumer culture, and the relentless march of industrialization. Thus, "The New Face of Fashion" is not merely a celebration of progress but a call to action—a call to confront the uncomfortable truths that lurk beneath the surface of our polished garments and glossy advertisements. It is a reminder that sustainability is not a destination but a journey, a journey fraught with obstacles and setbacks, yet illuminated by the flickering flame of hope. As we embark on this journey together, let us not shy away from the complexities that lie ahead, but rather embrace them as opportunities for growth and transformation. Let us envision a future where fashion is not just about looking good but doing good—a future where style and sustainability converge, defining a new paradigm for the industry and inspiring generations to come.

Sustainable Strategies in Branded Apparel

- **Materials Sourcing:**

One of the fundamental pillars of sustainability in branded apparel is the sourcing of materials. Traditional materials such as conventional cotton and synthetic fibers have significant environmental impacts, including water consumption, chemical pollution, and greenhouse gas emissions. To address these issues, brands are increasingly turning to eco-friendly alternatives such as organic cotton, recycled polyester, and lyocell. Additionally, initiatives such as the Better Cotton Initiative (BCI) and Forest Stewardship Council (FSC) certification help ensure responsible sourcing practices and support biodiversity conservation.

- **Manufacturing Processes:**

The manufacturing phase of apparel production is another critical area where sustainability initiatives can make a substantial impact. Brands are adopting measures to optimize energy and water usage, minimize waste generation, and reduce emissions of harmful pollutants. This includes investments in energy-efficient machinery, implementation of lean manufacturing principles, and adoption of water recycling and treatment technologies. Furthermore, some companies are exploring innovative approaches such as 3D knitting and on-demand manufacturing to reduce overproduction and inventory waste.

- **Supply Chain Management:**

Ensuring sustainability throughout the supply chain is essential for branded apparel companies to uphold their commitments to environmental and social responsibility. This involves working closely with suppliers to promote fair labor practices, improve working conditions, and uphold human rights standards. Brands are increasingly conducting supply chain audits, providing training and capacity-building support to suppliers, and incorporating sustainability criteria into supplier selection and performance evaluation processes. Collaborative initiatives such as the Sustainable Apparel Coalition (SAC) also facilitate industry-wide collaboration and transparency.

- **Marketing and Communication:**

Effective communication of sustainability initiatives is crucial for branded apparel companies to build trust and credibility with consumers. Transparency and authenticity are key principles guiding communication strategies, which include sharing information about sourcing practices, manufacturing processes, and social impact initiatives. Brands are leveraging various channels such as social media, websites, and product labeling to educate consumers about their

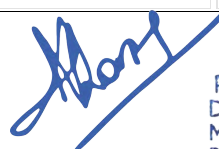
sustainability efforts and engage them in meaningful dialogue. Collaborations with influencers, NGOs, and sustainability advocates further amplify brand messages and reach wider audiences.

- **Stakeholder Engagement:**

Engaging with stakeholders, including consumers, employees, investors, and community members, is integral to the success of sustainable strategies in branded apparel. Brands are fostering dialogue and collaboration with stakeholders through platforms such as advisory councils, focus groups, and feedback mechanisms. By actively listening to stakeholder concerns and incorporating their feedback into decision-making processes, companies can build stronger relationships, foster trust, and drive continuous improvement in sustainability performance.

Review of Literature

Authors	Year	Title	Key Findings	Relevance of Research
Smith et al.	2022	The Impact of Sustainable Sourcing on Brand Image: A Review	Sustainable sourcing positively influences brand image. Consumers are increasingly considering sustainability when evaluating apparel brands.	This research is relevant as it highlights the importance of sustainable sourcing for brand image, crucial for competitive advantage in the apparel industry.
Johnson & Lee	2023	Green Marketing Strategies in Fashion Retail: A Meta-Analysis	Green marketing positively impacts consumer perceptions and purchase intentions in the fashion industry. Strategies such as eco-friendly advertising and product labeling are effective in enhancing brand image.	This study is relevant as it explores effective marketing strategies for promoting sustainability in the fashion retail sector, crucial for brand differentiation.
Chen & Wang	2024	Corporate Social Responsibility and Brand Equity: A Systematic Review	Corporate social responsibility initiatives contribute to the enhancement of brand equity in the apparel industry. Consumers perceive socially responsible brands more favorably and are more likely to exhibit brand loyalty.	This review is relevant as it underscores the importance of CSR in building brand equity and fostering consumer loyalty in the apparel sector.
Garcia et al.	2022	Sustainable Fashion Consumption: A Literature Review	Consumer demand for sustainable fashion products is growing rapidly. Factors influencing sustainable fashion consumption include environmental concerns, social responsibility, and product quality.	This literature review is relevant as it addresses the increasing consumer demand for sustainable fashion and factors driving this trend, vital for market positioning.
Kim & Park	2023	The Role of Eco-Friendly Packaging	Eco-friendly packaging enhances the sustainability credentials of	This study is relevant as it highlights the significance of eco-friendly



