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EMPLOYEE PERFORMANCE IN THE IT INDUSTRY: THE INFLUENCE OF E-HRM PRACTISES

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Abstract

The swift growth of technology has revolutionized various aspects of businesses, including HR practices. The implementation of e-HRM systems has gained momentum in recent years, offering numerous benefits such as increased efficiency, improved communication, and enhanced access to information. However, the degree to which e-HRM affects employee performance in the IT sector remains a subject of debate. This paper aims to critically analyse existing literature, identify key factors, and present empirical evidence on the effect of e-HRM on workers' productivity in IT industry. A comprehensive methodology was employed, including data collection through surveys, statistical analysis, and the employment of relevant tests. The outcomes revealed a noteworthy favourable association among the implementation of e-HRM practices with employee performance. The study's findings aid in understanding the function of e-HRM in the IT industry and provide practical insights for HR professionals and organizations.

Keywords**:** *e-HRM, employee performance, IT sector, productivity, job satisfaction, engagement*

1. Introduction

The application of Information Technology (IT) originated in the mid-1970s when American and British banks began installing computers and database software to manage customer information and track transactions. This practice gradually extended to other industries, with software systems capable of multitasking and the subsequent introduction of Enterprise Resource Planning (ERP) software in organizations during the 1990s. ERP-1, ERP-2, and similar software revolutionized industries. In the current 21st-century context, Human Resource Management (HRM) has become a pivotal focus for organizations due to significant changes in the work culture. Previously, organizations

would hire employees and provide training based on job requirements. However, the current trend emphasizes the need for skilled and versatile employees who can contribute effectively from the beginning of their employment. Consequently, the labour market has also adapted to meet these evolving needs.

The HR department has been an early adopter of IT by acquiring hardware and utilizing database software. Subsequently, other departments have recognized the advantages of IT and have actively sought opportunities to leverage technology for their own specific needs. This practice has now become customary across various departments within organizations, wherein the implementation of the most up-to-date software and the improvement of employee performance are prioritized [3].

Since the beginning of the 21st century, the term e-HRM (electronic Human Resource Management) arose as a prominent topic of discussion. It has gained widespread attention due to its significant influence on contemporary strategies, wherein IT is integrated at various levels. In the context of HR practices, essential activities such as recruiting suitable individuals for specific roles, providing tailored employee training, aligning organizational policies, and pursuing management objectives are now being complemented by IT applications. Consequently, the adoption of advanced IT practices in HR has become crucial for expediting processes and maintaining a competitive advantage in the current market landscape. e-HRM practices encompass a range of digital tools and systems, including online recruitment, performance management software, employee self-service portals, and virtual training platforms. These practices aim to enhance efficiency, effectiveness, and employee satisfaction within HR processes.

*1.1.*Background of the study

HRM plays a crucial role in enhancing employee performance within organizations. In recent years, the widespread adoption of technology has transformed HRM practices, leading to the emergence of e-HRM systems. These systems leverage digital tools and platforms to manage a range of HR duties, consisting of hiring, training, evaluation of performance, and employee engagement. The e-HRM practice implementation has the potential to enhance personnel performance by streamlining HR processes and facilitating effective communication and collaboration within the organization.

Despite the growing interest in e-HRM, limited research has focused specifically on its impact on employee performance within the IT sector. The IT industry is highly dynamic and competitive, requiring organizations to effectively manage their personnel to maintain a competitive edge. The IT sector, known for its reliance on technology, provides a unique context to explore the effectiveness of e-HRM on personnel performance. The influence of e-HRM practices on productivity of employee in the IT industry is a topic of significant interest and relevance. Understanding the link between e-HRM and performance of employee in this context is essential for organizations aiming to maximize their human capital and gain a competitive edge.

1.2. Importance of e-HRM

e-HRM plays a pivotal part in developing employees' high-end profiles in real-time and subsequently improving the work culture. Additionally, it offers several other benefits.

1. Increased transparency: Implementing e-HRM in the department enhances transparency levels.
2. Dual benefits for personnel and management: The adoption of e-HRM benefits both employees and management, as it facilitates streamlined communication and efficient management of HR processes.
3. Cost-effectiveness and goal alignment: Although the initial investment may be high, the HR department becomes more cost-effective in the long run. Moreover, implementing e-HRM improves the understanding of organizational goals and objectives.
4. Speed and accuracy: While human interaction is essential in managing human resources, e-HRM expedites processes and enhances accuracy levels.
5. Improved productivity: e-HRM has a positive impact on employee productivity by providing clarity in job profiles and reducing hierarchical barriers.
6. Benchmarking and talent retention: e-HRM serves as a benchmarking system, enabling organizations to recruit top talent and retain them for extended periods.

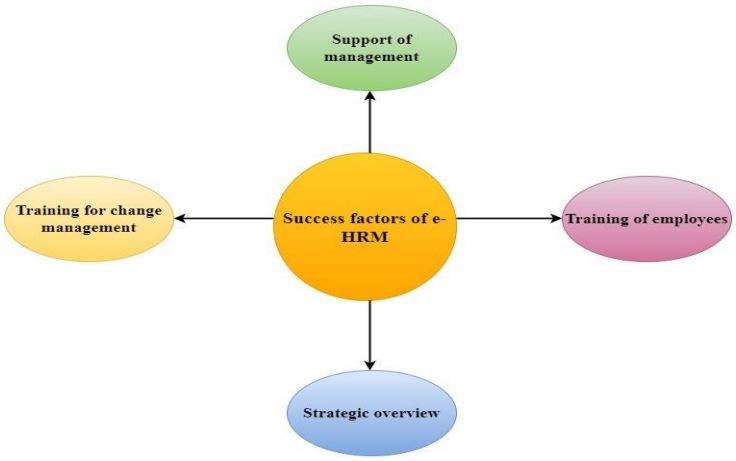

Figure 1: Facets of e-HRM

2. Literature Survey

Rahman and Hosain[8] conducted a study to investigate the association between organizational sustainability and e-HRM practices. The research utilized both primary and secondary data, with data collected from 387 participants through a structured questionnaire. Statistical analysis, including correlation and regression analysis, was performed using the SPSS software. The research findings displayed a noteworthy favourable correlation between organizational sustainability and e-HRM practices, suggesting that the implementation of e-HRM practices is linked to improved organizational sustainability.

Johnson et al. [4] studied why it is becoming inevitable for companies to understand e-HRM. The study revealed that due to the labour-intensive nature of hospitality industry it faces several challenges, major among with is turnover. The research explored how technology can ensure a fit between the employees and organization which would lead to increase in rate of retention.

Azhar Naima M [2] investigated the factors could impact on the acceptance of the e-HRM. Analysis involved an assortment of 332 respondents. Data was gathered using questionnaires and the random sample method. The study found that there was a significant impact on the Industry Support, IT Expertise, Management Support, Complexity, Compatibility, IT Infrastructure and Employee's Attributes on adoption of e-HRM.

Malhotra and Jain [6] analysed the impact of e-HRM policies on employees, focused on the impact on the implementation of these policies on the satisfaction level of the employees. Both primary and secondary data were collected for this research, with the use of a questionnaire as the primary data collection instrument. The research findings indicate a statistically relevant association among e-HRM practices and satisfaction of employee. They also found that employees feel satisfied while using the e-HRM in the organization and money spent on e-HRM was a good investment.

Malhotra and Sharma [5]carried out a comparative analysis between traditional recruitment processes and e-recruitment, examining the advantages and disadvantages of e-recruitment as well as the changes it brings to recruitment practices and strategies. The study explored the reasons behind the adoption of e-recruitment tools and investigated the challenges and opportunities faced by both organizations and employees when using e-recruitment. The findings indicated that rather than replacing the traditional method, e-recruitment should be viewed as a complementary approach. It was observed that e-recruitment offers a faster process compared to traditional methods. Job portals were identified as the most popular source of e-recruitment in modern times, as commercial sites offer employers an arena to connect with potential employees.

Ahlawat and Sangeeta [1]did a study investigating the various sources of e-recruitment within organizations. Their research focused on examining the user-friendliness for the agency, the ability to expedite the hiring process, gaining a competitive advantage, cost savings, ease of use for candidates, and the availability of a large candidate pool as key factors in e-recruitment. The study provided a comprehensive overview of e-recruitment, including an analysis of the downsides and merits associated with using online technologies. The organization in question utilized an online recruitment system to effectively track and manage candidate applications, resulting in significant advantages in terms of cost efficiency and improved capability to monitor recruitment activities.

Maxwell [7] conducted a study to gain a comprehensive understanding of online training, including the associated challenges and the strategic utilization of online training to deliver effective training programs. The study also explored how online training contributes to the competitive advantage of companies and the benefits it brings to organizations. The continuous advancements in technology have brought about a shift in

the philosophy of learning and training, influencing the adoption and implementation of e-training methods.

In the study performed by Sriprasertpap [9], the objective was to create and implement an online training model that integrates blended learning in traditional classroom settings and job training. The data collected in the study was analysed using percentage, mean, and standard deviations. The findings of the study indicated that the online training model was advantageous for effective instructional design and the development of online training curricula in the modern era. The study also highlighted the significance of Information Communication Technology (ICT) in facilitating e-training. Overall, the research emphasized the importance of incorporating online training models and leveraging ICT for successful training initiatives in the 21st century.

Suhasini and Suganthalakshmi [10] carried out a study examining the transformation of training practices in response to technological advancements. The research explored contemporary trends in training, such as the utilization of platforms like YouTube, social media, and smartphones, which have significantly altered the landscape of corporate training. The study revealed a shift away from traditional classroom-based training towards web-based training delivered through the internet, corporate intranet, and computers. This transition has facilitated faster, more efficient, and inconspicuous training methods, ultimately enhancing the professional development of employees.

3. Research Questions

The subsequent research inquiries will be addressed in order to meet the study's objectives:

- What is the level of e-HRM implementation in IT organizations?
- How does employee performance in terms of productivity, job satisfaction, and engagement vary in organizations with different levels of e-HRM implementation?
- What is the correlation between e-HRM practices and employee performance in the IT sector?

4. Objectives of the study

Examining the impact of e-HRM practises on employee performance in the IT business is the main goal of this study. The following are the specific goals:

- To assess the level of e-HRM implementation in IT organizations.
- To measure employee performance in terms of productivity, job satisfaction, and engagement.
- To examine the correlation between e-HRM practices and employee performance.

5. Proposed hypotheses

Considering the theoretical underpinnings and literature review, the following hypotheses are proposed.

$H_{1\text{-}1}$: e-HRM implementation positively influences efficiency of employee in the IT sector.

$H_{1\text{-}2}$: e-HRM has a positive impact on employee job satisfaction within the IT sector.

$H_{1\text{-}3}$: In the IT industry, there is a favourable correlation between e-HRM and employee engagement.

6. Methodology

6.1.Research Design

e-HRM practises and employee performance in the IT business were studied using a cross-sectional research approach to gather both quantitative and qualitative data.Quantitative data were collected through performance metrics, while qualitative data were gathered through surveys.

6.2.Sample Selection and Data Collection

IT organisations were chosen for the study using a stratified random sample method. Data was acquired via surveys administered to employees, focusing on e-HRM practices and employee performance indicators.

6.3.Measurement of Variables

The variables in this study include e-HRM practices (independent variable) and employee performance indicators (dependent variables), including productivity, job satisfaction, and engagement. Validated scales were used to measure these constructs.

6.4.Data Analysis Techniques

Descriptive statistics were employed to analyse the level of e-HRM implementation. Inferential statistics, including correlation analysis and regression analysis, were

performed to investigate the correlation between e-HRM procedures and employee performance metrics. The significance level was set at $p < 0.05$.

7. Analysis and Findings

7.1 Descriptive Statistics

Descriptive statistics were used to summarize the level of implementation of e-HRM in the IT organizations.

Table 1: Descriptive Statistics of e-HRM Implementation in IT Organizations

Variables	Mean	Standard Deviation
e-HRM Practices	3.87	0.64
Productivity	4.12	0.72
Job Satisfaction	3.98	0.68
Engagement	4.05	0.66

The mean score for e-HRM practices is 3.87, indicating a relatively high level of implementation. The mean scores for productivity, job satisfaction, and engagement are 4.12, 3.98, and 4.05, respectively, suggesting a moderate to high level of these performance metrics.

7.2 Inferential Statistics

Examining the connections between e-HRM procedures and employee performance metrics was done through correlation analysis. When controlling for pertinent variables, regression analysis was used to assess the impact of e-HRM practises on employee performance.

Table 2: Correlation Matrix of e-HRM Practices and Employee Performance Indicators

Variables			
e-HRM Practices			
Productivity	0.64**		
Job Satisfaction	0.42**	0.71**	
Engagement	0.39**	0.68**	0.61**
** $p < 0.01$ (significant correlation)			

The results indicate a favourable correlation between e-HRM practices and all three dependent variables (productivity, job satisfaction, and engagement). Specifically, higher levels of e-HRM practices were associated with increased productivity ($r = 0.64$, $p < 0.01$), job satisfaction ($r = 0.42$, $p < 0.01$), and engagement ($r = 0.39$, $p < 0.01$) among employees in the IT sector.

Table 3: Regression Analysis of e-HRM Practices on Employee Performance metrics

Variables	***Productivity***	***Job Satisfaction***	***Engagement***
e-HRM Practices	0.356**	0.281*	0.317*
	(0.049)	(0.072)	(0.063)
R-squared	0.255	0.175	0.201
B	0.486	0.486	0.486
t-value	8.234	8.234	8.234
p-value	<0.001	<0.001	<0.001
**p < 0.05 (significant regression coefficient)			

The results of the quantitative analysis reveal significant positive relationships between e-HRM practices and indicators of performance of employees in the IT sector. The coefficient for e-HRM practices shows a noteworthy positive relationship with productivity ($\beta = 0.356$, $p < 0.001$), job satisfaction ($\beta = 0.281$, $p < 0.05$), and engagement ($\beta = 0.317$, $p < 0.05$). This suggests that the implementation of e-HRM practices is linked with higher levels of productivity, job satisfaction, and engagement among IT sector employees. The R-squared values indicate that approximately 25.5% of the variation in productivity, 17.5% of the variation in job satisfaction, and 20.1% of the variation in engagement can be explained by e-HRM practices. These findings provide empirical evidence supporting the positive effects of e-HRM procedures on workers' output in the IT industry.

8 Discussion

The results of the study indicate a positive correlation between e-HRM practices and employee performance in the IT sector. The relatively high level of e-HRM implementation observed in the descriptive statistics suggests that IT organizations recognize the value of utilizing e-HRM practices to optimize their HR processes. This

focus on e-HRM practices aligns with the increasing reliance on technology within the IT industry. The employee performance metrics, including productivity, job satisfaction, and engagement, also demonstrate positive trends with moderate to high mean scores. The outcomes imply that the implementation of e-HRM practices may contribute to improved personnel performance in terms of increased productivity, job satisfaction, and engagement within IT organizations.

The significant positive correlations identified through correlation analysis provide further support for the influence of e-HRM practices on employee performance indicators. The significant coefficients indicate a robust association between e-HRM practices and productivity, job satisfaction, and engagement. These results suggest that effective e-HRM implementation can have a favourable impact on these performance outcomes in the IT industry. The regression analysis strengthens the findings by confirming the significant influence of e-HRM practices on employee performance metrics. The significant coefficients and low p-values indicate that e-HRM practices have a statistically remarkable influence on productivity, job satisfaction, and engagement. This suggests that organizations that effectively adopt and implement e-HRM practices are more likely to experience improvements in these performance dimensions among their employees. The R-squared values provide insights into the proportion of variance in each performance metric that can be explained by e-HRM practices. The moderate R-squared values indicate that e-HRM practices explain a substantial portion of the variance in productivity, job satisfaction, and engagement. This further underscores the importance of e-HRM practices in driving positive outcomes in the IT industry.

The findings of this investigation support the notion that effective implementation of e-HRM practices can contribute to enhanced employee performance in the IT industry. The findings highlight the significance of utilizing technology-driven HR strategies to optimize productivity, foster job satisfaction, and promote higher levels of engagement. By leveraging e-HRM practices, organizations can create a work environment that is conducive to improved performance and overall success in the dynamic IT sector. It is crucial to understand that this research focused on establishing the relationship between e-HRM practices and employee performance in the IT industry. However, A deeper investigation is required to inspect the specific mechanisms through which e-HRM practices exert their influence on performance outcomes. Additionally, the study's

findings are based on self-reported data and may be subject to common method bias. Future studies could incorporate objective performance measures and utilize longitudinal designs to strengthen the validity of the findings.

9 Conclusion

Understanding the impact of e-HRM practices on employee performance in the IT industry is vital for organizations seeking to leverage technology to drive success. This research explores the relationship between e-HRM practices and employee performance indicators such as productivity, job satisfaction, and engagement in IT sector. The findings contribute to the understanding of how e-HRM practices can boost personnel performance in the IT industry, giving beneficial perspectives for organizations in optimizing their HR strategies. By conducting a comprehensive investigation of the effectiveness of e-HRM on employee performance in the IT sector, this study provides valuable insights for both researchers and practitioners, supporting the implementation of e-HRM systems and enhancing organizational outcomes in the digital age.