Authors	Year	Title	Key Findings	Relevance of Research
		in Sustainable Fashion Brands	fashion brands. Consumers show a preference for brands using sustainable packaging materials, such as recycled paper or biodegradable alternatives.	packaging in enhancing brand sustainability and consumer preference in the fashion industry.
Wong & Ng	2024	Circular Economy Practices in the Apparel Industry: A Review	Circular economy practices, such as clothing rental and resale, are gaining traction in the apparel industry. These practices contribute to waste reduction, resource efficiency, and extended product lifecycles.	This review is relevant as it discusses emerging circular economy practices in the apparel industry, essential for sustainable resource management and business innovation.
Patel & Shah	2022	Ethical Fashion: A Comprehensive Review of Practices and Challenges	Ethical fashion encompasses various practices, including fair labor, animal welfare, and sustainable sourcing. Challenges in ethical fashion include supply chain transparency, cost implications, and consumer awareness.	This comprehensive review is relevant as it addresses ethical considerations and challenges in the fashion industry, imperative for promoting responsible business practices.
Li & Chen	2023	Sustainability Reporting in Fashion Companies: An Overview	Fashion companies are increasingly publishing sustainability reports to communicate their environmental and social performance. Key aspects of sustainability reporting include transparency, accountability, and stakeholder engagement.	This overview is relevant as it sheds light on the growing trend of sustainability reporting in the fashion sector, vital for corporate transparency and accountability.
Tan & Lim	2024	Innovative Materials in Sustainable Fashion: A Review	Innovative materials, such as bio-based textiles and recycled fibers, are driving sustainability in the fashion industry. These materials offer alternatives to conventional fabrics, reducing environmental impact and promoting circularity.	This review is relevant as it explores the role of innovative materials in advancing sustainability in the fashion industry, crucial for eco-friendly product development and market competitiveness.
Martinez et al.	2022	The Influence of Influencers: A Review of Sustainability Marketing	Influencers play a significant role in promoting sustainability in the fashion industry through social media channels. Collaborations between brands and influencers can effectively raise awareness and	This review is relevant as it examines the impact of influencers on sustainability marketing, essential for leveraging social media for promoting sustainable fashion brands.

Authors	Year	Title	Key Findings	Relevance of Research
			drive consumer engagement with sustainable fashion.	

Conclusion

It can be concluded that diverse forms of sustainable branded apparel represent a multifaceted approach to addressing environmental, social, and ethical concerns within the fashion industry. From organic and recycled materials to fair trade practices and transparent supply chains, these forms reflect a growing commitment among brands to promote sustainability and responsibility throughout their operations. By embracing organic clothing, recycled materials, fair trade principles, and zero-waste techniques, fashion brands can reduce their environmental impact, conserve natural resources, and support ethical labor practices. Slow fashion encourages mindful consumption habits, while up cycled and vintage clothing offer creative solutions to reduce waste and extend the lifespan of garments. Biodegradable materials and transparent supply chains foster accountability and trust between brands and consumers, while carbon-neutral initiatives aim to mitigate the industry's contribution to climate change. Together, these forms of sustainable branded apparel demonstrate a collective effort to transform the fashion industry into a more sustainable and ethical sector.

As consumers increasingly demand eco-friendly and ethically produced clothing, brands have a vital role to play in driving positive change and promoting responsible consumption habits. By embracing sustainability in all its forms, fashion brands can not only reduce their environmental footprint but also contribute to a more equitable and sustainable future for the industry as a whole.

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Investigating the long-term viability of the Hybrid Work Model: A Case of IT Companies

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Abstract

In the wake of the pandemic, remote work has become increasingly prevalent, with IT companies leading the way and other organizations following suit. While Covid restrictions are being lifted, offices are planning to reopen in a hybrid model that combines remote and in-person work. This shift is driven by the fact that people have become more comfortable with remote work and have shown increased productivity and job satisfaction. The hybrid work model aims to prioritize employee well-being, mental health, and work-life balance. It also offers benefits such as reduced office space, energy conservation, and increased flexibility for employees. By adopting this model, companies can retain top talent, enhance productivity, foster collaboration, and improve communication.

Keywords: Hybrid Work Model, IT Company, Sustainability, Strategies

Introduction

Hybrid work model

The word ‘hybrid’ in general means a combination or blend of something. Now the term hybrid work in today’s competitive world especially after pandemic means the companies are trying to adopt the combination of offline and online mode of work for the betterment of their and employees growth and productivity or in other words , a hybrid workplace model refers to a flexible work environment that combines remote work with office work.

Many employers want their workforce back in the office but many employees wish to still work from home because of the covid impact. The resulting vision for many employers is a model that combines office time with remote working.

This thought brings in the new hybrid work model. This model allows employees to work from home part of the time and come into the office between 1 and 4 days a week.