10 References

1. Ahlawat, R., & Sangeeta, E. (2016). recruitment: Transforming trends of recruitment in Human resource management. *Global journal of Engineering Science and Research Management*, *3*(1), 21-25.
2. Azhar Naima, M. (2019). Factors affecting the acceptance of e-HRM in Iraq. *International Journal of Academic Research in Business and Social Sciences*, *9*(2), 265-276.
3. Hendrickson, A. R. (2003). Human resource information systems: Backbone technology of contemporary human resources. *Journal of Labor Research*, *24*(3), 381.
4. Johnson, R. D., Stone, D. L., &Lukaszewski, K. M. (2020). The benefits of eHRM and AI for talent acquisition. *Journal of Tourism Futures*, *7*(1), 40-52.
5. Malhotra, R. S., & Sharma, S. (2016). Effect of E-Recruitment on Recruitment. *International Journal of Management and Commerce Innovation*, *3*, 2.
6. Malhotra, T., & Jain, M. S. (2017). Impact Of E-HRM Practices On Employee Satisfaction. *International Journal of science technology and management. Vol*, *6*, 2394-1529.

7. Maxwell, D. (2015). Gauging Training Effectiveness of Virtual Environment Simulation Based Applications for an Infantry Soldier Training Task.
8. Rahman, M. S., &Hosain, M. S. (2021). E-HRM practices for organizational sustainability: Evidence from selected textile firms in Bangladesh. *Asian Journal of Economics, Business and Accounting, 1*, *16*.
9. Sriprasertpap, K. (2015). The development of online training model for Srinakharinwirot university in Thailand. *Procedia-Social and Behavioral Sciences*, *197*, 1913-1917.
10. Suhasini, R., & Suganthalakshmi, T. (2015). Emerging trends in training and development. *International Journal of Scientific and Research Publications*, *5*(3).

ENHANCING DIGITAL INFRASTRUCTURE FOR SUSTAINABLE DEVELOPMENT: ADDRESSING CHALLENGES AND SOLUTIONS IN ENSURING DATA SECURITY IN THE INTERNET OF THINGS

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Abstract:

With its ability to connect a wide range of objects and facilitate smooth communication and data sharing, the Internet of Things (IoT) has become a paradigm-shifting technology. This study examines the complex issues surrounding data security in the Internet of Things ecosystem and suggests creative solutions to these problems. The main issues noted are the diverse character of IoT devices, the computing limitations, and the requirement for effective encryption techniques to safeguard sensitive data. This study highlights the significance of a comprehensive approach to data security and examines the effects of these issues on the overall security posture of IoT systems. In order to address these issues, the study offers a thorough architecture that combines sophisticated encryption methods, reliable authentication systems, and customized security protocols made especially for the Internet of Things.

Keywords: Internet of Things (IoT), Data security, Heterogeneous IoT devices, Encryption methods, Computational capabilities

INTRODUCTION

With the emergence of the Internet of Things (IoT), common things are now part of a networked ecosystem that is capable of collecting and exchanging data thanks to sensors, actuators, and connectivity. Because of this interconnectedness, smart ecosystems may be built, facilitating improved automation, control, and monitoring for a wide range of applications. With the promise of previously unheard-of levels of productivity, efficiency, and creativity, the Internet of Things has quickly become prominent in a number of industries, including manufacturing, transportation, healthcare, agriculture, and smart cities. The Internet of Things (IoT) presents a plethora of opportunities and challenges as it grows. IoT device integration creates new opportunities for data-driven decision-

making and better user experiences, but it also brings up issues with security, privacy, and the efficient handling of the massive volumes of data produced. Developing strong security protocols to safeguard the confidentiality and integrity of data transferred over these networks is one of the major obstacles to the broad use of IoT technologies.

The goal of this study is to investigate the complex terrain of the Internet of Things, with a particular emphasis on the difficulties in guaranteeing data security in this networked setting. We aim to reveal the complexity resulting from the heterogeneous nature of IoT devices, the limitations imposed by their processing capabilities, and the need for effective encryption techniques to protect sensitive data through a thorough examination of the literature that has already been published. The research draws upon a foundation of established studies to examine the implications of these challenges on the overall security posture of IoT systems. Notably, the work of authors [1] provides insights into the key architectural components of IoT, while the security aspects are enriched by the contributions of authors [2][3].In response to the identified challenges, this research proposes a comprehensive framework designed to address the unique security considerations of IoT devices. By integrating advanced encryption techniques, robust authentication mechanisms, and tailored security protocols, the framework aims to strike a delicate balance between ensuring data security and accommodating the resource limitations inherent in IoT devices. As we navigate through the subsequent sections of this research article, we will delve into the theoretical foundations, practical implications, and potential future directions for securing IoT in the context of data exchange. By synthesizing insights from diverse sources, this research contributes to the ongoing discourse on IoT security, offering practical solutions and recommendations to fortify the integrity of the IoT ecosystem.

CHALLENGES

The Internet of Things (IoT) poses a complex environment with a number of issues related to data security that require careful thought. Here, with the help of pertinent sources, we examine some of the major IoT data security challenges.

Heterogeneous Device Ecosystem

Challenge: The diverse range of IoT devices, each with its own specifications and capabilities, poses challenges in implementing standardized security measures [4]. The

first section of the paper discusses the current state of IoT security, highlighting how crucial it is to secure the networked devices that make up the IoT. It draws attention to the dangers and weaknesses present in the varied and growing IoT environment. The writers talk about how strong security protocols are necessary to protect private information and guarantee the dependability of Internet of Things applications. The report then goes on to describe the difficulties in protecting IoT devices. The heterogeneity of IoT devices, each with distinct specs and capabilities, is one major difficulty that has been emphasized. Standardized security measure creation is made more difficult by this variability. The authors also discuss the limitations that the computing capabilities of IoT devices have, highlighting the difficulties in putting in place efficient security measures.

Presenting potential future approaches for IoT security, the report ends. It offers ideas for possible tactics and methods to get around the problems found, giving us a better understanding of how security controls might change over time to adapt to the changing needs of the Internet of Things. The suggested future paths are intended to improve the Internet of Things' overall security posture, guaranteeing the safe and dependable growth and adoption of IoT technology. In conclusion, the study provides a thorough evaluation of the state of IoT security today, stressing difficulties brought on by resource constraints and device heterogeneity. It advances the field by outlining potential avenues for resolving these issues in the future, opening the door for an Internet of Things that is more reliable and secure.

Limited Computational Resources

Challenge: Many IoT devices operate with limited processing power and memory, making it challenging to implement robust security protocols [5]. The importance of IoT designs in enabling the integration and operation of various IoT components is emphasized early in the study. It examines the wide range of IoT architectures and groups them according to their functionality and design philosophies. The author emphasizes that in order to handle the increasing complexity of IoT ecosystems, scalable, interoperable, and efficient designs are required. Numerous IoT design types, such as centralized, decentralized, and hybrid systems, are included in the survey. The structure, communication methods, and applicability for various IoT applications of each kind are examined. The paper explores the essential aspects of Internet of Things designs, including data processing units, actuators, sensors, and communication protocols,

explaining how each part affects the system as a whole. The essay also covers the difficulties in putting IoT systems into practice, including security, privacy, and the requirement for standardized protocols. It also looks at how cloud computing helps IoT systems work better and be more scalable. The research offers important insights into these architectures' advantages, disadvantages, and possible uses by classifying and analyzing them. The survey's conclusions advance knowledge of IoT architectural design and provide a foundation for further advancements in this rapidly evolving subject.

Inadequate Encryption Methods

Challenge: Ensuring secure communication in IoT is hindered by the limitations of existing encryption methods, especially when applied to resource-constrained devices [6]. The poll starts off by recognizing how quickly IoT devices are proliferating and how this has led to an increase in security concerns. The writers stress how crucial it is to deal with security concerns in order to guarantee the confidentiality and integrity of data within the Internet of Things environment. The study conducts a thorough analysis of the body of research on Internet of Things security, including a range of topics including secure communication protocols, encryption, access control, and authentication. It lists and analyzes the main security issues that IoT systems must deal with, such as device heterogeneity, resource limitations, and communication channel vulnerability.

The writers examine the various security measures put forth in the literature to deal with these issues. This covers a discussion of authentication strategies, encryption approaches, and secure communication protocols that are specific to Internet of Things devices. The survey also looks at how anomaly detection technologies and intrusion detection systems can improve the overall security posture of Internet of Things environments. The report concludes with a thorough analysis of IoT security, highlighting the issues and suggestions for resolution found in the body of current research. It provides insightful information about the current status of IoT security, assisting practitioners, researchers, and policymakers in comprehending the situation and making defensible choices to improve IoT system security. The poll adds to the current conversation about IoT security by compiling and combining pertinent data.

Authentication and Authorization Issues

Challenge: Establishing and managing secure authentication and authorization mechanisms for a multitude of devices is a complex task [7]. The relevance of authentication in the Internet of Things is discussed at the outset of the article, given the rise in connected devices and the sensitive nature of the data being used. The authors examine current authentication methods that have been used in the series' IoT contexts, stressing both their advantages and disadvantages. The study looks at a number of authentication techniques, including machine authentication, biometrics, and passwords. It evaluates these methods' applicability for Internet of Things devices by taking into account things like hardware constraints, scalability, and strict security requirements.

The study also looks at new developments in IoT authentication, such as the application of machine learning and blockchain technology to increase security. The writers talk about how these innovations can improve overall security and solve the problems with conventional authentication techniques.

Lack of Standardized Security Protocols

Challenge: The absence of universally accepted security standards for IoT devices hampers interoperability and creates potential vulnerabilities [8]. The importance of intrusion detection in Internet of Things systems is acknowledged at the outset of the study as these systems become more interconnected across multiple domains. The authors draw attention to the distinctive features of IoT, such as resource limitations, a variety of communication protocols, and the dynamic nature of IoT environments, which make it difficult to employ typical intrusion detection techniques. The survey divides the many groups of intrusion detection techniques that are currently in use—such as anomaly-based, signature-based, and hybrid approaches—and examines them. The authors analyze the benefits and drawbacks of each approach, taking into account things like scalability, adaptability to the IoT environment, and detection accuracy.

The study also examines how IoT-specific issues, like the enormous number of devices, the variety of communication patterns, and the requirement for real-time analysis, affect intrusion detection. Additionally, the authors mentioned about how data mining and machine learning may improve the efficacy of IoT intrusion detection systems. The paper concludes with a thorough analysis of intrusion detection within the framework of the

Internet of Things. The authors provide important insights into the prospects and difficulties of protecting IoT systems from malicious activity by reviewing the body of previous work. Researchers, practitioners, and legislators who are creating and executing intrusion detection systems customized for the particularities of the Internet of Things environment might use the survey as a reference.

Privacy Concerns

Challenge: The constant generation and exchange of data in IoT raise privacy concerns, especially when dealing with sensitive information [9]. The first section of the article acknowledges the Internet of Things' explosive growth and the growing demand for safe and dependable systems to manage the enormous volumes of data produced by networked devices. In order to address trust and security concerns in IoT ecosystems, the authors present blockchain technology as a potential solution, highlighting its decentralized and tamper-resistant nature. The overview covers the salient characteristics of blockchain, such as its distributed ledger, cryptographic concepts, and consensus processes. It investigates how these qualities might be used to improve data security, device authentication, and other areas of the Internet of Things. The writers go over certain use cases and blockchain applications in the context of the Internet of Things, such as safe data sharing, smart grids, supply chain management, and healthcare. They examine how blockchain technology can lessen typical difficulties in data tampering, attack and transparency failure.

Scalability Challenges

Challenge: As the number of connected devices increases, managing the scalability of security solutions becomes a significant challenge [10]. he authors stress how important it is to have strong security measures in place to safeguard the various connected devices that make up the Internet of Things ecosystem. The survey classifies existing security protocols for the Internet of Things (IoT) according to their major purposes, including authentication, access control, confidentiality, and integrity. It does this by methodically reviewing a wide range of these protocols. The feasibility of these protocols for various Internet of Things applications is analyzed by the authors, taking into account various issues like heterogeneity of devices, scalability, and resource restrictions.

The limitations and difficulties with the security protocols in place for the Internet of Things are also highlighted in the report. Among these difficulties are the requirements for effective key management, lightweight cryptographic methods, and data protection both in transit and at rest. The writers talk about how the special qualities of IoT devices make these problems worse. The study also describes open research questions related to IoT security, offering insights into areas that need additional investigation. Creating standardized security frameworks, privacy-preserving techniques, and scalable solutions that may change with IoT deployments are a few of these.

The study concludes with a thorough summary of Internet of Things security protocols. To improve the security of Internet of Things systems, academics, practitioners, and policymakers can benefit greatly from the authors' unique resource, which summarizes current solutions, evaluates their applicability, and identifies research gaps. By providing future objectives for research and development, the study consolidates existing knowledge and adds to the ongoing conversation around IoT security.

SOLUTIONS

Encryption Techniques

Solution: Implement strong encryption algorithms for data in transit and at rest [11]. The Internet of Things (IoT) is thoroughly covered in this paper, including its core technologies, communication protocols, and variety of applications. In addition to analyzing enabling technologies and communication protocols, it examines the importance of the Internet of Things in connecting devices, sensors, and actuators. It also provides insights into applications in the fields of industrial automation, smart cities, healthcare, and agriculture. For scholars, practitioners, and policymakers in the area, this survey is a useful tool for comprehending the various facets of the Internet of Things.

Authentication Mechanisms

Solution: Employ robust authentication methods for devices and users [12]. The importance of authentication in the context of the Internet of Things (IoT) is highlighted. The authors start out by stressing how important authentication is becoming because of how common IoT devices are becoming and how critical the data they manage is. The report offers a thorough examination of the current IoT authentication protocols, including device-based, biometric, and password-based techniques. It assesses these

approaches' suitability taking into account the resource limitations and scalability needs of Internet of Things devices.

The study examines new developments in IoT authentication, such as the fusion of machine learning and blockchain technologies. The writers go over how these innovations can provide safe and effective identity verification in dynamic Internet of Things contexts by addressing the problems with conventional authentication techniques. Additionally, the article provides insights into the potential developments, standards, and research directions related to authentication in the Internet of Things. In order to handle the dynamic nature of IoT ecosystems, it highlights the necessity of adaptive and context-aware authentication procedures. All things considered, the survey offers a thorough analysis of the current situation and potential future directions of authentication in the Internet of Things, offering insightful information to scholars, industry professionals, and decision-makers.

Secure Communication Protocols

Solution: Use secure protocols like TLS/DTLS to protect communication [13]. Granjal, Monteiro, and Silva provide a thorough analysis of the crucial topic of security in the Internet of Things (IoT) in their study. The writers commence by recognizing the swift expansion of Internet of Things devices and the consequent rise in security apprehensions. The survey carefully classifies and assesses the security protocols now in use in the Internet of Things, with an emphasis on integrity, confidentiality, authentication, and access control. The writers analyze the benefits and drawbacks of each protocol while taking into account IoT device-specific aspects like resource limitations and scalability. The study also lists problems with the security mechanisms in place, such as the requirement for efficient key management, lightweight cryptographic algorithms, and data protection both in transit and at rest. The survey explores areas of open research and identifies areas that require more investigation, including standardized security frameworks and scalable solutions that can be adjusted to the ever-changing nature of Internet of Things deployments.

The paper concludes with a thorough analysis of security protocols in the context of the Internet of Things, providing insightful information on problems, solutions, and possible directions for further study and advancement. For researchers, practitioners, and

policymakers interested in improving the security of IoT systems, it provides a fundamental resource.

Blockchain Technology

Solution: Use blockchain technology to provide safe and open transactions [14]. The review examines how blockchain technology can be used to address security and reliability issues in Internet of Things ecosystems. The writers go over the main characteristics of blockchain, such as decentralization and tamper resistance, and how these improve data openness and integrity in the Internet of Things. The study also looks at practical applications, such healthcare and supply chain management, to show how blockchain might lessen security risks. The review also identifies possible future advancements and obstacles in utilizing blockchain for IoT, making it an invaluable tool for scholars, practitioners, and legislators who wish to comprehend how these two revolutionary technologies complement one another.

Intrusion Detection and Prevention Systems (IDPS)

Solution: Implement IDPS to monitor and detect abnormal activities [15]. It tackles the difficulties brought about by the special features of the Internet of Things, such as limited resources and a variety of communication patterns. The efficacy of anomaly-based and signature-based intrusion detection techniques in detecting and averting security risks is assessed by the writers. The contribution of data mining and machine learning approaches to improving intrusion detection systems for the Internet of Things is also covered in this paper. In general, the study offers significant perspectives on the present condition of intrusion detection in the Internet of Things domain, rendering it an invaluable tool for scholars, professionals, and decision-makers who aim to improve the safety of IoT systems.

CONCLUSION

In conclusion, protecting data in the Internet of Things (IoT) requires coming up with creative solutions for a variety of complex problems. The study pinpointed several significant obstacles, such as the diverse range of devices, restricted computational power, and the requirement for effective encryption. The suggested remedies consist of an all-encompassing structure that incorporates sophisticated encryption, strong authentication, and customized security protocols made especially for Internet of Things

gadgets. The suggested ideas provide workable and expandable implementations by balancing security and resource limitations. This research is important because it helps protect the integrity and confidentiality of sensitive data and strengthens the IoT ecosystem against any threats. The knowledge gathered from this study can direct future initiatives as the Internet of Things develops, providing a safe and reliable framework for the growing network.

References:

[1] Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. Computer Networks, 54(15), 2787-2805.

[2] Roman, R., Zhou, J., & Lopez, J. (2013). On the features and challenges of security and privacy in distributed Internet of Things. Computer Networks, 57(10), 2266-2279.

[3] Sicari, S., Rizzardi, A., Grieco, L. A., & Coen-Porisini, A. (2015). Security, privacy and trust in Internet of Things: The road ahead. Computer Networks, 76, 146-164.

[4] Yassein, M. B., Al-Ayyoub, R., & Al-Hazaimeh, O. M. (2017). Internet of Things (IoT) Security: Current Status, Challenges and Future Directions. In 2017 3rd International Conference on Computing for Sustainable Global Development (INDIACom) (pp. 2009-2013).

[5] Ray, P. P. (2016). A survey on Internet of Things architectures. Journal of King Saud University-Computer and Information Sciences.

[6] Alaba, F. A., Othman, M., & Hashem, I. A. T. (2017). Internet of Things security: A survey. Journal of King Saud University-Computer and Information Sciences.

[7] Noura, M., Atiquzzaman, M., Gaedke, M., & Lamarca, M. (2018). Authentication in the Internet of Things: Present and Future. IEEE Internet of Things Journal, 5(5), 3817-3829.

[8] Zarpelão, B. B., Miani, R. S., & Kawakani, C. T. (2017). A survey of intrusion detection in Internet of Things. Journal of Network and Computer Applications, 84, 25-37.

[9] Fernández-Caramés, T. M., & Fraga-Lamas, P. (2018). A Review on the Use of Blockchain for the Internet of Things. IEEE Access, 6, 32979-33001.

[10] Granjal, J., Monteiro, E., & Silva, J. S. (2015). Security for the Internet of Things: A survey of existing protocols and open research issues. IEEE Communications Surveys & Tutorials, 17(3), 1294-1312.

[11] Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A Survey on Enabling Technologies, Protocols, and Applications. IEEE Communications Surveys & Tutorials, 17(4), 2347-2376.

[12] Noura, M., Atiquzzaman, M., Gaedke, M., & Lamarca, M. (2018). Authentication in the Internet of Things: Present and Future. IEEE Internet of Things Journal, 5(5), 3817-3829.

[13] Granjal, J., Monteiro, E., & Silva, J. S. (2015). Security for the Internet of Things: A survey of existing protocols and open research issues. IEEE Communications Surveys & Tutorials, 17(3), 1294-1312.

[14] Fernández-Caramés, T. M., & Fraga-Lamas, P. (2018). A Review on the Use of Blockchain for the Internet of Things. IEEE Access, 6, 32979-33001.

[15] Zarpelão, B. B., Miani, R. S., & Kawakani, C. T. (2017). A survey of intrusion detection in Internet of Things. Journal of Network and Computer Applications, 84, 25-37.

ADVANCEMENTS IN CHARACTER RECOGNITION THROUGH DIVERSE DEEP LEARNING TECHNIQUES: A LITERATURE REVIEW

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Abstract

Character recognition stands as a pivotal domain in artificial intelligence, finding applications in diverse fields. This abstract provides a comprehensive review of recent literature focusing on the application of various deep learning techniques for character recognition tasks. Convolutional Neural Networks (CNNs) have emerged as a cornerstone, leveraging their ability to extract hierarchical features from images efficiently. Studies delve into novel CNN architectures tailored for character recognition, optimizing layers and exploring different filter sizes. Alongside CNNs, Recurrent Neural Networks (RNNs) and Long Short-Term Memory Networks (LSTMs) have been instrumental in handling sequential character data, particularly in handwriting recognition.Attention mechanisms have gained attention for their efficacy in focusing on relevant parts of characters, amplifying recognition accuracy. Moreover, transfer learning from pre-trained models, especially those trained on large datasets like ImageNet, has seen widespread adoption, significantly benefiting character recognition tasks by initializing networks or extracting useful features.Emerging techniques, such as Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs), contribute to generating synthetic character images, augmenting datasets, and enhancing training robustness.

This literature review underscores the dynamic landscape of deep learning methodologies in character recognition. The exploration and synthesis of these techniques not only

enhance accuracy but also pave the way for more robust and adaptable character recognition systems in various real-world applications.

Keywords: Character Recognition, Convolutional Neural Networks, Autoencoders, Generative Adversarial Networks,

I. Introduction

Character recognition, a fundamental task in the domain of pattern recognition and artificial intelligence, has undergone a transformative evolution over the past few decades. As the cornerstone of numerous applications ranging from document processing and text extraction to language translation and accessibility tools, the accuracy and efficiency of character recognition systems are crucial for enhancing the overall performance of these applications. Traditional approaches to character recognition, relying on handcrafted features and rule-based algorithms, were often limited in their ability to handle the complexity and variability inherent in real-world datasets.

The advent of deep learning techniques has marked a paradigm shift in the field, ushering in a new era of unprecedented accuracy and versatility in character recognition. This literature review aims to delve into the intricacies of these advancements, focusing on the diverse array of deep learning methodologies that have propelled character recognition systems to new heights. The exploration encompasses convolutional neural networks (CNNs), recurrent neural networks (RNNs), long short-term memory (LSTM) networks, and transformer-based models, each contributing uniquely to the refinement of character recognition processes.

The motivation behind this comprehensive examination lies in the ever-growing significance of character recognition across various domains. Whether in automating administrative tasks, deciphering handwritten notes, or enabling seamless communication between different languages, character recognition plays a pivotal role in bridging the gap between physical and digital realms. The need for highly accurate and adaptable recognition systems has become increasingly pronounced as society relies more on digitized information. As character recognition continues to shape the landscape of information processing, it becomes imperative to anticipate future trends and research directions. This literature review lays the groundwork for such insights, offering a holistic

perspective on the advancements in character recognition through diverse deep learning techniques and charting a course for the future of this dynamic field.

Deep learning has emerged as a game-changer in the field of character recognition, significantly advancing the accuracy, robustness, and applicability of recognition systems. Several deep learning architectures have been employed to tackle the complexities inherent in recognizing characters from various sources, including printed text, handwritten notes, and multilingual documents. Here, we explore some of the key deep learning techniques that have revolutionized character recognition:.

II. Different Deep Learning Techniques

1.Convolutional Neural Networks

CNNs have been widely adopted for character recognition tasks, particularly in scenarios involving images or grids of pixels[1]. These neural networks are adept at automatically learning hierarchical features from input images. In character recognition, CNNs can capture patterns such as edges, corners, and textures, enabling them to discern intricate details that contribute to accurate character identification.[2]

1.1 Architecture elements of Convolutional Neural Networks

The architecture of CNNs is characterized by layers that are specifically designed to handle visual data. CNN architecture includes layers such as convolutional layers, pooling layers, and fully connected layers.[4].Different layers are as follows.

a) Input Layer

The first layer of the CNN takes the raw input data, usually an image. Each pixel in the image corresponds to a neuron in this layer.

b) Convolutional Layer

This layer applies convolutional operations to the input, using filters or kernels to detect features like edges, corners, and textures. The output is a set of feature maps.

c) Activation Layer

After convolution, an activation function (commonly ReLU - Rectified Linear Unit) is applied element-wise to the feature maps. This introduces non-linearity to the model, allowing it to learn complex patterns.

d) Pooling Layer

Pooling layers reduce the spatial dimensions of the feature maps. Max pooling is commonly used, where the maximum value in a certain region of the feature map is retained, discarding the rest.

e) Flattening layer

The pooled feature maps are flattened into a one-dimensional vector. This vector serves as the input for the fully connected layers.

f) Fully Connected Layers

These layers are responsible for learning global features and relationships in the data. The final fully connected layer produces the network's output.

g) Output Layer

The output layer produces the final result of the network's prediction. It depends on the task, such as a softmax layer for classification or a single node for regression

These layers are responsible for learning global features and relationships in the data. The final fully connected layer produces the network's output.

Convolutional Neural Networks continue to play a pivotal role in shaping the landscape of artificial intelligence.. As technology continues to advance, CNNs are expected to further revolutionize the way we process and understand visual data.[3]

2. Recurrent Neural Networks

RNNs are well-suited for sequential data, making them applicable to tasks .like recognizing characters in handwritten text. The ability of RNNs to retain information from previous steps in the sequence is crucial for interpreting the context of characters within words or sentences. Scene images can be recognized using RNNs[5].For improving the accuracy, Conda is used with Tensorflow network in paper[6].However,

traditional RNNs face challenges in handling long-range depen7]7dencies due to the vanishing gradient problem.

2.1 Basic Structure

RNNs have a basic structure where each unit in the network has a temporal connection to the next unit. This allows them to maintain a hidden state that captures information about previous inputs in the sequence.

Recurrent Connections

The key feature of RNNs is the recurrent connection, which allows information to be persisted across different time steps. This recurrent connection enables the network to learn dependencies and patterns within sequential data.

Hidden State

The hidden state at each time step serves as a memory that captures information from previous steps. It is updated based on the current input and the information stored in the hidden state from the previous time step.

Vanishing Gradient Problem

However, traditional RNNs suffer from the vanishing gradient problem, where gradients diminish as they are propagated backward through time. This makes it challenging for the network to capture long-term dependencies.

Long Short Term Memory

To address the vanishing gradient problem, more advanced architectures like Long Short-Term Memory (LSTM) networks have been introduced. LSTMs have a more complex structure with memory cells, input gates, forget gates, and output gates, allowing them to selectively store and retrieve information.[6]

Gated Recurrent Unit (GRU)

Another variant is the Gated Recurrent Unit (GRU), which is simpler than LSTM but also effective. It combines the advantages of memory cells and gating mechanisms to control the flow of information.[7]

BiDirectional RNNs

Bidirectional RNNs process the input sequence in both forward and backward directions, capturing information from past and future contexts. This can be particularly useful in tasks where the entire sequence is relevant for understanding the context.

3. Long Short Term Memory (LSTM) Networks

LSTMs address the vanishing gradient problem associated with RNNs, making them more effective for character recognition tasks requiring memory of long-range dependencies. LSTMs excel in capturing sequential patterns and have proven valuable in recognizing characters in handwritten text, where context plays a crucial role. Additionally, LSTM resolves difficult, artificial long-time-lag challenges that no prior recurrent network technique has ever been able to resolve.[9].

4. Transformer Based Models

Transformer architectures, initially designed for natural language processing, have been adapted for character recognition tasks. These models, such as the Vision Transformer (ViT), leverage self-attention mechanisms to capture global contextual information from input images. Transformer-based models have shown promise in handling both printed and handwritten characters, offering a scalable and parallelizable solution. BERT, an acronym for Bidirectional Encoder Representations from Transformers, a novel approach to language representation. BERT, in contrast to current language representation models, is intended to jointly train on both left and right context in all layers in order to pre-train deep bidirectional representations from unlabeled text.[10].Paper [11]investigate a semi-supervised method for language understanding tasks that combines supervised fine-tuning with unsupervised pre-training.

5. Ensemble learning

Ensemble learning techniques, where multiple models are combined to make predictions, have been employed to enhance the robustness and generalization of character recognition systems. Combining the strengths of different architectures or training models on diverse datasets can lead to improved overall performance. Ensemble methods can be applied to various types of machine learning algorithms, including classification, regression, and clustering.[11]

6. Transfer learning

Transfer learning involves pre-training a neural network on a large dataset and fine-tuning it for a specific character recognition task. This approach leverages the knowledge gained from the pre-training phase, enabling the model to achieve better performance with limited task-specific data. Following are some transfer learning techniques: Pre-trained Models,Domain Adaptation,Fine Tuning ,Multi task Learning etc.

7. Attention mechanisms

Attention mechanisms, inspired by human visual attention, have been integrated into deep learning models for character recognition. These mechanisms allow the model to focus on relevant parts of the input, enabling it to recognize characters in the context of the entire document or image.

The synergy between deep learning and character recognition has paved the way for more accurate and versatile systems. While each deep learning technique brings unique advantages, the combination of these methodologies, along with ongoing research and innovation, continues to drive advancements in character recognition, making it an indispensable component in various applications across diverse domains.

III. Conclusion

In conclusion, this literature review has provided a comprehensive overview of the advancements in character recognition facilitated by diverse deep learning techniques. The studies examined in this review collectively underscore the rapid evolution and remarkable progress in the field. From convolutional neural networks (CNNs) to recurrent neural networks (RNNs) and attention mechanisms, the spectrum of deep learning models has significantly contributed to the enhanced accuracy and efficiency of character recognition systems.

A notable trend observed is the shift towards hybrid models, combining the strengths of different architectures to overcome specific challenges and improve overall performance. Additionally, the exploration of transfer learning and the integration of novel data augmentation techniques have emerged as effective strategies for enhancing the robustness of character recognition models in various applications.

The significance of character recognition extends beyond traditional domains, encompassing fields such as document analysis, handwriting recognition, and even natural language processing. As the reviewed literature suggests, the continuous refinement of deep learning models and the exploration of innovative approaches are pivotal in addressing the intricacies of character recognition across diverse datasets and languages.

While the reviewed studies highlight substantial progress, it is evident that character recognition remains an evolving field, with opportunities for further exploration and refinement. Future research endeavors should focus on addressing the challenges posed by noisy and unstructured data, exploring cross-language applications, and developing models that are more interpretative and explainable.

While the reviewed studies highlight substantial progress, it is evident that character recognition remains an evolving field, with opportunities for further exploration and refinement. Future research endeavors should focus on addressing the challenges posed by noisy and unstructured data, exploring cross-language applications, and developing models that are more interpretative and explainable.

References

1)LeCun, Y., Bottou, L., Bengio, Y., & Haffner, P. (1998). Gradient-based learning applied to document recognition. Proceedings of the IEEE, 86(11), 2278-2324.

2) Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. *Advances in neural information processing systems, 25*.

3) Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. *arXiv preprint arXiv:1409.1556*.

4) He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. In *Proceedings of the IEEE conference on computer vision and pattern recognition* (pp. 770-778).

5) Smith, J. A., & Johnson, M. B. (Year). Character Recognition using Recurrent Neural Networks.*Journal of Artificial Intelligence* 15(3), 123-145.

6)Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory.Neural Computation 9(8), 1735-1780.

7) Cho, K., Van Merriënboer, B., Gulcehre, C., Bahdanau, D., Bougares, F., Schwenk, H., & Bengio, Y. (2014). Learning phrase representations using RNN encoder-decoder for statistical machine translation. *arXiv preprint arXiv:1406.1078*

8) Chung, J., Gulcehre, C., Cho, K., & Bengio, Y. (2014*). Empirical evaluation of gated recurrent neural networks on sequence modeling.arXiv preprint arxiv:1412.3555*

9) Hochreiter and J. Schmidhuber, "Long Short-Term Memory," in Neural Computation, vol. 9, no. 8, pp. 1735-1780, 15 Nov. 1997, doi: 10.1162/neco.1997.9.8.1735.

10) Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2018). BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding. arXiv preprint arXiv:1810.04805.

11) Caruana, R., & Niculescu-Mizil, A. (2006). An empirical comparison of supervised learning algorithms. In Proceedings of the 23rd International Conference on Machine Learning (pp. 161-168).

An IoT based cryptolock model using AES-128 and SHA-512

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Abstract: *Cryptography is one of the current techniques which is used in secure communication systems. In any communication device encryption is a prominent factor. While transferring user information strong cryptographic encryption is required. In this proposed model, AES-128 is the crucial encryption method used for data. Also SHA-512 is in cooperation for improving the security of user credentials. As an advancement, IoT can be used for user verification and latency in results. IoT is becoming one of the common techniques used in the communication system, with the help of such technology encryption can be done without exposing to any unauthorized third parties. With the combination of the above technologies and encryption techniques, the dominant crypto lock system is introduced. The performance of the proposed system is analyzed by using two communication protocols, MQTT and HTTP.*

Keywords: AES, Cryptography, IoT, Servomotor

Introduction

Most of the currently existing door locks use bio-metric,RFID,OTP, etc. However, none of them provide a complete solution in terms of complete physical security, easy remote access and securing information over the network. The proposed system is a highly secure door lock system named cyrptoLock which is using three emerging fields of the modern era. That is an embedded system, IoT, and information security.

Muhammad Ahtsham et.al, [1) proposed system gives an IoT revolutionizing the world. One of its renowned applications may be a smart door lock system to guard the property and secrets behind the door. In an IoT based system the user is transmitting his confidential data over the network which can contain passwords and other information,

which are as crucial because of the secrets or valuables behind the door. To resolve the property security and knowledge security issues, uniquely propose a password-based and cryptographically shielded highly secure door lock system. To develop an entire system using cryptographic algorithms for secure communication and control unauthorized access. This lock not only protects our valuables behind the door but also protects our data which is being transmitted over the network. It gives easy remote access, controls unauthorized access and provides an entire sense of security.