Employees and employers who took the Remote Work & Compensation Pulse Survey in May 2021, 48% expressed a desire to be fully remote. 44% of employees favored hybrid working arrangements. Among employers, 51% support the hybrid work model, while only 5% mention fully remote work as a possibility. (LLC, 2023).



Types of Hybrid work model (B.Vidhyaa, july , 2022)

1. Flexible hybrid work model: Under this employees can choose their locations and working hours depending upon their priorities.
2. Fixed hybrid work model: Here the organizations fix the particular days & times for employees to come to office and to go remotely.
3. Office-First hybrid work model: The employees have to be onsite for the work and can have the flexibility choose a few days a week to work remotely.
4. Remote-First hybrid work model: Employees work mostly offline or work from home but can visit the work stations or locations for team building, collaborations and for training purposes.

Sustainability of Hybrid work model for the future

Sustainability encompasses the integration of environmental, social, and economic dimensions. The hybrid work model offers employees a high level of autonomy to maintain a balance between work and personal life, resulting in improved performance and fostering a positive relationship between employers and employees.

To ensure the sustainability of the hybrid work model, organizations must first assess its technological feasibility. Equipping remote employees with the necessary tools and infrastructure for seamless work is crucial. Organizations should carefully evaluate employees' technological needs before transitioning to a flexible work environment to maintain productivity and employee satisfaction.

Review of Literature

According to Gallup studies (hybrid-work-best-employees, 2023), 2 out of 3 professionals such as engineers, computer programmers, consultants prefer to be hybrid and half of them choose to be hybrid based upon the plans of employers.

Gallup research has discovered that what workers in hybrid mode want, such as the following aspirations are expected by them:

- Improved work-life balance
- Maximum utilization of time
- more autonomy
- less burnout
- Increased productivity

According to a recent survey conducted by Adobe, over 1000 employees and managers in India expressed their belief in the positive impact of sustainability practices in the workplace. The survey revealed that these professionals feel more motivated and productive when sustainability initiatives are implemented, leading to increased collaboration with their team members. Additionally, a significant majority of Indian employees, 90%, believe that adopting a blended work system could contribute to making businesses more sustainable.



According to the Hybrid Work Survey conducted in Slovakia in 2021, findings indicate a significant shift in work arrangements due to the COVID-19 pandemic. Prior to the pandemic, 43% of companies did not permit remote work, whereas now, only 21% of surveyed companies are advocating for a complete return to the traditional office setup. The majority of respondents, comprising 79%, expressed support for a new hybrid model that combines remote work with office presence.

Among the respondents, 34% favored a hybrid work arrangement where employees can divide their time between working from home and working in the office, with flexibility in scheduling. The survey also highlighted the necessity for organizations to adapt their strategies and management styles to accommodate this evolving work landscape, ensuring both operational efficiency and employee well-being in the future of work.

NASSCOM (NASSCOM, 2021), a technology-based industry in India with offices in Bangalore and Chennai, conducted a survey on the feasibility of the hybrid work model upon employees' return to the office post-pandemic. The primary research and stakeholder interactions revealed that both employees and employers are inclined towards returning to the office, with approximately 50% of employees expressing a preference for a 3-day work week starting in January 2022. The motivations for this return include enhanced collaboration opportunities, improved infrastructure and hardware facilities, and reduced distractions compared to remote work.

Moreover, findings suggest that 60% of organizations are expected to be prepared to reopen office spaces by 2022, focusing on aspects such as data security, meeting stakeholder demands, and implementing safety measures. Looking ahead, it is anticipated that larger organizations with over 1000 employees will increasingly adopt the hybrid work model system in the future.

Research Methodology

The paper is based on secondary data and the data is collected from journals, articles, etc. Moreover descriptive study is undertaken.

Objectives

- To know the benefits of hybrid work model
- To perceive the ways and strategies to be successful in a hybrid work environment
- To understand how the blended mode is sustainable for future

Analysis

Advantages of Hybrid Work Model



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1. Cost reduction: It is beneficial for both employees and employers. For organizations due to less footprints the power consumption, expenditure on maintenance of workspaces, food, tea, snacks, water and parking ,etc will going to be less. On the other hand, for employees the cost of travel, food and time will reduce.
2. Improved productivity of employees: By less commuting to office, they will be able to save time and hence will be able to concentrate more on the work, stress level be low and they will be in mood to think of more and will try to give more outputs than earlier which will in return will produce good results which means their productivity level be enhance.
3. Increased Employee satisfaction: By providing the greater autonomy to the employees, they will be able to set their own responsibilities for them will work accordingly in a comfortable zone hence will always be happier and satisfied with personal as well as professional outcomes.
4. Effective recruitment tool: An IWG (International workspace group) surveyed different number of HR professionals and said that hybrid mode is an effective tool for recruiting a top talent from anywhere around the world as well is helpful in retaining the talent for longer period of time. (Golden, 2022), as per the survey report, the respondents said that 55% of their organization used blended mode with child care concerns,47% using it addressed both the work life balance and health issues and 69 % of HR professionals said that employees have used time for care giving responsibilities more than commuting to offices.
5. Employee's health and safety: As hybrid model provides the flexibility to employees when to be remote and in office so whenever they are sick can work from home and take care of their health and the time they are fit can come to office for their work. The organizations are taking full care of their employees.
6. Improves work life balance: Work-life balance is considerably improved under the hybrid model, as it gives employees wider scope to plan their work, and avoid unnecessary commute by giving them autonomy over working hours and location; thereby reducing burnout or stress.