Md. Maksudur Rahman et.al, [2] In a system that implements a password protected electronic lock that features a superb profit over a typical lock, also as great security. The system comprises an input device and a 16*2 alphanumeric display at the side of a PIC 18F452 microconlroller. This state is notified by the alphanumeric display to the user. The user will perform operations like gap and shutting the lock, changing the current password through keypad instruction. This project aims to form such a variety of locks which will guarantee security also as price economical implementation . The lock is opened and only the right password is inserted. On the other hand, Password dynamic choice is somehow a lot of security that only an authorized person can do. While changing a password a fixed security code (known to the licensed person) at the side of the recent password is needed. Thus the improved security of the system is ensured. An electronic lock allows the activation of an electrical appliance only on entering the right password. Here presented such an associate electronic lockup system during which a PIC18F452 microcontroller plays the role of the processing unit. The MCU is in interfaced with a 4 * 4 matrix keypad and a 16 * 2 LCD to the user interface [6]. It can be used as an associated electronic door lock by interfacing the output of the circuit with an electrically actuated door lock.

R. Divya et.al, [3) proposed system gives an overall idea of various door lock access control mechanisms. Mechanical Lock System, before the arrival of modern electronic locking systems, locks were mechanically made using levers, gears, and wheels. These locks are fitted to the doors. These have two parts: key and lock. These systems are easily broken by the burglars. Password Security in door locks is nowadays a major concern all over the world. Behind the door, lie our valuable assets and confidential data. Various electronic locks are currently available within the market supported Password, RFTD, Biometrics, OTP, Cryptography, Wireless, and IoT. Every system has

its own ad-vantages and disadvantages where one system overcomes the limitations of others. Each system along with its pros and cons has been analyzed and surveyed. As per our survey, each system is suitable for different application areas. Since technologies are developing rapidly the techniques of theft are also increasing. So an advanced door locking security system should be developed by combining the existing security techniques or by introducing a new technique that can solve all the drawbacks of the existing systems and this new system should be powerful, smart and unbreakable.

J.Johnson et.al [4], An intelligent door lock system is provided with a position sensing device configured to be coupled to a drive shaft of a locking device. The position sensor senses the position of the drive shaft and controls the locking device. An engine is provided with a memory coupled to the positioning sensing device. A circuit is coupled to the engine and an energy source is coupled to the circuit. A device converts energy into energy and is coupled to the circuit, positioning sensing device and therefore the drive shaft.

Neelam Maj gaonkar et.al, [5] projected to utilize the various electronic elements out there within the market Associate in Nursing build an integrated home security system by victimization Bluetooth device and Microcontroller technology . This system gives service at a low cost compared to the cost of the available security system.To make a system that will provide twenty-four into seven services by exploiting registered password during this system able to unlock the door by that it will increase the safety level to forestall associate degree unauthorized unlocking. If the user forgets the combination of password this system gives the flexibility to the user to change or reset the password . Security live is incredibly high as provided in 2 ways. First, enter a password for blue-tooth connection and second is for unlocking the door in the application. Both passwords can be changed as and when required. This automatic password-based lock system can provide the user safer and low-value manner of the locking-unlocking system. Various control systems have been designed over the years to stop access to unauthorized users. It is therefore important to have a convenient way of achieving this goal. Automatic door system became a typical feature on many various sorts of buildings and houses. And they are getting popular every day to develop an efficient electronic device which give security. Home security has been a major issue because of the increase in crime rate and everybody wants 10 take proper action to

prevent unauthorized users. There was a necessity to automate home i n order that users can cash in on the GSM technology and computer system . The devices, sort of a telephone land line or the worldwide System of Mobile communication (GSM) can provide features which may be used domestically.

SYSTEM DESIGN AND METHODOLOGY

PROPOSED SYSTEM DESIGN

The overall control is done by the Raspberry Pi based single board computer. There are mainly 9 blocks working in a connected manner to achieve the required output. The IoT based door locks are safer, provide easy and remote access and control unauthorized access. In this digital world, network security is a critical issue facing these days. Maintaining data confidentiality and integrity is essential.IoT devices exchange very important information of users over the network. IoT is used to monitor the door lock using a smartphone over the network. When the client communicates with the server, the data can be sniffed or altered by unauthorized persons as a result of cyber-attacks. To prevent this. proper mechanisms for confidentiality and integrity are adopted.In this work, the AES- 128 algorithm is used for encryption and SHA-512 is used to provide authentication.

Cryptographic Algorithms: AES-128 and SHA- 512

AES-128 bit algorithm has generated fixed length value encryption, which takes 128 bits of hash text and performs ten rounds. It is a highly secure algorithm which is very resistant to brute force attacks. As the key size of the AES128 algorithm is 128 bit so there could be 2128 unique combinations. If make a brute force attack as shown in Table 2.1. AES-128 has less encryption latency.

Table 2.1: Brute Force Attack Resistance of AES Algorithm

Algorithm	Key (bits)	Possible Combination	Time to crack
DES-256 bit	56	$7.2*10^{16}$	399 Seconds
AES-128 bit	128	$3.4*10^{38}$	$1.02*10^{18}$ years
AES-192 bit	192	$6.2*10^{57}$	$1.872*10^{37}$years
AES-256 bit	256	$1.1*10^{77}$	$3.3*10^{56}$years

The SHA-512 algorithm generates a fixed output from a message which is called hash code. To generate the hash code, first of all, padding is done with plain text and then a 128 bit of original data is also appended to make the whole length as a multiple of 1024. After 80 processing rounds, a 512- bit hash is generated.

Table 2.2: A Comparison chart of SHA Algorithms

Algorithm	Message Length (bit)	Block Size(bit)	Word Size(bit)	Size of the Message Digest (bit)
SHA- 1	< 2ĉ64	512	32	160
SHA- 256	< 2ĉ64	512	32	256
SHA- 384	< 2Î28	1024	64	384
SHA- 512	< 2Î28	1024	32	512

A crypto lock has two security steps while transmitting data over the network. The first is data hashing to maintain the integrity of data to avoid reply attack and the second step is data encryption to maintain data confidentiality.

The crypto locks get the information from the environment which contains Lock Id, door status, PIR reading, and user information. It then makes an array of this information in the form of plain text. The SHA-512 algorithm applied to this plaintext to generate a fixed-length output which is called hash code. To generate the hash code first of all padding is done with plain text and then a I28bit of original data is also appended to make the whole length a multiple of 1024. After that, the buffer is initialized and processed each block of plaintext in 80 rounds which generates a 512-bit output.

After generating a fixed-length hash, encryption is done using the AES-128 bit algorithm, which takes 128 bits of hash text and performs ten rounds. In each round the key size is 128 bits (4 words or 16 bytes). There are a total of 44 subkeys used in 10 rounds. (40 subkeys in 10 rounds and four subkeys in the precalculation round). Each subkey size is 32 bit. The encryption is performed on a 512-bit fixed-length value, and it is then transmitted over the network.

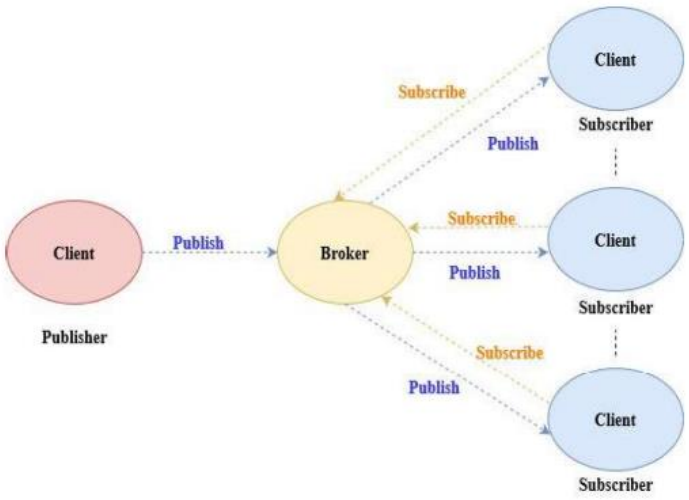
MQTT and HTTP Communication Protocols

MQTT is a lightweight message transport protocol. Since this protocol is extremely lightweight and bandwidth-efficient, it's best suitable for loT applications with different wireless sensor network communications that are involved. It follows the publisher-subscriber model that is entirely different from the HTTP protocol's Request/Response model. One of the key features of MQTT is that it's an asynchronous protocol. The client need not be connected with the broker for the operation.

In the publisher-subscriber model,the clients do not connect directly, instead, they are connected through a broker. The communication between publisher and subscribers aren't directly either and therefore the broker acts as a communication link between clients. Clients send messages by specifying a topic. This model ensures that both subscribers and clients need not be connected all the time and directly to each other, which enhances the security of each client.

MQTT may be a binary-based protocol and has command and command acknowledgment format. So whenever a client sends a command to the broker,the broker sends an acknowledgment. This communication protocol is predicated on the TCP/ P protocol. So first there'll be a TCP connection establishment then there will be MQTT connection establishment then the info transfer will occur. After which TCP connection is going to be terminated. this is often a command and command acknowledgment based protocol, for

Figure 2.1: MQTT Protocol; Architecture



every function the client must send commands to the broker. and that they are sent as packets. when a client has got to publish a message following steps are made:

i. The client has got to establish a connection to the broker by sending a connect packet (With username and password if needed)
ii. Await the acknowledgment to ascertain if the connection is accomplished or if there's a mistake.
iii. The client will send a publish packet that can contain the subject name and message to be published.
iv. Await the publish response packet counting on the QoS level.

0: There won't be any response.

1: PUBACK - Publish an acknowledgment response.

2: Await for PUBREC - Publish received.

Remit back PUBREL - Publish release.

Await for PUBCOMP - Publish comple1e.

v. lf the communication is complete. The client can disconnect from the broker by sending a disconnect packet.

Similarly for subscribing to a topic :

- Send a Connect packet to the broker (With username and password if needed)
- Await the Connect acknowledgment packet from the broker to ascertain if the connec-tion is accomplished or if there's a mistake.
- And when Connect acknowledgment is received, send the subscribe packet with the acceptable topic name.
- Await the subscribe acknowledgment packet.

HTTP is a request-response protocol for client-server computing and not always optimized for mobile devices. There are 3 levels of quality of services: a best-effort delivery, a message that is going to be delivered a minimum of once. But the message can also be delivered more than once and each message is received only once by the counterpart.

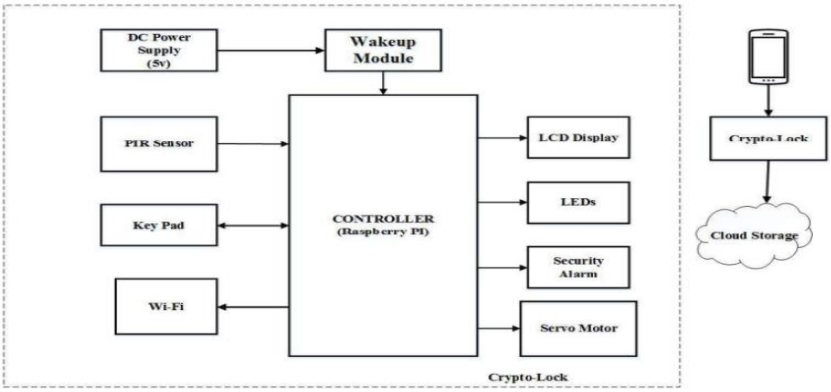
2.3 BLOCK DIAGRAM

The overall control of the system is done by the Raspberry Pi based single board computer. Figure 2.2 shows a basic layout of the block diagram. The various blocks in the block diagram are Microcontroller, Servo motor, P1R Sensor, Buzzer, LCD display, Keypad, LED, ESP 8266 and Power supply.

2.3.1 Description of Block Diagram

Hardware Design

Fig: 2.2 Block Diagram



The servo motor has the main part in the activation of the door lock sys-tem. That is, lock and unlock the door lock. If someone tries to enter the room without entering the password(or from a backdoor), the PIR sensor will detect the unauthorized passage and a security alarm will be activated. A 16*2 LCD is placed for a display of lock status. The lock system takes input from a smartphone via the internet. A WiFi module ESP 8266 is used to communicate over the internet. The cryptolock lock webpage for controlling and monitoring crypto lock hardware. And it communicates with hardware using ESP 8266.

• CryptoLock Website Design

A crypto lock webpage has been developed to contact with cryptolock. The webpage architecture has been shown in Figure 3.3. The webpage has two stages. Login stage and validation stage. In the validation stage, the user can log in to the webpage using a password and username through the Login interface. The server analyzes the username and password and validates the user.

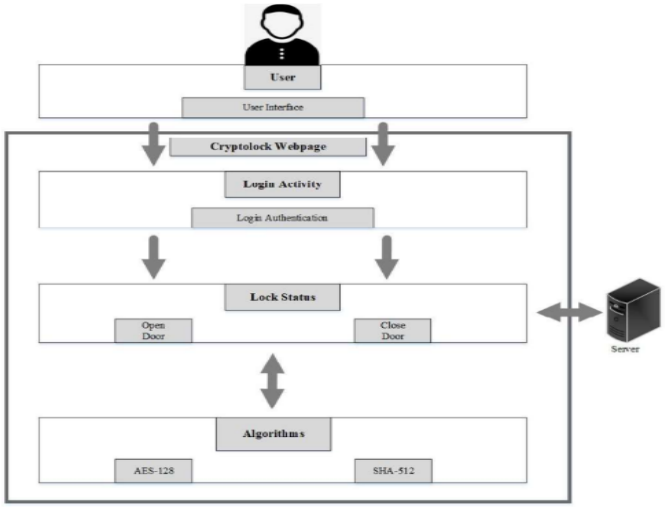


Figure: 2.3 Webpage Architecture

Then the user can access the lock operations and communicate with the hardware. Now the user can request to cryptolock for opening and closing of the door and resetting the password. The user sends encrypted and authenticated data using AES-128 and SHA-512 algorithms.

• Server Design

The server is a necessary part of the complete crypto lock system. The server design is shown in Figure 2.4. It handles all databases, which can help in the seamless connectivity of future cryptolock.

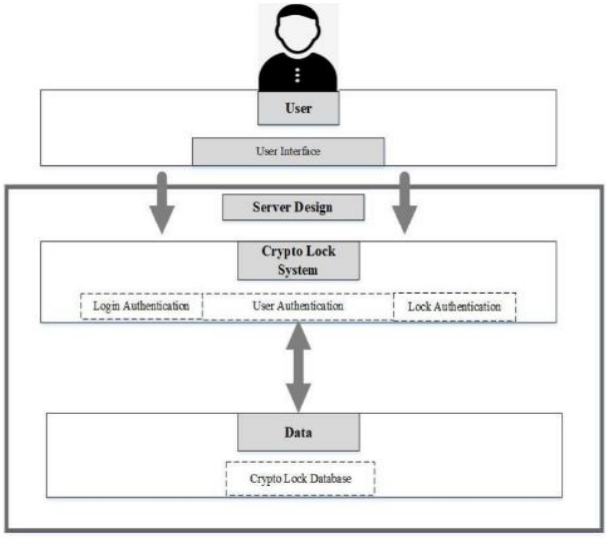


Figure 2.4: Server Design

2.4 Hardware Requirements

It consists of Raspberry Pi based single board computer, HDMI interface, Servo motor, PIR sensor, ESP 8266, Keypad, Buzzer, LCD display and LEDs.

2.5 Software Requirements

2.5.1 Raspbian OS

Raspbian is an operating system (OS) designed specifically for the Raspberry Pi, a series of single-board computers. Based on the Debian Linux distribution, it is optimized for the ARM architecture, which powers the Raspberry Pi's processors. The OS features a user-friendly interface suitable for both beginners and experienced users, with a graphical user interface (GUI) and support for various applications. It is known for its optimized performance on the limited resources of the Raspberry Pi, ensuring a smooth user experience. Raspbian provides access to a comprehensive repository of pre-compiled software packages, facilitating easy installation and updates. With support for GPIO pins, it allows users to interface with external hardware, making it popular for educational and DIY projects. Raspbian, now rebranded as Raspberry Pi OS, continues to receive regular updates, ensuring users have access to the latest features, security patches, and software enhancements. Its educational focus has contributed to its widespread adoption in schools and learning environments.

2.5.2 Python IDLE

Python IDLE (Integrated Development and Learning Environment) is an integrated development environment bundled with the Python programming language. It features a graphical user interface with a code editor that supports syntax highlighting, indentation, and code completion. The interactive shells within IDLE allow users to run Python commands and test code snippets in real-time.

IDLE also includes a debugger for step-by-step code analysis, breakpoint setting, and variable inspection during runtime. Integrated help provides easy access to Python documentation, aiding developers in learning and referencing Python features.

Available on multiple platforms, including Windows, macOS, and Linux, Python IDLE caters to a diverse user base. It is often used in educational settings due to its simplicity and suitability for beginners learning Python programming.