Strategies /Ways to succeed in hybrid work environment:

To be effective in competitive world with this novel work model, the leaders and the business managers needs to adopt certain strategies, HR practices or policy's, have to follow recent trends in order meet the demands of employees and to grow in future. There are different strategies followed by different organizations depending upon the policies, market demand. The paper discusses the common ways to be successful in hybrid mode:

- Setting up of new plans and policy's for changed style of working:
Almost all organizations who are going for hybrid style of work needs to modify their goals, plans, policy's as per the requirement of employees, culture and processes. Leaders must set organizational principles and behavioral guardrails such as (thinking about mental state of employees,, considering equity, communicating expectations clearly, employee feedback and setting up of

measurement criteria for success, etc) and then they can go with this, after this the managers or leaders must be well equipped and empowered to set agreements with the employees.

- **Strengthening Communication channels/networks:**
As for proper flow of information it is vital for both organization and employees to communicate messages or information through proper established channels such as email, messaging apps, video conferencing platforms, and project management tools. There must be responsive and proactive flow of information so that parties involved in channel are staying connected at same level.
- **Increasing use of Artificial Intelligence (AI):** For more complex tasks, AI is likely to be adopted by more companies to improve efficiency and productivity. These technologies can be used to automate repetitive tasks, process large amounts of data, and make more accurate predictions for future growth.
- **Emphasis on building conducive culture for enhanced mental well being of employees:** Due to longer work at home, this has led to social isolation, so new work model can succeed well if proper work environment is built keeping in mind the well being, employers to provide free access to mental health professionals for therapy and mindfulness sessions either in-house or through an employee assistance program. Companies may also collaborate with external companies to provide training surrounding mental health awareness and preventing burnout.
- **Focus on DEI initiatives:**
DEI stands for Diversity, Equity and Inclusion. These are the actions taken by the organization to prefer for building a diverse workforce and to create an environment that is equitable and inclusive to each and everyone.
 - **Focus on Collaboration:** (Baker, 2021), According to Gratner's Research, 71 % of HR leaders are more concerned about employee collaboration. At individual level, the team members can collaborate when and where they want to meet to discuss the matters, and on the other hand, organizations and the managers also need to create an opportunities to make them collaborate effectively.
 - **Enhancing training development sessions for employees as when required by them for new style of work, methods and tools they are work upon.**
 - **Embracing the Agile hybrid work model**



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Sustainability of Hybrid Work Model for the Future

Over the past two to three years many reports and survey shows us that employers are eagerly waiting for their employees to return to office as soon as possible. How the population will behave

on adopting the “New Normal or Hybrid Work Model” is question of concern for many organizations and also to check viability of sustainable practices.

Sustainable workplaces mean that an organization persuades employees to use natural resource in a well mannered way. Sustainability is defined as providing the benefits of current needs in such manner that needs of future generations are not compromised in future. It has three aspects, Environmental, Social and Economic.

(Rafi, 2021) Accordingly, 90% of executives think that sustainability is important and only 60 % have sustainability strategy. It is very important for business leaders to whole heartedly engage themselves in implementations of the strategies to conserve resources. According to Mckinsey, to be sustainable there is role to play for leaders to do long term investment. In today’s digital world, many businesses are thinking of recycling or reusing the resources or are moving towards the circular economy.

A Deloitte report shows that 57% of companies have started using energy-efficient or climate-friendly machinery, technologies, and equipment and are also imparting employee training on climate change/climate action. (Holeiciuc, 2023)

Organization must prioritize the following:

- Well being and rights of the employees
- Adhere to the ethical and transparent practices
- Employees must also think that institutions providing sustainable benefits are boosting the productivity, rate their company’s at top, open more opportunities for innovation and creativity and also improves work culture at office spaces.
- Organization following sustainable norms or practices gains increased importance both financially as well as improves people perception towards them

There are several aspect that A Hybrid Work Model has the potential be sustainable in future such as:

1. Reduced footprints: the need for physical office has reduced because of the work from home option available which can lead to reduction in environmental impact of workstations by cut in real estate costs and office space utilization can boost the sustainability.
2. Better buildings or infrastructure: According Environmental, Social and Governance targets it is noted that how the infrastructure is built what material is being used, as reports tell us that buildings are responsible for 40 % of global energy consumption and 33% green house gas emission. The recent reports shows us that buildings cab be made of recycled materials.
3. Reduced commuting emissions: As per International work grades (IWG) “with just a relatively modest one day a week of working from home during an average year, the overall energy saved from less commuting is around four times larger than the increase in residential energy consumption.