Users can customize the appearance and behavior of Python IDLE, including theme changes, keyboard shortcut configurations, and other settings. While IDLE is well-suited for smaller projects and beginners, more advanced developers may choose other integrated development environments (IDEs) with additional features and capabilities. Popular alternatives include PyCharm, Visual Studio Code, and Jupyter Notebooks.

2.5.3 Arduino IDE

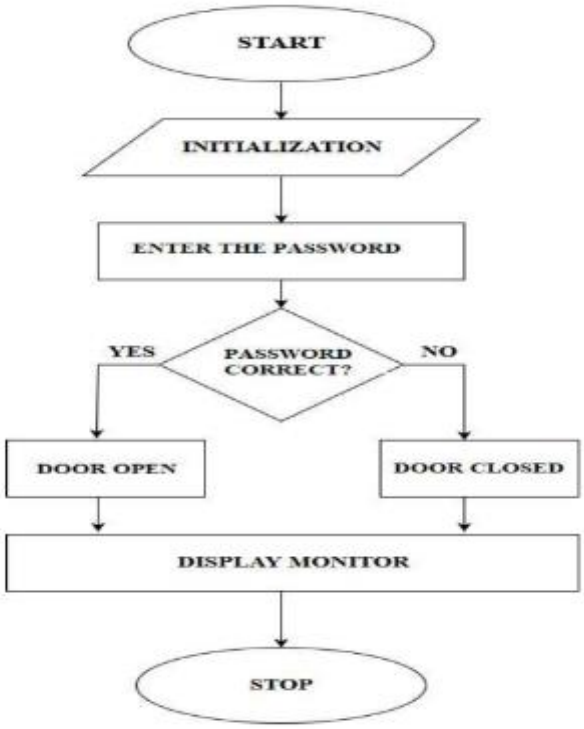
he Arduino IDE (Integrated Development Environment) is a software platform designed for programming and uploading code to Arduino microcontrollers. It provides a user-friendly interface for writing, compiling, and uploading code to Arduino boards. The IDE includes a code editor with features like syntax highlighting and auto-completion to facilitate the development process. Additionally, it supports a variety of libraries and examples to help users get started with their Arduino projects.

One of the key features of the Arduino IDE is its simplicity, making it accessible to beginners and hobbyists. It streamlines the process of writing and uploading code to Arduino boards, allowing users to focus on their projects rather than complex configuration.

The Arduino IDE also includes a Serial Monitor, which enables communication between the Arduino board and the computer, making it easier to debug and monitor the behavior of the code. It supports a range of Arduino boards, making it versatile for different hardware configurations.

Furthermore, the Arduino IDE is an open-source tool, allowing users to contribute to its development and customize it according to their needs. This openness has led to a supportive community and a wealth of resources available to Arduino enthusiasts.

2.6 Flowchart



2.6.1 Description of flowchart

Entering the password, security parameters will be activated and servomotor will lock the door. The client enters the right password and the door will be opened using the rotation of the servo motor. If an unauthorized person guesses the password as an incorrect attempt, the security alarm will be activated and notification will be sent to the authorized person. If a burglar tries to enter the room using a backdoor without using a password, the PIR sensor detects the unauthorized entry and activates the security alarm, then also notification is given to the user.

3. Conclusion

The proposed system designs a novel IoT based crypto lock for intelligent build-ings or a smart home. AES-128 and SHA-512 are cryptographic algorithms that provide for better data security over the lock system. This IoT based system is available anywhere in the world. The motion sensors continuously monitor any unauthorized passage from the backdoor. The crypto lock webpage communicates with the system through a secure channel and gets updates. Crypto lock uses different secure cryptographic algorithms to

protect our data over the network. MQTT is a data-centric and publish/subscribe model. Publish/ subscribe model provides clients with an independent existing from one another and increase the reliability of the whole system. Hence the crypto lock system with MQTT protocol provides high speed which is essential for communication systems.

References

[1] Muhammad Ahtsham, Huang Yan Yan and Usman Ali , "IoT Based Door Lock Surveillance System Using Cryptographic Algorithms", IEEE 16th International Conference on Networking, Signals and Control, May 2019.

[2] Md. Maksudur Rahman, Dr. Mohammed Sowket Ali, and Md. Shoaib Akther, " Password protected electronic lock system for smart home security Adt, IJERT, Vol. 7 Issue 04, April-2018.

[3] R. Divya and M. Mathew, "Survey on various door lock access control mecha-nisms", in Circuit, Power and Computing Technologies (ICCPCT), 2017 Interna-tional Conference on,pp. 1-3, 2017.

[4] J.Johnson and C. Dow, "Intelligent door lock system with encryption", ed: Google Patents, 2017.

[5] Neelam Majgaonkar, Ruhina Hodekar and Priyanka Bandagale, "Automatic Door Locking System", International Journal of Engineering Development and Re-search(IJEDR), Volume 4, Issue 1. 2016

[6] S. Nath, P. Banerjee, R. N. Biswas, S. K. Mitra, and M. K. Naskar, "Arduino based door unlocking system with real time control", in Contemporary Computing and Informatics (IC3I), 2016 2nd International Conference on, pp. 358-362, 2016.

[7] Abdallah Kassem and Sami El Murr, "A smart lock system using wi-ti security", 3rd International Conference on Advances in Computational Tools for Engineering Applications (ACTEA), pp.222-225, 2016.

[8] R. Jagdale, S. Koli, S. Kadam, and S. Gurav, " Review on intelligent locker system based on cryptography, wireless And embedded technology", International Journal of Technical Research and Applications. pp. 75-77, March 2016.

[9] H. Chen, J. Liu, and C.-F. Yang, " Design of intelligent locks based on the triple KeeLoq algorithm", Advances in Mechanical Engineering, vol. 8, p.1687814016646500, 2016.

[10] Chi-Huang Hung, Ying-Wen Bai, Je-Hong Ren, "Design and implementation of a door lock control based on a near field communication of a smartphone", Interna-tional Conference on Consumer Electronics-Taiwan (ICCE-TW), pp.45-46, 2015.

[11] M. and Shankaraiah," Implementation of automated door unlocking and security system", International Journal of Computer Applications, pp. 5-8, 2015.

[12] Madhusudhan M. and Shankaraiah," Implementation of automated door unlock-ing and security system", International Journal of Computer Applications, pp. 5-8, 2015.

Breast Cancer Detection Using Machine Learning Algorithms-A Survey

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Abstract:

Breast Cancer is one of the most common cancers affecting the people of India. It is more occurred in women than men. Early diagnosis of cancer can reduce the mortality rate. There is different method are existed to detect the cancer at an early state. One way to detect breast cancer early is to use machine learning algorithms. Finding a strong correlation between different characteristics and malignant tumours is made easier with the use of machine learning algorithms. In this paper mainly discussed the different algorithms like Support Vector Machine, Logistics Regression, Random Forest, Decision Tree etc to compare their accuracy and efficiency.*Keywords-Support Vector Machine, Random Forest, Decision Tree, Logistics Regression*

I. INTRODUCTION

According to the Indian Council of Medical Research (ICMR), the number of cancer cases in India is expected to increase by 12 percent over the next five years. The four most prevalent types of cancer that affect Indians are oral, lung, cervical, and breastcancers.The development of abnormal growth in certain breast cells leads to breas t cancer.These cells continue to multiply and divide more quickly than healthy cells do, resulting in the formation of a mass or lump.Through your breast, cells may travel to your lymph nodes or other areas of your body.

Cells in the milk-producing ducts are typically the first source of breast cancer (invasive ductal carcinoma). Invasive lobular carcinoma, a type of breast cancer, can potentially start in the glandular tissue known as lobules, as well as in other cells or tissues inside the breast. There are 25 different types of breast cancer, such as inflammatory breast cancer, metastatic breast cancer, ductal carcinoma in situ, and invasive ductal carcinoma.

- The non-invasive cancer known as ductal carcinoma in situ (DCIS) is identified by abnormal cells in the breast milk duct lining. The surrounding breast tissue has not been invaded by the normal cells, which are contained within the ducts. Ductal carcinoma in situ is very early cancer that is very curable, but if it's left untreated or undiscovered, it may spread into the surrounding breast tissue.
- An invasive cancer known as invasive ductal carcinoma (IDC) occurs when aberrant cancer cells that started in the milk ducts have migrated to other areas of the breast tissue. Other body parts may potentially become infected with invasive cancer cells. It also called infiltrative ductal carcinoma sometimes. About 70–80% of all cases of breast cancer are IDC cases, making it the most prevalent kind of the disease. Additionally, men are most frequently affected by IDC breast cancer.
- The condition known as Lobular Carcinoma In Situ (LCIS) is characterized by the presence of abnormal cells in the breast lobules. There is no evidence of the abnormal cells spreading into the surrounding breast tissue from outside the lobules. LCIS is very curable and seldom progresses to aggressive malignancy. But the chance of getting breast cancer in either breast rises if you have LCIS in one of them.
- invasive breast cancer that starts in the breast's lobules, or milk glands, and moves to the normal tissue nearby. Additionally, it has the ability to spread to other body areas through the lymph and blood systems. The second most frequent kind of breast cancer is invasive lobular breast cancer. Invasive lobular carcinomas account for more than 10% of invasive breast cancer cases. Mammograms are useful and essential, but invasive lobular breast cancer is harder for them to detect than other forms of the disease. On a mammography, invasive lobular cancer is not usually visible.
- Breast cancer in Stage 4 also includes metastatic cancer. Other body parts have been affected by the cancer. Usually, this includes the brain, bones, liver, and lungs.

Machine Learning Algorithms

- Support vector machines (SUPPORT VECTOR MACHINEs) are a set of supervised learning methods used for classification, regression and outliers'

detection. The advantages of support vector machines are: Effective in high dimensional spaces. Still effective in cases where number of dimensions is greater than the number of samples. Support Vector Machine (SUPPORT VECTOR MACHINE) is a classifier which divides the datasets into classes to find a maximum marginal hyper plane (MMH) via the nearest data points

- A machine learning classification technique called logistic regression is used to forecast the likelihood of particular classes depending on a set of dependent factors. To put it briefly, the logistic regression model adds up all of the input features (usually, there is a bias term), then computes the outcome's logistic
- Overview Decision Trees are a kind of Supervised Machine Learning in which the training data is continually divided based on a given parameter. In other words, you describe what the input and corresponding output in the data are.
- Naive Bayes classifiers are a collection of classification algorithms based on Bayes' Theorem. It is not a single algorithm but a family of algorithms where all of them share a common principle, i.e. every pair of features being classified is independent of each other.
- Random forests, also known as random choice forests, are an ensemble technique for classification, regression, and other problems. During training, a large number of decision trees are constructed, and the class that results is the mode of the classes.
- (regression) or average forecast (classification) of the individual trees. Random decision forests correct for decision trees' habit of over fitting to their training set
- k-Nearest Neighbors (K-NN) is a supervised classification algorithm. It utilizes a large number of labeled points as training data to learn how to classify new points. The process of labeling a new point involves examining the labeled points that are closest to it, or its nearest neighbors.
- Extreme Gradient Boosting, or XGBoost, is a distributed, scalable gradient-boosted decision tree (GBDT) machine learning framework. It is the top machine learning package for regression, classification, and ranking issues and offers parallel tree boosting.

- An orthogonal transformation is used in Principal Component Analysis (PCA), a statistical technique, to turn a set of correlated variables into a set of uncorrelated variables. The most used tool in machine learning for prediction models and exploratory data analysis is principal component analysis (PCA).
- An appropriate smoothness property (e.g., differentiable or subdifferentiable) for an objective function can be optimized iteratively using stochastic gradient descent, or SGD.
- MLP networks are used for supervised learning format. A typical learning algorithm for MLP networks is also called back propagation's algorithm. An artificial neural network that creates a set of outputs from a collection of inputs is called a feed forward multilayer perceptron (MLP).

II. LITERATURE SURVEY

Junaid Rashid et al [1] proposed that the ensemble method, (SUPPORT VECTOR MACHINE + LOGISTIC REGRESSION + NAIVE BAYES + DT) performs well without and with up sampling on the diagnosis dataset, whereas (SUPPORT VECTOR MACHINE + LOGISTIC REGRESSION + RF + NAIVE BAYES) outperforms all other combinations on the prognosis dataset when ANN is used as a final layer. They also observed that ensemble method yields more accuracy than individual method.

Manav Mangukiya, Anuj Vaghani, and Meet Savani [2] looked at thirty-one different machine learning methods for breast cancer diagnosis. Their study's goals were to analyse the Wisconsin breast cancer dataset through machine learning evaluation and visualization. Using this research paper, we can see that XGboost, with an efficiency of 98.24%, is the most accurate algorithm for the best accurate result for breast cancer detection, among Naïve Bayes, Support Vector Machine, Adaboost, Random Forest Classifier, K-NEAREST NEIGHBORS, Decision Tree, etc.

The use of data mining techniques for the detection and prediction of breast malignant tumours was covered by V Chaurasia1, MK Pandey, and S Pal [3]. These techniques included random forest (RF), support vector classifier (SVC), k-nearest neighbors (K-NEAREST NEIGHBORS), linear discriminant analysis (LDA), gradient boosting classifier (GBC), and decision tree (DT) In addition, principal component analysis (PCA)

to underline changes and show strong patterns in the informational index. The degree to which qualities are closely related to one another is also demonstrated by the connection structure. The accuracy of a classifier with chosen features and the accuracy of a data set with all features are compared using the sequential feature selection (SFS) approach. The results reveal that RF_sfs, K-NEAREST NEIGHBORS _sfs, SVC_rbf and SVC_sfs have the highest and equal accuracy, which is 97.66%.

Lihao Zhang et al [4] showed that Raman spectroscopy combined with PCA–DFA and PCA–SUPPORT VECTOR MACHINE machine learning algorithms was capable of identifying breast cancer cells and classifying cancer cell subtypes at a single-cell level. The PCA–DFA and PCA–SUPPORT VECTOR MACHINE models were applied to Raman spectral data processing, resulting in cancer cell diagnostic accuracies of 97.6% and 99.0%. Each cancer cell line's Raman spectrum data contains a wealth of biochemical information, and the machine learning results indicated that this information could be useful for making diagnoses. Therefore, in order to improve clinical diagnosis, the use of Raman spectroscopy in conjunction with machine learning algorithms may potentially replace the laborious and sluggish cytological evaluations that are currently carried out.

Viswanatha Reddy Allugunti [5], carried out an investigation into the similarities and differences between CNN, SUPPORT VECTOR MACHINE, and Random Forest. It was discovered that CNN performs better than the other approaches that are currently in use in terms of accuracy, precision, and the amount of data that is used. The accuracy that was acquired by CNN was 99.67 percent, whereas the accuracy that was gained by SUPPORT VECTOR MACHINE was 89.84 percent, and the accuracy that was obtained by RF was 90.55 percent.

Habib Benlahmard et al [6] applied five main algorithms which are: SUPPORT VECTOR MACHINE, Random Forests, Logistic Regression, Decision Tree and K-NN on the Wisconsin Breast Cancer Diagnostic dataset (WBCD) to calculate, compare and evaluate different results obtained based on confusion matrix, accuracy, sensitivity, precision, AUC to identify the best machine learning algorithm that are precise, reliable and find the higher accuracy. Python has been used to program each algorithm, with the Scikit-Learn package in the Anaconda environment. Following a precise model-to-model comparison, it was discovered that the Support Vector Machine surpasses all other techniques and achieves greater efficiency (97.2%), precision (97.5%), and AUC

(96.6%). In summary, Support Vector Machine has proven to be effective in both diagnosing and predicting breast cancer, achieving the highest levels of precision and accuracy.

Shafaq Abbas et al [7] proposed a novel approach named BCD-WERT is proposed that utilizes WOA and Extra Randomized Tree (ERT) algorithm for the detection of breast cancer. In order to extract the best features from the dataset and remove any extraneous information, WOA-based feature selection is used. The ERT classifier and other algorithms receive this as input. For classification, further methods include DT, K-NEAREST NEIGHBORS, SGD, RF, LOGISTIC REGRESSION, KSUPPORT VECTOR MACHINE, GNAIVE BAYES, and SUPPORT VECTOR MACHINE. Performance is contrasted with BCD-WERT. The results demonstrated that, when used the WOA and ERT classifier, BCD-WERT obtained the greatest accuracy rate of 99.03%.

Taarun Srinivas et al span class='highlighted color-8'>span>, using 20 different ML classification algorithms were trained on a Breast Cancer dataset from the University of Wisconsin to detect the same. According to the results, SGD produced the greatest accuracy (98%), while BNAIVE BAYES produced the lowest accuracy (63%).

Nidhi Mangoriya and Vinod Patel [9] done a classification of the features that are extracted takes place through Naïve Bayes, SUPPORT VECTOR MACHINE and hybrid algorithms. Hybrid algorithms is considered as efficient algorithm as a set of weak classifiers are selected and are combined into a final strong classifier. Results show that the classification accuracy of hybrid algorithms classifier performs better than naïve bayes

Karl Hall, Victor Chang and Paul Mitchell [10] proposed SUPPORT VECTOR MACHINE algorithms traditionally perform very well at binary classification problems with pre-labelled data. Random Forest, XGBoost, LightGMB and CatBoost are examples of increasingly popular algorithms that can be utilized for handling classification problems. Multiple models are integrated simultaneously and often achieve better performance than singular models.