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The different study states that US workers by shifting to a more flexible work option, can save up to 960 million hours of time per year by 2030 and on the other reducing carbon emissions by more than 100 million tons.

4. Increased productivity: By adopting the remote work or hybrid combination, the employees are in their comfortable zone whether at home or office, they are likely to give more output than forced to work under controlled work environment. Moreover by less commutation to office the energy consumption at office will be less which is making them environmentally sustainable too.
5. Focusing on employee well being: The blended model provides them greater flexibility resulting in lesser stress and anxiety or other health issues and allowing a better work life balance. A healthy and happy workforce is more likely to be productive, which can contribute to a more sustainable workplace.

The hybrid work model and sustainability is like a twin sister, for relevant growth in future, the role of both the elements co exists. Whenever we will think of hybrid work mode then not only we are going think of small offices, management of remote work but also to push ourselves that how this management can be done in eco-friendly way or in sustainable manner.

Examples of Some IT Company's following sustainable hybrid work model (Koeva, 2022):

1. Amazon is currently using hybrid work model. Each individual decide when to come work remotely and office.
2. Meta (Facebook) trying since jan 2022 to make their employees return to office space on new normal basis. They want their employees to work on at least 3 days a week
3. Microsoft: They gave option to employees to remotely up to 50% of the time by taking top-down approach.
4. Salesforce: they offered 3 alternatives to individuals like firstly, Flex: 1-3 days in the office for collaboration, customer meetings, and presentations. Secondly, Fully Remote: For employees who don't live near an office or whose job doesn't require one. Lastly, Office-based: Only for roles that require a physical presence in the office.
5. Hubspot: It is famous for CRM platform. It also offers its workforce 3 options.
 - Home : Employees can come to office 1 to 2 times a quarter
 - Flex: Employees to come for office 2 or fewer days.
 - Office: Employees who work on-site 3 or more times per week.



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Conclusion

In a nut shell, the blended work system motivates business leaders as well as employees to work with more zeal and enthusiasm. The benefits, strategies enlightens up to build strong base for both

employees and employers to build up more productivity, more clarity of flex mode to work upon and also how to achieve profitability and employee satisfaction by using the resources effectively. As discussed, majorly IT companies are at forefront in adopting the hybrid work model with proper arrangements to conserve future resources reasonably.

- In order to adopt hybrid work model in an organization, proper arrangements needs to made before initiating the model.
- Higher importance needs to be given to those institutions that are following sustainable practices side by side while following the blended work model.
- Adaptability to basic changes in infrastructure both by the employers and employees.
- Enhancing the agile working mode

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Political Marketing in India: A Study Of Promotional Strategies Adopted By BJP in The 17th Lok Sabha Election (2019)

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Abstract

Earlier, it was believed that digital marketing would not have any future in Indian politics due to huge digital divide between rural & urban India but the rise of cheap data on mass mobile telephone has indicated that the digital divide is much less relevant to voters than ever before. Through this paper, the authors aimed to study the Modi factor and various promotional strategies adopted by BJP during the 17th Lok Sabha election. The research methodology is explanatory in nature. The findings indicated that if we gaze upon the promotional marketing strategies adopted by BJP in the 17th Lok Sabha election then, there are some striking facts to be noticed such as the BJP's holds on the digital marketing landscape which provided a strong narrative shaped to cater its agendas, reiterate its strengths and sidestep its weaknesses and faults.

Keywords: BJP, India, Lok Sabha, Political, Marketing.

Introduction

In modern days, political marketing has emerged as one of the simple solution to the complex question faced by the political parties in reaching to the voters. Political marketing is a strategic, technical and active ways of political communication where political candidates share their ideas and try to maximize the voters' perception in their favour. It is growing at a rapid pace. Political parties require adopting new techniques for quickly attracting the voters as voters for political parties are like what customers are meant to business marketers. In the age of technological advancement, digital marketing is playing the role of kingmaker in today's politics.

Earlier, it was believed that digital marketing would not have any future in Indian politics due to huge digital divide between rural & urban India but the rise of cheap data on mass mobile telephone has indicated that the digital divide is much less relevant to voters than ever before. Many Political parties of contemporary times are following the new strategies having amalgamation of both traditional and modern marketing tools mainly digital marketing. The current ruling political party i.e. Bhartiya Janata Party (BJP) has almost completely incorporated this amalgamation of marketing strategies by keeping main focus on digital marketing in its election campaign as witnessed during the 16th & 17th Lok Sabha elections in the year 2014 & 2019 respectively.

If we gaze upon the pattern of marketing strategies adopted by BJP in the 17th Lok Sabha election then, there are some striking facts to be noticed such as the use of social media platforms (like Twitter, Facebook, etc.), mind-catching slogans like Sabka Saath Sabka Vikas, NaMo app and

many more. The main purpose of the study is to provide an information about the promotional strategies of BJP, which helped in gaining the majority in the year 2019 as it, is significant to know to get new knowledge about the emerging marketing pattern. The main targeted audience for this research paper is scholars, management students, academicians and all the persons who are interested in the field of political marketing.

Literature Review

Lot of literature is available on the political marketing in India and around the world. Infact, some academicians have researched on the political marketing strategies. However, such documentation is currently absent from the perspective of political marketing strategies of BJP particularly and adopted Modi factor. The review of available literature is provided below:

- **Binshad & Afsal (2020)** in the paper titled “Influence of Social Media as a tool of Political Marketing in General Elections” mentioned that social media marketing have created a new dimension in online advertising. The main purpose was to analyze the voter’s behavior related with decision making while they vote. An online survey through questionnaires to know the impact of social media on politics was conducted. Descriptive analysis tools were used and Chi square has applied to test the hypothesis. The conclusion indicated that the social media has an unleashed potential to change the face of political communication in the coming years.
- **Kumar (2019)** in the paper titled “Political Marketing in India: A review of Key strategies” highlighted that political marketing is compulsory ingredients for the success in politics. These strategies are like the way of communication with the electorate. His paper is based on already published sources. He discussed about the types of elections in India, role of election commission, comparative analysis of Lok Sabha elections held during 1951-52 & 2019-20. Dr. Kumar believed that Indian political parties are using both traditional and modern strategies. He provided the critical analysis of strategies used by political parties in India. In the concluding lines, he said that although, political marketing is a prerequisite for a politician’s success but it should be applied strategically.
- **Kaur & Sohal (2019)** in the paper titled “Examining the relationship between political advertisements, party brand personality, voter satisfaction and party loyalty” addressed the gap in the academic literature by determining the relationship between the multifaceted political advertising, party brand personality, loyalty construct. The sample included the 930 respondents from the major cities of Punjab through multistage stratified random sampling technique. The findings indicated that voter’s attitude towards political advertisement had a significant effect on their satisfaction and loyalty.
- **Goel & Brar (2018)** in the paper titled “Structural equation modeling of political marketing strategies adopted by political parties” highlighted that political marketing is quite these days phenomenon and has gained significance quickly around the world. They tried to understand the perceptions of voters towards political marketing strategies adopted by various politicians in India. The study was derived from three major factors viz. direct political marketing, relationship political marketing and transactional political marketing influencing the perception of voters towards the methods followed by Indian Politicians.
- **Duhan (2017)** in the paper titled “Influence of Social media on the first time voters and Youth in Favour of Bhartiya Janta Party” discussed about the impact of social media in India on general election of 2014. The BJP government adopted various medium including television, twitter, Facebook, etc. to mobilize the voters and social media played crucial

role in assuring the victory of BJP. She analyzed the impact of social media on the youth and first time voters supporting the BJP and found out that the urban youth supported the BJP comparatively more than the rural youth.

- **Kumar, Dhamija & Dhamija (2016)** in the paper titled “Political Marketing: The Horizon of Present Era Politics” discussed that politics is quite interesting in itself as it always grab the attention of common people as compared to other things. Various characteristics of political marketing are provided alongwith their impact on the present era politics. The authors believed that both politics and marketing are like alliance to each other. The concluding lines highlighted that political marketing is not restricted to merely advertisements, road shows and public appearances rather than it has much more depth into it.

Through this paper, the researcher aims to build a basic understanding of the Modi factor and the various political marketing strategies of BJP followed in the 17th Lok Sabha election (2019).

Research Methodology

Objectives

1. To understand the Modi factor followed in the promotional strategies adopted by BJP in the 17th Lok Sabha election.
2. To identify the promotional strategies adopted by BJP in the 17th Lok Sabha election.

Data Source

Data collected for this study belong to secondary data, which is collected, from various books, journals, website and other relevant sources.

Methodology

The research methodology is explanatory in nature.

Discussion & Findings

The major discussion and findings of the objectives taken on the basis of secondary data is provided below:

- **The Modi factor followed in the promotional strategies adopted by BJP in the 17th Lok Sabha election.**

It is unmistakably the BJP leadership that has been its formative vanguard, both in 2014 and 2019. The unreservedly ‘larger than life’ portrayal of Prime Minister Modi, as the usherer of then ‘New’ India and her emboldened stand in the global arena. The hyper-masculine figure of ‘*chappan inch ki chaati*’ has made its rebounds in the calls of ‘*Modi Hai, toh Mumkin Hai*’ --- the sincere faith of voters in the Prime Minister meant every vote casted in the name of ‘*Kamal*’ was seen as a direct vote for Narendra Modi. Though not for the first time, 2019 Indian General Election was held in the most presidential style, where individual MPs were amiss and the PMO was the final ground of polling, where local issues evaporated to give way to a national-nationalist agenda, and debates shifted from policy to ‘If not Modi, then who?’. Acknowledging the acceptability of PM Modi as

a mainstream moderate as against his more hardliner peers in the party, the BJP ranked the Prime Minister right, left and center – where every BJP success in public or policy was attributed to his name, and in reciprocal aggrandizement, the PM’s image uplifted that of the BJP’s too. Thus, by making the Narendra Modi the sole leader of appreciation in the manifesto, posters and all other forms of election propaganda. It was never the BJP government that the people were choosing to elect back to power but the Modi government, the Modi agenda and the Modi rate of growth and promise of security that was assured to votes. This is less the BJP campaign and more so a Modi campaign.