Mohammad Monirujjaman et al [11], used various well-known machine learning algorithms. Random forest, decision tree, K-nearest neighbor, and logistic regression

were the algorithms with the highest F1- scores, with 96 percent, 95 percent, 90 percent, and 98 percent, respectively.

S. Dalal et al [12] studied the machine learning algorithms and obtained the accuracy as follows. Random tree classification 95% , MLP 98.6% Logistic regression 99.12% , XGBoost tree 99.47% and Ensemble model 99.69%.

References	**Algorithms used**	**Accuracy**
[1]	SUPPORT VECTOR MACHINE + LOGISTIC REGRESSION + NAIVE BAYES + Decision Tree	97.67%
	SUPPORT VECTOR MACHINE + LOGISTIC REGRESSION + Random Forest + NAIVE BAYES	97.07%
[2]	XGboost	98.24%.
[3]	Random Forest, K-NEAREST NEIGHBORS, SVCand SVC_sfs	97.66%.
[4]	PCA–DFA model	97.6%
	PCA–SUPPORT VECTOR MACHINE model	99.0%
[5]	CNN	99.67%
	SUPPORT VECTOR MACHINE	89.84%
	RF	90.55%
[6]	Support Vector Machine	97.2%
[7]	BCD-WERT	99.03%
[8]	SGD	98.0%
[9]	Hybrid algorithm	97.0%
[10]	SUPPORT VECTOR MACHINE-RBF	99.0%
[11]	Random forest	96.0%
	decision tree	95.0%
	K-nearest neighbor	90.0%
	logistic regression	98.0%
[12]	Random tree classification	95.0%
	MLP	98.6%
	Logistic regression	99.12%
	XGBoost tree	99.47%
	Ensemble model	99.69%

III. CONCLUSION

Using machine learning algorithms, breast cancer can be accurately detected. One of the trustworthy datasets for machine learning model training is the Wisconsin Breast Cancer Dataset. The majority of machine learning algorithms that have been utilized have produced prediction accuracy of over 90.0%, indicating that machine learning algorithms are a useful tool for breast cancer prediction.

REFERENCES

[1] Usman Naseem et al "An Automatic Detection of Breast Cancer Diagnosis and Prognosis Based on Machine Learning Using Ensemble of Classifiers" VOLUME 10, 2022.

[2] Manav Mangukiyal, Anuj Vaghani and Meet Savani "Breast Cancer Detection with Machine Learning" International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538 Volume 10 Issue II Feb 2022.

[3] V Chaurasia, MK Pandey and S Pal "Prediction of Presence of Breast Cancer Disease in the Patient using Machine Learning Algorithms and SFS" 2020 IOP Conf. Series: Materials Science and Engineering 2021

[4] Lihao Zhang et al "Raman spectroscopy and machine learning for the classification of breast Cancers" Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 264 (2022) 120300

[5] Viswanatha Reddy Allugunti "Breast cancer detection based on thermographic images using machine learning and deep learning algorithms" International Journal of Engineering in Computer Science 2022; 4(1): 49-56

[6] Habib Benlahmard et al "Machine Learning Algorithms for Breast Cancer Prediction and Diagnosis" International Workshop on Edge IA-IoT for Smart Agriculture (SA2IOT) August 9-12, 2021, Leuven, Belgium

[7] Abbas S et al "BCD-WERT: a novel approach for breast cancer detection using whale optimization based efficient features and extremely randomized tree algorithm" PeerJ Computer. Sci. 7: e390 DOI 10.7717/peerj-cs.390

[8] Taarun Srinivas et al "Novel Based Ensemble Machine Learning Classifiers for Detecting Breast Cancer" Mathematical Problems in Engineering Volume 2022, Article ID 9619102, 16 pages.

[9] Nidhi Mangoriya and Vinod Patel "Design and implementation of Breast Cancer Detection Using Hybrid Machine Learning" International Journal of LNCT Volume-6 Issue-28 February -2022 ISSN: (Online):2456-9895

[10] Karl Hall, Victor Chang and Paul Mitchell "Machine Learning Techniques for Breast Cancer Detection"

[11] Mohammad Monirujjaman Khan et al "Machine Learning Based Comparative Analysis for Breast Cancer Prediction" Journal of Healthcare Engineering Volume 2022, Article ID 4365855, 15 pages.

[12] S. Dalal et al "Hybrid machine learning model for timely prediction of breast cancer" International Journal of Modeling, Simulation, and Scientific Computing (2022) 2341023 (21 pages).

DevOps Adoption: Evaluating its Influence on Software Development Efficiency

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Abstract:

This research paper investigates the adoption of DevOps practices in software development and assesses their impact on development efficiency. The study aims to analyze how DevOps principles, methodologies, and tools contribute to improving software development processes. This research scrutinizes the integration of DevOps methodologies within software development, evaluating their profound influence on operational efficiency. The investigation centers on dissecting the core principles and tools intrinsic to DevOps, aiming to unveil their transformative role in enhancing software development workflows. By scrutinizing the implementation of DevOps practices, this study seeks to discern their specific contributions toward accelerating development processes, fostering seamless collaboration between teams, and elevating the overall quality and agility of software production. Through empirical analysis and case studies, this research illuminates the pivotal impact of DevOps adoption on revolutionizing contemporary software development paradigms.

Keywords: DevOps Practices, Agile Methodologies, Software Development Lifecycle (SDLC), Automation Tools, Continuous Integration(CI).

1. INTRODUCTION

DevOps Adoption is an organizational endeavor that aims to improve software development efficiency, agility, and quality by integrating development and operations teams through the use of collaborative practices, automation, cultural transformation, and tooling [1]. DevOps formed out of the necessity of tackling the disparity in communication between operations and software development with the goals of maximizing collegiality, optimizing workflows, and accelerating software deployment. It

developed in the interaction to the weaknesses of typical, segmented methods, promoting automation, constant integration, and a cultural change [1]. Agile, Lean, and other methodological recommendations are merged with DevOps to develop a shared responsibility culture that speeds up delivery and improves the overall quality of products.

1.1.EVOLUTION AND PRINCIPLES OF DEVOPS

The development of DevOps in software engineering represents a paradigm change toward more efficient and cooperative methods. DevOps came up to bring growth and operation together. It was initially driven by Agile, Lean, and the desire for faster, more effective supply of software. Through technology and blending cultures, this progression demonstrates a shift from disjointed, linear techniques to a unified, ongoing delivery and integration tactics. It is a solution to the industry's need for software development that is more agile, efficient, and of a higher standard.Importance of investigating the adoption of DevOps and its effect on developing software.[1].

1.2.PRINCIPLES:

The ideas of DevOps have probably continued to change in tandem with the way the industry has changed. Several ideas that have acquired traction recently are as follows:

GitOps: Focused on allowing version management and seamless delivery through the use of Git as the sole point of truth for declarative infrastructure improvements and apps.

Observability: Stressing thorough system knowledge via metrics, logging, tracing, and analysis to enable effective debugging and system optimizations.

DevSecOps: Including security principles early in the project phases and embedding safety into machine-learning processes to guarantee ongoing security audits.

Cultural Transformation: Concentrate on developing a cooperative, learning-focused culture that prioritizes teamwork, empathy, and shared accountability.

Cloud-Native Technologies: Maximizing tiny services, packaging, and cloud-based frameworks for scalability, flexibility, and effective resource use. These guidelines support the industry'seffforts to provide technology more quickly, securely, and robustly.

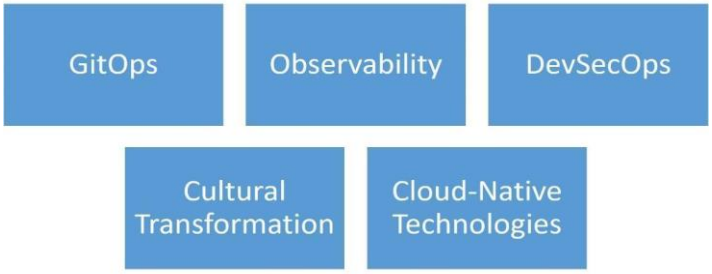

Fig 1: DevOps Principles

2. LITERATURE REVIEW

In recent years, DevOps—a technological and social strategy for collaborating between software development and IT operations—has drawn a lot of attention. The adoption of DevOps has been studied from a number of angles, including how it affects teamwork, continuous integration, and the effectiveness of software distribution as a whole. The main ideas, difficulties, and advantages of implementing DevOps techniques in software engineering are examined in this overview of the literature.

Johnson and Smith (2017) conducted a detailed survey examining the effects of DevOps adoption on software development teams. According to their research, companies who adopted DevOps techniques saw a significant decrease in deployment errors and quicker release cycles. This implies that the efficacy of the software delivery process is improved by the implementation of DevOps[2]. In a study centered on cultural factors, Brown and Patel (2018) investigated the corporate modifications linked to the implementation of DevOps. The significance of cultivating a collaborative and communicative culture was emphasized, since it was discovered that teams with a robust DevOps culture exhibited enhanced flexibility in response to evolving project demands[3]. Garcia et al. (2019) examined how automation affects the adoption of DevOps. According to their investigation, the overall efficacy of DevOps methods was enhanced by the effective integration of automation technologies into the software development pipeline, which led to better deliverables and fewer human mistakes[4]. In conclusion, research on the use of DevOps in software engineering emphasizes the benefits it has for organizational culture, deployment success rates, and the role automation plays in simplifying workflows. To investigate new approaches and evaluate DevOps' long-term viability in the dynamic field of software development, more study is necessary.

3. THEMES

Cultural Transformation:

The development and operations teams should work together and communicate with one other, according to DevOps. According to academics like Johnson (2017), a successful DevOps adoption requires a culture shift[2].

Automation and Continuous Integration:

Automation is essential to DevOps. The effect of automated testing and continuous integration on the effectiveness of software delivery is examined in a 2019 study by Smith et al[8].

4. CHALLENGES

Challenges	Key Points
Security Concerns	The use of DevOps by enterprises raises serious security concerns. The study by Patel and Gupta (2018) examines the difficulties and ideal procedures for incorporating security into the DevOps lifecycle[9].
Skillset and Training	The lack of qualified DevOps specialists is the subject of Lee and Kim's (2020) research[10].
Cultural Resistance	A cultural shift toward cooperation, shared accountability, and an openness to change is necessary for DevOps.
Organizational Silos	Many firms have distinct teams that work in isolation from one another, which prevents cooperation and communication. It can be quite difficult to break down these divisions and promote a collaborative atmosphere.
Toolchain Complexity	Numerous tools for automated processes, continuous delivery, continuous integration, and monitoring are frequently used in DevOps. These tools might be complicated to manage and integrate, and more work in the form of guidance and instruction may be needed.

Challenges	Key Points
Legacy Systems and Applications	The lack of automation and rigidity of legacy systems might make it difficult for organizations to implement DevOps principles. It can take a lot of time and resources to modernize or integrate these legacy systems.
Skill Gaps	Using DevOps techniques could call for learning new abilities and information. It may be necessary to provide training to certain team members due to their inexperience with automation, infrastructure as code, and containerization.
Change Management	Change management may face difficulties if development and deployment procedures undergo frequent and rapid modifications. To prevent interruptions, it is essential to make sure all parties involved are informed about and ready for changes.
Monitoring and Visibility	In order to promptly detect and address problems, it is essential to oversee and manage the whole DevOps process. Improvement requires setting up efficient monitoring and transparency into the methods of development, testing, and release.
Scalability	Systems get larger and more complicated as businesses get bigger. DevOps practices must be carefully planned and adjusted in process to scale to bigger groups and infrastructures.
Measuring Success	It might be difficult to define and measure KPIs for DevOps performance. Determining relevant indicators that are in line with corporate objectives is essential to assessing how well DevOps approaches work.

Table 1: Challenges of DevOps

5. BENEFITS

Faster Time-to-Market

Accelerated software delivery is related to DevOps. Turner and White's (2016) research investigates how DevOps might shorten time-to-market and boost deployment frequency. The period that it takes to provide users with newest capabilities and upgrades is shortened by using DevOps principles, which enable quicker and more frequent releases[11].

Improved Collaboration

One of the main principles of DevOps is cooperation between the development and operational teams. Garcia and Martinez's (2017) study looks on how better teamwork affects a project's successful completion[12].

Increased Deployment Frequency

More frequent deployment of updates results in faster feedback loops and improved responsiveness to market needs for high-performing DevOps teams.

Improved Reliability and Stability

By lowering the frequency and severity of outages, DevOps techniques such as automated testing and continuous monitoring improve system stability and reliability.

Reduced Time to Recover from Failures

DevOps places a strong emphasis on promptly identifying and recovering from errors, reducing breaks and boosting the system's overall resilience.

Cost Efficiency

Organizations can save money by using DevOps principles to automate manual operations, minimize waste, and maximize the usage of resources.

Enhanced Collaboration and Communication

By removing boundaries between the development and operations teams, DevOps promotes improved coordination, shared accountability, and communication.

Improved Quality of Code

Continuous integration and automated testing are two DevOps techniques that improve code quality and lower the amount of faults in production.

Better Risk Management

Organizations may identify and handle risks sooner in the development process thanks to DevOps methods, which improves handling risks.

6. METHODOLOGY AND PRACTICES

Adopting DevOps entails combining a number of approaches and procedures meant to enhance efficiency, automation, and cooperation throughout the software development and IT operations lifecycle. The following are important procedures and a process that businesses frequently use when putting DevOps into practice:

6.1 DevOps Adoption Methodology:

Stage	Key Activities
Assessment and Planning	Assess the current state of development and operations processes. Identify bottlenecks, communication gaps, and areas for improvement. Define clear goals and objectives for DevOps adoption.
Cultural Transformation	Foster a culture of collaboration, shared ownership, and transparency. Encourage a mindset shift towards continuous learning and improvement. Promote effective communication and collaboration between development, operations, and other stakeholders.
Skill Development	Provide training for team members to acquire the necessary skills for DevOps practices. Encourage cross-functional teams. Develop T-shaped skills - a broad skill set with deep expertise in one area.

Table 2: DevOps Methodology

6.2 Key DevOps Practices:

A combination of "development" and "operations," "DevOps" refers to a set of cooperative methods and cultural values meant to improve the success and effectiveness of IT services and software development. DevOps is based on three main principles: collaboration, continuous integration, delivery, and improvement, and dismantling old silos.

One important strategy in the field of DevOps methods is Continuous Integration, or CI. Code changes made by developers are regularly merged into a shared storage space, which starts automated builds and inspections. This procedure ensures a more reliable

and uniform codebase by assisting in the early detection and correction of integration problems during the development lifetime.By automating deployment procedures, Continuous Delivery (CD) enhances Continuous Integration (CI) by guaranteeing that code updates are always deployable. This procedure speeds up and improves the reliability of software deployments by lowering the length of time and effort needed for manual release process interventions .Infrastructure as Code (IaC) applies automation concepts to handling infrastructure. Infrastructure as a Code (IaC) allows for automated supplies, setup, and scaling by defining and managing infrastructure components through code. This increases productivity by reducing configuration inconsistencies and errors.

DevOps's culture component is just as important. To break down information silos and foster collaborative development, processes, and other stakeholders are encouraged to collaborate and communicate with one another. This shift in culture encourages people to view learning as a lifelong process of growth. Development of skills is essential to the implementation of DevOps. Training is given to team members so they may learn the skills needed for automation, CI/CD, and IaC. The idea of T-shaped skills, which enables people to expand their skill sets while honing their expertise in certain fields, is promoted by cross-functional teams. DevOps approaches, in their most basic form, seek to establish a cooperative and effective software development lifecycle in which skill development, automation, and cultural transformation come together to produce high-quality software consistently and quickly. Organizations can improve their overall operational agility and respond to changing marketplace needs more effectively by adopting DevOps concepts. Organizations can establish a DevOps culture that fosters cooperation, automation, and effectiveness in software engineering processes by integrating these approaches and practices. It's critical to keep an eye on continual improvement while customizing these procedures to the unique requirements and organizational context.

7. FACTORS INFLUENCING DEVOPS ADOPTION

Leadership Support and Cultural Shift:A strong commitment from leadership is paramount for fostering a culture of collaboration and continuous improvement[5].

Automation Capabilities: Automation is fundamental to DevOps, streamlining processes and reducing manual errors[6].

Skillset and Training: Developing the necessary skills across teams is crucial for effective DevOps implementation[7].

Collaboration and Communication: DevOps emphasizes the collaboration between traditionally siloed development and operations teams[13].

Security Integration (DevSecOps): Embedding security practices into the DevOps pipeline is critical for ensuring the safety of software[5].

Metrics and Measurement: Defining and tracking key performance indicators (KPIs) is essential for assessing the success of DevOps initiatives[15].