The BJP owes much of its glamour to the rise of brand Modi as the face and muscle that has made the erstwhile out of power, out of favor BJP into the staple of Indian national politics. The sheer acceptability of PM Modi as the face of ‘New’ India and his popularity makes the landslide victory of 2019 owed largely to Prime Minister Narendra Modi’s charisma and popularity.



Exhibit 1

Source: bjp.org

<https://www.bjp.org/files/2019-10/BJP-Election-english-2019.pdf>

If we look at the exhibit 1 then, it clearly indicated the BJP 2019 manifesto cover where the PM’s image superposes over even the party symbol. Here, the shifting narrative from ‘Chai Wala’ to ‘Chowkidar’ made PM Modi a guardian figure to the electorate. The elderly Modi, as compared to the youngster Rahul Gandhi as the INC candidate, and his neighborly ‘Chaukidar Chor Hai’, failed to stick against someone who viewed as the success of the Gujrat Model and a bootstrapped sage that has sacrificed his life for the national good. The carefully crafted image of PM Modi is one that is resilient to the political and rhetorical changes, viewed as a man of compassion, fiercely nationalist, and a strong leader for stability and security.


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Exhibit 2

Source: The Wire.

<https://thewire.in/politics/ec-sends-notice-to-bjp-mla-posters-iaf-pilot-abhinandan>

On the basis of exhibit 2, it is cleared that BJP poster in the year 2019 showed the PM in larger image and in greater context that the local leaders – who fight in his name and on his credentials. It was no longer the implications that the PM as only the head of the party or government, the Prime Minister was the government itself, and between the voters and government, the PM Modi was the arbiter, the guarantee of welfarist policy and the safeguard against corrupt practices. The spot clean image of Modi gave the BJP a contrasting look against the erstwhile UPA II steeped in corruption. Modi was the messenger and the message for the BJP. Thus, the BJP has remodeled Indian elections to resemble the nationwide appeal to Modi's presidential-style campaign.



Exhibit 3

Source: The Print.

<https://theprint.in/politics/what-congress-and-bjp-posters-in-poll-bound-madhya-pradesh-say-and-hide/1830378/>

The exhibit 3 clearly indicated BJP poster of the year 2019 with top leadership, national and state, a small array of the institutional capacity of the BJP, as against the Congress, in fielding future and present leaders of the party. A fragmented opposition, between the United Progressive Alliance (UPA) and the Federal Alliance of third front regional parties exaggerated the “There is NO Alternative” factor in the favor of the incumbent Modi-government, which had already successfully shifted Indian general elections from a parliamentary mode to a decisively presidential style of campaigning and voting. While ‘Modi ki Guarantee’ has been a late 2023 addition in the BJP repertoire, Modi was Bhajpa, and Bhajpa was Modi. Neither did the earlier

Mahagathbandhan - uniting all opposition parties into a united alliance against the BJP take off, nor did last minute SP-BSP-RLD in U.P pose a sincere challenge to the BJP's coherent narrative and unified leadership in Narendra Modi. The clear choice for voters running up to the polls became the Modi Government, under the clean, untouched by corruption face of the sage Minister. A deep contrast from the unraveling of UPA, the NDA made clear its policy platform, ideology and confirmed continuity under Prime Minister Modi.

Although this overdependence on the face of Modi may in the long term freeze the BJP's prospects as a national party in the post-Modi era, if left without a clear line of succession, the stardom certainly helps the BJP abundantly at the moment. Yet it will be too wrongful to suggest that the BJP does not have a strong secondary leadership, especially at the state level. While its national leadership is certainly made up of close confidants and supporters of Modi who had been his early vocal advocates in his post-2012 bid to become the BJP PM candidate, and choices for the CM's post in BJP ruled states have started to reside in the hands of the PM clique or the 'High Command', the undeniable organizational tenacity and ideological-professional persistence of BJP in the Sangh Parivar is more than an attribute of quality leadership churn out, helping the BJP with candidates that are locally sourced and Modi assured.

➤ The promotional strategies adopted by BJP in the 17th Lok Sabha election

The BJP inadvertently received a solid foundation in communicating clearly and with conviction display ideological background in 'Integral Humanism' and political 'Hindutva', as well as claim tradition in Sangh patriarchs Deendayal Upadhyaya and Vinayak Damodar Savarkar, despite its history of more moderate leadership in Syama Prasad Mukerjee and Atal Bihari Vajpayee. The Sangh pedigree has been inherited strong and willful in the case of BJP and it has intertwined ideological and cultural foundations into a fixed locus, building its indigenous and natural voter base in the less than crowded center-right of Indian politics. Thus, the core BJP issues of CAA-NRC, Ayodhya Ram Temple, abrogation of Article 370, and Hindu vigilantism are proximate proponents of its aggressive ideological baggage and its significant hardliner party membership.

Here, this exhibit is an oversimplified pedigree of the Sangh Parivar.

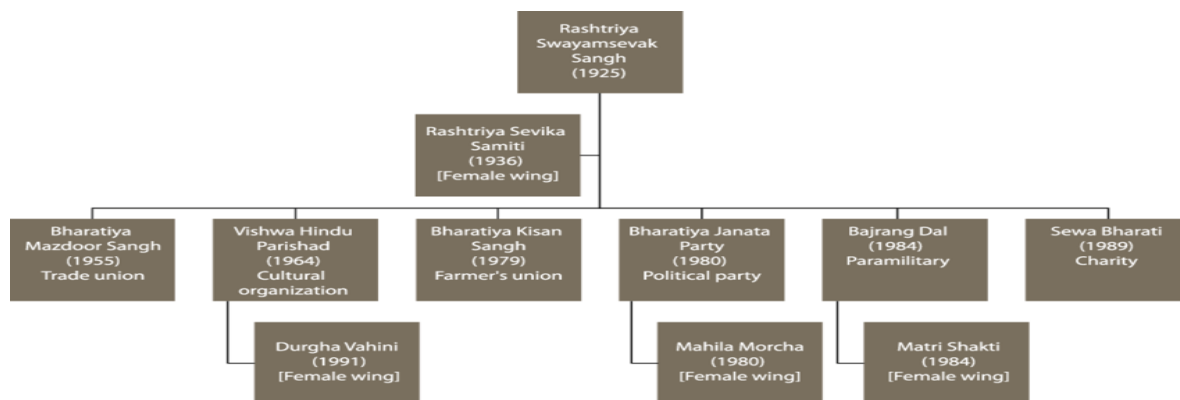


Exhibit 4

Source: ResearchGate.

https://www.researchgate.net/figure/Map-of-the-Sangh-Parivar_fig1_370645884

Infact, these steps towards what the Sangh Parivar ultimately holds to achieve in a 'Hindu Rashtra' have polarized sections of population and has been to a certain degree beneficial in not only garnering the support of the BJP core vote bank but also slide off shortcomings at times as nationalistic patience and at other times scapegoated onto the target minorities.

The fundraising faculties of the BJP as the largest recipient of electoral bonds, with vast resources pushing outreach. Even more so, as the political subsidiary of the Rashtriya Swayamsevak Sangh (hereafter, RSS), the BJP and its allies relies heavily on the grassroots support and organizational prowess of the Sangh Parivar.

The BJP spent nearly 45 percent or 27,000 crores of the total expenditure in the 2019 General Election, compared to Congress' 15-20 percent (Scroll, 4 June 2019). This not only far surpasses any competing opposition party but also shows an unrivaled monopoly over election resources. This provided the BJP an unequivocal war chest capable of sustained, long drawn and extensive campaigning. It is little surprising that the opposition surmises allegations of crony capitalism to the enriching Modi regime.

The BJP's holds on the digital media landscape provides a strong narrative shaped to cater its agendas, reiterate its strengths and sidestep its weaknesses and faults.

Conclusion

Indian politics is changing especially in terms of strategies followed by the political parties. The BJP has built overtime into an institutionalized party formation, unlike that of the Indian National Congress that had progressively lost its organization prowess and restrained itself to a cult catering to a definite lineage. While arguably, PM Modi's populism makes even the BJP somewhat vulnerable to person drawn votes, rather than an ideological vote, the mean fact of its current electoral asset in Prime Minster Modi's *lokpriyata*. BJP's strict list of candidates premised solely on winnability and support base became the only criteria while deciding on party tickets for polls. The BJP also held the caste calculus in mind in candidate selection, despite claiming on *kamandal* politics. Incumbents with receding grasp on their constituencies were replaces, past record, intra-party relations or spoil systems were systematically negated to choose from the best pool of leadership candidates. It nitpicked on constituencies with low margins of victory and concentrated human and material resources not only to retain what was won, but also gain what lost on small account in 2014. BJP hit the holy trifecta in having a resonating message, beloved messenger and an expansive machinery, laying a strong ground for the promotion of "*Modi fir ek bar*".

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- **B.Tech in Computer Science & Technology**
- **B.Tech in Information Technology & Engineering**
- **B.Tech in Computer Science & Engineering (AI)**
- **B.Tech in Computer Science & Engineering (AI&ML)**
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- **B.Tech in Electronics & Communication (ACT)**
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- **Master of Business Administration**
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