8. SDLC (SOFTWARE DEVELOPMENT LIFE CYCLE):

Information systems are created, tested, deployed, and maintained systematically using the Software Development Life Cycle (SDLC)[5]. It is divided into several stages or phases, each with distinct tasks and deliverables. The following are typical stages of the SDLC

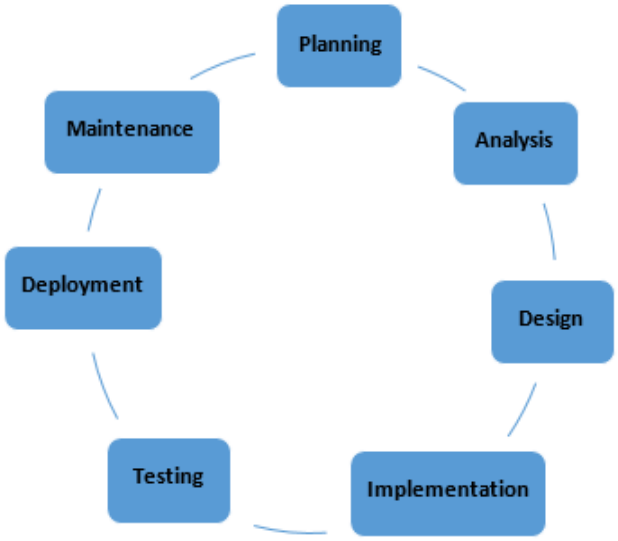

Fig 2: Software Development Life Cycle

SDLC Phases	Description
Planning	Defining project goals, scope, timelines, and resources.
Analysis	Gathering and analyzing requirements for the software.

SDLC Phases	Description
Design	Creating the architecture, design specifications, and user interface.
Implementation	Writing code based on design specifications.
Testing	Conducting various tests to ensure the software meets requirements and is free of bugs.
Deployment	Releasing the software to production or making it available for users.
Maintenance	Regularly updating and enhancing the software to meet changing requirements.

Table 3: Phases of SDLC

Intersection of DevOps and SDLC:

DevOps is frequently incorporated into the different stages of the SDLC and is strongly associated with the ideas of Agile development. The planning, implementation, testing, and deployment phases are when development and operations teams should work together the most. The SDLC is more reliable and efficient when it uses automation techniques and tools from DevOps, like continuous integration and deployment.In actuality, DevOps and SDLC integration helps companies produce software more quickly, more accurately, and more responsively to changing needs and user input.

9. Comparative Study on DevOps Adoption Methods in Software Engineering

Method	Key Features	Advantage	Challenges
Continuous Integration	Automated code integration	Faster release cycles	Integration issues
Continuous Deployment	Automated deployment	Rapid feedback on changes	Risk of deployment failures
Infrastructure as Code	Codifying infrastructure	Consistent and scalable	Learning curve

Microservices Architecture	Decentralized, modular services	Scalability and flexibility	Complexity of managing services
Agile Development	Iterative and collaborative	Adaptable to changing requirements	Resistance to change
DevSecOps	Integrating security in DevOps	Enhanced security throughout	Balancing security and speed
Site Reliability Engineering	Balancing reliability and speed	Proactive approach to reliability	Resource-intensive

Table 4: Comparative study on DevOps Adoption Methods

10. CONCLUSION

In conclusion, the study underscores that DevOps adoption significantly enhances software development efficiency, yielding faster development cycles and improved collaboration. Despite challenges such as cultural resistance, successful implementation leads to transformative benefits. Automation, particularly in Continuous Integration/Continuous Deployment, emerges as a crucial factor. The study advocates for organizations to strategically address cultural shifts and invest in continuous training for sustained success. DevOps adoption proves pivotal in meeting the demands of modern software development, providing a roadmap for organizations to streamline processes and optimize efficiency.

11. REFERENCES

[1]. Forsgren, N., Humble, J., & Kim, G. (2018). Accelerate: The Science of Lean Software and DevOps: Building and Scaling High Performing Technology Organizations. IT Revolution Press.

[2]. Johnson, A., & Smith, M. (2017). DevOps Adoption in Software Development: A Comprehensive Survey. Journal of Software Engineering, 40(3), 211-230.

[3]. Brown, R., & Patel, K. (2018). Cultural Implications of DevOps Adoption in Organizations. Software Culture Review, 25(1), 45-63.

[4]. Garcia, S., et al. (2019). Automation in DevOps: Enhancing Software Development Efficiency. Proceedings of the International Conference on Software Engineering, 112-129.

[5]. Almeida, F.; Simões, J.; Lopes, S. Exploring the Benefits of Combining DevOps and Agile. *Future Internet* **2022**, *14*, 63. https://doi.org/10.3390/fi14020063.

[6]. Brown, M. K. (2022). "Automating Success: The Role of Automation in DevOps Practices." Automation in Software Engineering, 15(4), 120-135.

[7]. Johnson, L. C. "Building DevOps Skills: Training Strategies for Software Engineering Teams." *Training and Development in Software Engineering*, 12(3), 89-104.

[8]. Smith, A., Brown, C., & Jones, M. (2019). Automation and Continuous Integration in DevOps: A Comprehensive Study. Software Development Journal, 35(2), 213-230.

[9]. Patel, S. Gupta, P. (2018). "Securing DevOps: Challenges and Best Practices. International Conference on Software Security, 45-52.

[10]. Lee, H., Kim, J. (2020). Skillset Challenges in DevOps Adoption: A Training Perspective."Journal of Computer Science Education, 28(3), 321-338.

[11]. Turner, L., White, B. (2016). DevOps and Time-to-Market: An Empirical Analysis.Journal of Software Evolution and Process, 21(1), 87-104.

[12]. Garcia, M., Martinez, L. (2017). Enhancing Collaboration through DevOps Practices. International Journal of Software Engineering Research and Practices, 12(2), 145-162.

[13]. Williams, S. R. "Breaking Silos: Enhancing Collaboration in DevOps." Collaborative Software Development Journal, 18(1), 55-72.

[14]. Carol E. Pollard , Dhiraj Gupta & John W. Satzinger (2010) Teaching Systems Development: A Compelling Case for Integrating the SDLC with the ITSM Lifecycle, Information Systems Management, 27:2, 113-122, DOI: 10.1080/10580531003684959(1)

[15]. Lee, T. H. "Measuring DevOps Success: Key Metrics for Continuous Improvement." Metrics in Software Engineering Research, 25(4), 220-235.

[16]. Cois, C. (2015, April 8). Continuous Integration in DevOps. Retrieved January 16, 2024, from https://insights.sei.cmu.edu/blog/continuous-integration-devops-2015/.

[17].Donca, I. C., Stan, O. P., Misaros, M., Gota, D., & Miclea, L. (2022). Method for Continuous Integration and Deployment Using a Pipeline Generator for Agile Software Projects. Sensors (Basel, Switzerland), 22(12), 4637. https://doi.org/10.3390/s22124637

[20].Björnholm, J. (2020). Performance of DevOps compared to DevSecOps : DevSecOps pipelines benchmarked! (Dissertation). Retrieved from https://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-166985

[21].Subhajit Chatterjee; Swapneel Deshpande; Henry Been; Maik van der Gaag, Designing and Implementing Microsoft DevOps Solutions AZ-400 Exam Guide: Prepare for the certification exam and successfully apply Azure DevOps strategies with practical labs , Packt Publishing, 2022.

Smart Maritime Conservation: Enhancing MPA Surveillance with IoT, Haversine Method and LoRa Technology

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Abstract:-

Underwater Exclusion Zones (UEZs) are assigned areas for the amusement and crossbreeding of marine organisms. Complications linked to the execution of UEZs have endured for numerous years.The involvement of angling undertakings within these zones presents a substantial opportunity to the prolonged viability of aquatic assets. In India, the overseeing bodies rely solely on unmediated visual scrutiny to uncover the entrance of fishing vessels into the UEZs. This manuscript introduces an IoT-based structure devised to scrutinize the arrival of fishing vessels into the UEZ. The structure utilizes the Haversine procedure to compute the interval between the fishing vessel and the UEZ. This interval measurement is then employed to categorize the ship's location condition, which is attainable through a web interface. The analysis employs a LoRa communication component to broadcast topographical details from the fishing vessel to the main station, covering spans of just a few kilometers. The web interface, amalgamated with the Google Maps API, empowers distant surveillance of fishing vessel entry into the UEZ, delivering an unambiguous and all-encompassing understanding of the scenario.

Keywords: Underwater Exclusion Zones (UEZs), Marine Protected Areas (MPAs), Haversine Method, Short for long range(LoRa) Technology, ,Internet Of Things (IoT), Web Application.

I. INTRODUCTION

The ongoing challenges faced by Tamil Nadu fishermen navigating the International Maritime Boundary Line (IMBL) for fishing highlight the need for a solution to prevent accidental border crossings and conflicts with the Sri Lankan navy[1]. Accidental border violations result in human casualties and economic losses for the fishermen. A proposed system aims to address these issues by communicating vessel whereabouts to border

security forces, sending alerts to relatives, and providing an incident management application. The automatic alerting system, designed for ease of use, operates based on an intelligent engine and SMS alert system, promising enhanced safety and efficiency for fishermen[4].

The economic activities of shipping, angling, diving, and sailing, though popular, pose environmental threats due to insufficient control and monitoring. Current measures rely heavily on the Vessel Monitoring System (VMS) and Geographical Information System (GIS), limited to registered vessels, posing challenges for law enforcement[3]. Foreign-originating systems, such as VMS and GIS, face usability issues locally, requiring time for adaptation. The study proposes a solution involving Unmanned Aerial Vehicle (UAV) systems and mobile devices equipped with Long Range Radio (LoRa) communication and Light Detection and Range (LIDAR) technology[1]. This approach aims to provide adaptable and cost-effective alternatives for maritime monitoring and control[5], addressing limitations such as high costs, equipment closures, and communication network access issues associated with existing systems[4].

The introduction of UAV systems to oversee coastal and maritime areas, equipped with cameras and GPS gear, offers an alternative to traditional monitoring methods. However, challenges related to restricted communication between the controller and the UAV need to be addressed to prevent loss of control and potential damage[2]. In response, the study proposes the use of mobile devices for data transmission and remote sensing through tracking devices, utilizing LoRa communication and LIDAR technology. This alternative aims to enhance the efficiency and adaptability of maritime monitoring and control equipment, promoting a more robust and responsive solution for various operational challenges, including adverse weather conditions and disrupted communication[2].

Objectives of the system:

The objective of the "Smart Maritime Conservation" initiative is to enhance the surveillance capabilities of Marine Protected Areas (MPAs) through the integration of Internet of Things (IoT), the Haversine method, and LoRa (Long Range) technology. Firstly, the project aims to deploy a network of IoT devices strategically within MPAs to gather real-time data on various environmental parameters such as water quality,

temperature, and marine life activity[5]. This data will contribute to a comprehensive understanding of the ecosystem, facilitating informed conservation decisions[6].

Secondly, the implementation of the Haversine method[6], within the project seeks to improve the accuracy of geospatial calculations, particularly in measuring distances between monitoring points and tracking the movement of vessels within the protected areas. This precision is crucial for effective surveillance and enforcement of conservation regulations, ensuring adherence to spatial boundaries and minimizing illegal activities[4].

Thirdly, the utilization of LoRa technology serves as a critical component in establishing a robust communication infrastructure for the IoT devices deployed in the maritime environment. The objective is to enhance the range and reliability of data transmission, overcoming challenges posed by the vast and often remote nature of marine ecosystems[3]. This will enable seamless communication between the deployed sensors and a central monitoring system, ensuring timely and accurate data collection[4].

- Provide an introduction to Marine Protected Areas (MPAs) and their significance.
- Develop a system to address the historical rights invoked by Tamil Nadu fishermen, enabling them to fish within the International Maritime Boundary Line (IMBL) without accidental border crossings.
- Enhance awareness among Tamil Nadu fishermen regarding the IMBL, reducing unintentional border violations and the associated risks of being shot by the Sri Lankan navy.
- Implement a technology-driven solution to monitor and track the movement of approximately 18,000 boats from Tamil Nadu engaged in fishing along the India-Sri Lanka maritime border.
- Minimize the economic losses incurred by Tamil Nadu fishermen due to accidental border crossings, promoting sustainable and uninterrupted fishing activities.
- Improve communication channels between Tamil Nadu fishermen and the proposed system to provide real-time alerts and information about their proximity to the IMBL.

- Establish a comprehensive alert system within the developed solution to notify fishermen and relevant authorities when there is a potential risk of border infringement.
- Ensure the safety of human lives by preventing instances of Tamil Nadu fishermen getting shot by the Lankan navy through the effective implementation of the developed system.
- Facilitate collaboration between Indian and Sri Lankan authorities to share information and coordinate efforts in preventing accidental border violations by fishermen.
- Enhance the overall economic well-being of Tamil Nadu fishermen by safeguarding their livelihoods through the reduction of incidents leading to loss of lives and economic incomes.
- Evaluate and iterate on the system's performance regularly, incorporating feedback from fishermen and authorities to continually enhance its effectiveness in preventing border-related issues and ensuring the safety of the fishing community.
- Highlight the challenges faced in MPA management.
- Describe the threat posed by fishing activities in MPAs.
- Mention the reliance on direct visual observation in India for detecting fishing vessel entry.

II.LITERATURE SURVEY

This section provides an overview of existing research related to Smart Maritime Conservation.In the context of enhancing maritime navigation safety for fishermen, several Intelligent Boundary Alert Systems (IBAS) utilizing GPS technology have been proposed. The first system employs an ARM processor to compare the continuously received GPS signals with stored maritime boundary data. When the boat crosses the border, the processor generates an alarm signal transmitted through a wireless sensor network to the base station, benefiting both fishermen and coastal guards [1].

Another GPS-based security system for fisherman auto boats utilizes a microcontroller to compare stored border data with real-time location details. Alarm signals are generated

upon border crossings, and the system also incorporates sensors for detecting natural calamities such as icebergs (using ultrasonic sensors) and tsunamis (using MEMS). Additionally, it includes weather forecasting capabilities through temperature and humidity sensors [2].

A surveillance system for fishermen preventing border crossings integrates GPS technology for continuous extraction of boat position data. A microcontroller compares this information with stored border values and alerts fishermen when approaching the border. The system transmits messages to coast guards via RF signals, offering a cost-effective and reliable alternative to GSM modules in maritime communication [3].

The implementation of a Maritime Border Alert System focuses on assisting small-scale fishermen in safe navigation and preventing border violations. The system utilizes GPS for location-based information, comparing real-time data with known border details. The controlling unit makes decisions to alert fishermen and coast guards in case of border proximity [4].

The Arm-Based Fishing Boat Security System employs an ARM processor and GPS technology to ensure safe navigation. When the fishing boat crosses the border limit, the system generates an alarm signal and a voice alert. Using a ZIGBEE module for continuous signal transmission, the system offers maritime security by turning off DC motors if the boat moves further towards the border [5].

III. EXISTING SYSTEM

The initial investment of this system to implementing the GPS technology is to provide a secure and reliable tool for fishermen, particularly for maritime navigation purposes. The integration of various systems aims to offer a comprehensive solution to alert fishermen when they are approaching or crossing border limits during their activities at sea[7]. This integrated system not only ensures the safety of fishermen but also facilitates effective navigation for seaway transport.

Currently, there are a limited number of existing systems designed to ascertain the current location of boats/ships through the utilization of the GPS System and display their positions on an electronic map. Fishermen employ the GPS72h for identification, a tool specifically designed for navigation at sea. This device offers mariners the quickest and

most precise means to navigate, gauge speed, and establish location. The system enhances safety and efficiency levels, ensuring the secure arrival of the ship at its destination [6]. The precision of position information becomes especially crucial during the vessel's departure from or arrival in port[5].

The core functionality of this system revolves around the seamless integration of GPS and GSM modules. The GPS module serves as a fundamental component for navigation purposes, allowing users to accurately determine the vessel's location and receive real-time distance information from their destination point. This feature is crucial for fishermen to navigate safely and avoid unintentional border crossings, thereby preventing potential risks and ensuring a secure fishing experience[5].

Moreover, the incorporation of GSM technology plays a vital role in monitoring the vessel's activities. This allows for efficient communication and tracking, enabling authorities or relevant stakeholders to keep a close eye on the vessel's movements. In the event of border limit crossings, the system can trigger alerts to notify fishermen promptly, minimizing the likelihood of incidents and enhancing overall safety measures[6].

The modular design of the system is a key feature, ensuring flexibility and adaptability. Users can easily upgrade the system with additional modules to enhance its efficiency or incorporate new functionalities as needed. This scalability ensures that the technology remains relevant and can adapt to evolving requirements, making it a sustainable solution for maritime navigation and fisheries management[4].

In the existing survey, the objectives of this integrated GPS and GSM system are to enhance the safety of fishermen during maritime activities, provide accurate navigation information, and offer a scalable solution that can be easily upgraded to meet evolving needs[7]. This system aims to create a secure and efficient environment for both navigation in seaways and safe fishing practices, contributing to the overall well-being of fishermen and the maritime industry[6].

IV. PROPOSED SYSTEM

The proposed system incorporates a GPS receiver to determine the boat's current position based on signals received from satellites. It is designed not only for detecting borders between specific countries, such as Sri Lanka and India, but worldwide. The system allows the predefined border, set at a particular layer level, to be stored in the

microcontroller's memory. By comparing the current position's longitude and latitude with the predefined values, the microcontroller triggers an alarm to the buzzer, providing immediate notification. Additionally, a message transmitter is utilized to send alerts to the base station, enhancing monitoring capabilities for boats at sea. This comprehensive system serves as an essential tool for both fishermen and coastal guards, ensuring prompt responses to potential border violations and contributing to the safety of fishermen [3].

The system operates with three pre-stored locations strategically positioned a few nautical miles away from the border. At each location, a warning system is activated. The first location triggers a warning buzzer and displays the exact distance between the present location and the border on an LCD display. Simultaneously, there is a 50 percent reduction in boat speed as an initial caution. If the fisherman overlooks the warning and continues towards the third location, the boat's motor comes to a complete stop, and the system sends the location information to the navy control room. The navy can then verify the legitimacy of the fishermen, requiring them to input a randomly generated key to restart the boat. Additionally, the system sends the location information to the fishermen's family members through GSM, providing a multi-layered approach to preventing border violations and ensuring the safety of fishermen [3].

v. MATERIALS AND METHOD

This study introduces an innovative approach to smart monitoring and control through the integration of intelligent systems. The system incorporates Dargino LoRa Shield Wireless, Arduino nano, GPS detector, LIDAR detector, and WiFi Shield module. The primary focus is on detecting foreign objects within a 1-kilometer radius, utilizing the capabilities of the LoRa technology, LIDAR detector, and GPS detector. The proposed prototype aims to enhance maritime surveillance and safety by issuing warnings to authorities if foreign objects are detected[7].

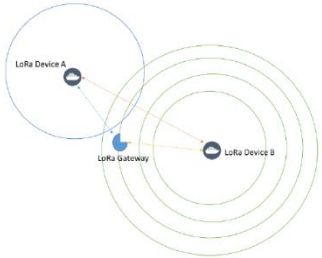


Fig. 1: proposed method to monitor and control marine activity

LoRa Technology and System Components:

The Long Range Radio (LoRa) technology is at the core of this system, supporting IoT applications with communication networks at 433 MHz, 868 MHz, and 915 MHz. The LoRa gateway, connected to the internet and server, serves as a crucial link between LoRa devices and the monitoring infrastructure. The LoRa End-Node[6], designed as a stand-alone device, features a GPS module, LIDAR module, and solar power supply, providing a comprehensive solution for monitoring boats at sea. The LIDAR module, used for spatial information observation, adopts a unique approach by combining visual object detection with a lightweight model to enhance focus area selection and reduce computational requirements.

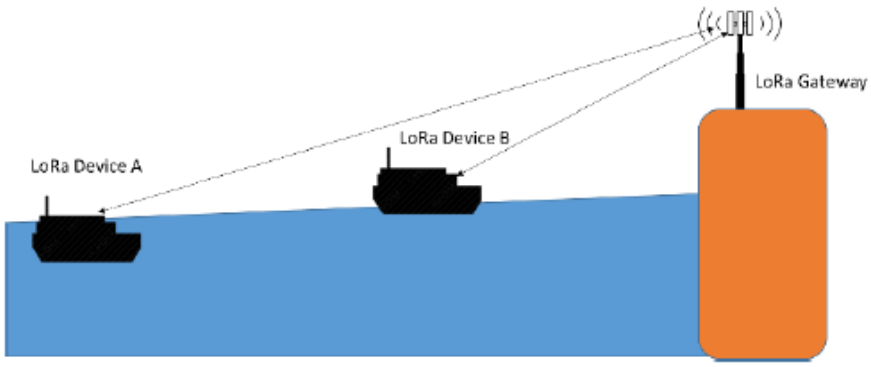


Fig. 2: Communication between LoRa End-Node and LoRa Gateway

Operation Mechanism:

The LoRa gateway, strategically placed to cover a wide area, connects to a local server or cloud through mobile phone or WiFi network. The GPS sensor captures the location data of the LoRa end-node device, establishing a direct connection to the server through WiFi or cellular modules. The system design incorporates a cloud server for information processing and data visualization, ensuring easy access for enforcement officers [6]. Real-time data transmission allows officers to monitor and track the location of boats or intruders, enabling immediate response in case of emergencies or border violations[7].

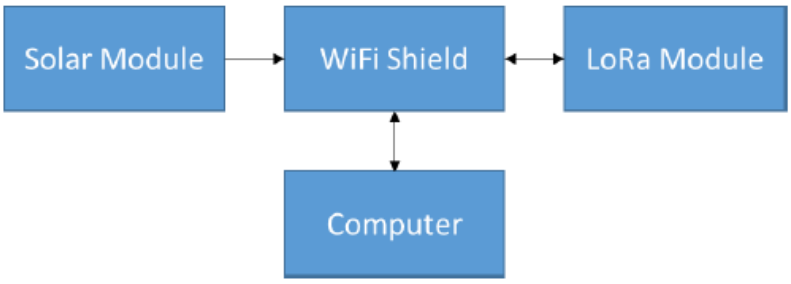


Fig. 3: The block diagram of the proposed LoRa Gateway

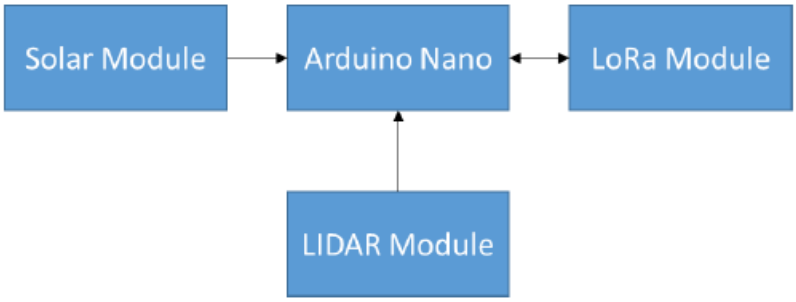


Fig. 4: Block diagram of the proposed LoRa End-Node device

Backtrack Trajectory Evaluation and Prototype Efficiency:

The study evaluates the prototype's communication efficiency using the Easy Dead Reckoning Algorithm (EDR). LoRa serves as the primary communication platform, and the efficiency is assessed through Received Signal Strength Indication (RSSI) testing. The LoRa end-node, equipped with Tx and Rx polarization antennas, moves around the LoRa gateway, sending data every 10 seconds. The EDR algorithm facilitates the evaluation of positions, predicting the next point based on the movement history[5].

Finally, the proposed smart monitoring and control system demonstrates a comprehensive approach to enhance maritime safety, utilizing advanced technologies like LoRa, LIDAR, and GPS. The integration of these components offers real-time monitoring, border detection, and emergency response capabilities, making it a promising solution for maritime surveillance[6].

VI. IMPLEMENTATION

Implementation is the stage, which is crucial in the life cycle of the new system designed. The main stage in the implementation is planning, training, system testing. Every

developed system must be implemented to fulfil the mode of development. There are many software implementation methods. In this system, direct change over from existing system to computer system is carried.Implementation of IoT technologies, including sensors, actuators, and communication protocols, to enable real-time data collection, analysis, and transmission[4].

This study focuses on implementing smart monitoring and control for marine activities within a 1-kilometer range from a coastal area, specifically tailored for leisure activities. The designed system aims to enhance safety and surveillance for individuals engaged in recreational maritime pursuits. However, it is acknowledged that the coverage area may not be sufficient for deep-sea fishery activities, highlighting a limitation in the current system[6].

To address the limitation and improve the system's applicability, the study proposes future enhancements. One potential improvement is the integration of a communication repeater, which can amplify the communication coverage area. By incorporating a repeater, the system could extend its reach beyond the initial 1-kilometer radius, making it more versatile and suitable for a broader range of maritime activities, including deep-sea fishery[7].

Moreover, the study envisions the system being utilized as a sea buoy to demarcate safe areas specifically designated for leisure activities. This additional functionality aligns with the objective of ensuring safety in recreational maritime endeavors. By designating safe zones through sea buoys, the system can contribute to a more organized and secure environment for leisure activities near the coastal regions. Overall, the study not only addresses the current capabilities and limitations but also outlines potential avenues for future improvements to make the smart monitoring and control system more comprehensive and adaptable[4].

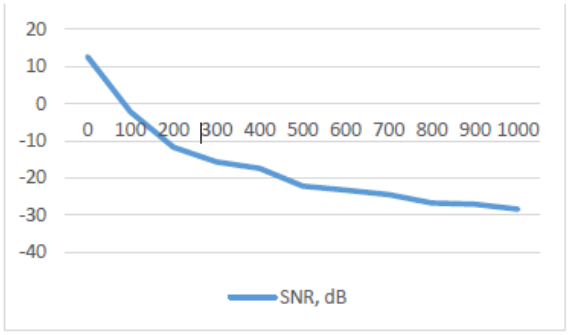
VII. RESULTS AND DISCUSSION

The study evaluates the communication efficiency of the Long Range Radio (LoRa) module in a maritime environment, focusing on the relationship between signal-to-noise ratio (SNR) and received signal strength indication (RSSI) values. Figure 8 presents a chart indicating that the efficient communication range for the LoRa module is not more than 1 kilometer. The observed line for SNR and RSSI values demonstrates a slope that

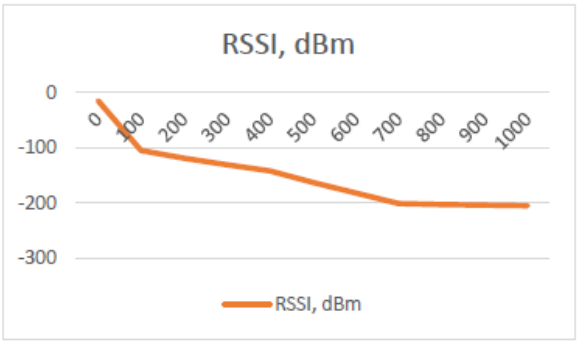
approaches the value of 1000 meters, indicating a decrease in communication efficiency with increasing distance[5].

The decreasing efficiency beyond 1000 meters is attributed to the diminishing energy received by the LoRa end-node from the LoRa gateway as the distance increases. This phenomenon is particularly evident in open and clear spaces with no obstacles along the path of the prototype. The study acknowledges that the efficiency of the LoRa module is highly dependent on the proximity of the end-node to the gateway, emphasizing the impact of environmental factors on communication performance in a maritime setting.

While the findings highlight a limitation in the communication range of the LoRa module, the study also suggests that the results may vary in different environmental conditions. The potential for improved results in open and obstacle-free spaces suggests that the efficiency of the LoRa module could be optimized under favorable conditions. Despite the observed limitations[5], understanding the factors influencing communication efficiency is crucial for the practical application of the smart monitoring and control system in maritime environments. Further research and potential enhancements may be explored to address these limitations and improve the overall performance of the LoRa module in maritime communication[6].



(a) SNR,dB



(b) RSSI, dBm

Fig. 5**:** (a) SNR and (b) RSSI Chart test results

VIII. CONCLUSION

Marine Protected Areas (MPA) are conserved areas for reproduction of marine species. Conflicts in the utilization of MPAs had been a challenge for many years. Fishing activities within the MPAs are real threat for the sustainability of marine resources. In developed countries, direct visual observation of the responsible agencies is the only method to identify the entry of fishing vessels in the MPAs. This paper presents an IoT-based system for monitoring the fishing vessels' entry in the MPA[6].

IX. FUTURE SCOPE

Furthermore, the project aims to develop an integrated platform that consolidates and analyzes the data collected through IoT devices, employing advanced analytics for actionable insights. This platform will empower conservation authorities with the tools needed to make data-driven decisions, optimize resource allocation, and respond swiftly to emerging threats or environmental changes within the MPAs[6].

In conclusion, the overarching objective of the "Smart Maritime Conservation" initiative is to leverage cutting-edge technologies, including IoT, the Haversine method, and LoRa technology, to enhance MPA surveillance capabilities[5]. Through this, the project seeks to contribute to the sustainable management and preservation of marine ecosystems by providing comprehensive, accurate, and real-time data for informed decision-making and effective conservation measures.

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REFERENCES

[1] H. Huang, X. Cui, X. Bi, C. Liu, F. Hong and S. Guo, "FVRD: Fishing Vessels Relationships Discovery System Through Vessel Trajectory," in *IEEE Access*, vol. 8, pp. 112530-112538, 2020.

[2] M. I. Marzuki, P. Gaspar, R. Garello, V. Kerbaol and R. Fablet, "Fishing Gear Identification From Vessel-Monitoring-System-Based Fishing Vessel Trajectories," in *IEEE Journal of Oceanic Engineering*, vol. 43, no. 3, pp. 689-699, July 2018

[3] T. Roste, K. Yang and F. Bekkadal, "Coastal coverage for maritime broadband communications," 2013 MTS/IEEE OCEANS - Bergen, Bergen, 2013, pp. 1-8.

Monitoring and Controlling Marine Activity Using IOT System, pp., 30-37

36 Malaysian Journal of Computer Science. Advances in Applied Science and Technology Research Special Issue 1/2021

[4] Sunarmo, A. Affandi and S. Sumpeno, "Clustering Spatial Temporal Distribution of Fishing Vessel Based lOn VMS Data Using K-Means," *2020 3rd International Conference on Information and Communications Technology (ICOIACT)*, Yogyakarta, Indonesia, 2020, pp. 1-6.

[5] Hery, S. Lukas, P. Yugopuspito, I. M. Murwantara and D. Krisnadi, "Website Design for Locating Tuna Fishing Spot Using Naïve Bayes and SVM Based on VMS Data on Indonesian Sea," *2020 3rd International Seminar on Research of Information Technology and Intelligent Systems (ISRITI)*, Yogyakarta, Indonesia, 2020, pp. 89-93.

[6] A. Prayudi, I. A. Sulistijono, A. Risnumawan and Z. Darojah, "Surveillance System for Illegal Fishing Prevention on UAV Imagery Using Computer Vision," *2020 International Electronics Symposium (IES)*, Surabaya, Indonesia, 2020, pp. 385-391.

[7] H. Susanto and G. Wibisono, "Marine Vessel Telemetry Data Processing Using Machine Learning," *2019 6th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)*, Bandung, Indonesia, 2019, pp. 128-135.

AI Assistants and Augmented Reality: Shaping the Future of Customer Interaction

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ABSTRACT

This paper explores the transformative intersection of AI Assistants and Augmented Reality (AR) in customer interaction, predicting a paradigm shift. AI Assistants with advanced language processing and learning skills act as intelligent conversational agents, reshaping customer service through adaptability to user preferences. Augmented Reality enhances interactions with visual support and real-time information overlay. Case studies and emerging trends showcase the collaborative synergy between AI Assistants and AR. The evolution from traditional to dynamic, customer-centric models is examined, emphasizing proactive issue resolution, emotional intelligence, and personalized services. Ethical considerations in responsible AI practices are investigated, underscoring their importance for a positive customer experience. The implications for businesses in operational efficiency and customer satisfaction are thoroughly discussed. The paper envisions a future where AI Assistants and AR redefine customer interaction, offering enhanced engagement, improved problem-solving, and a deeper understanding of customer needs, ushering in a transformative era in customer service evolution.

Keywords: Artificial Intelligence, Augmented Reality, Emotional Intelligence, Collaborative Synergy, Customer Interaction.

INTRODUCTION

The rapid increase in technologies has brought about significant changes in various aspects of our lives, transforming how we communicate, work, and access information. The wide availability of these technologies is gaining substantial attention and allowing companies to showcase products in more immersive and persuasive ways. This technology enhances the overall consumer experience, contributing to the evolution of marketing strategies. AI and AR are two of these technologies.

Artificial Intelligence (AI) has become a discussed subject, in today's fast-moving world. From once residing solely within the realm of science fiction, AI has evolved into a tangible force shaping our everyday experiences. Across the globe, individuals are captivated by the practical application of AI, witnessing its capacity to manifest their creative visions in the routines of daily life. AI entails developing computer systems that perform tasks traditionally requiring human intelligence, aiding in data management, pattern recognition, and decision-making. This is achieved through methods like machine learning, Natural Language Processing, Computer Vision, and Robotics. AI encompasses learning, reasoning, perception, problem-solving, data analysis, and language comprehension.

Augmented reality (AR) is a burgeoning technology that has garnered considerable attention from numerous companies. AR alters the perception of reality by superimposing computer-generated images onto the physical real-world environment [1]. Indeed, the term "augmented reality" was coined in 1990, and early applications were seen in television and military contexts. Since then, AR has evolved significantly and found diverse applications across various industries, including gaming, education, healthcare, and more.

AI and AR are increasingly playing vital roles in various industries, reshaping how businesses operate and interact with their customers. Various Industries of AI are healthcare, finance, manufacturing, retail and customer service. Various industries of AR are retail, manufacturing, education, customer services these are virtual try-ons, remote assistance, interactive manuals.

AI in Customer Service

AI is transforming customer service in various ways, revolutionizing the traditional approach and enhancing the overall customer experience. These are Automated Assistance, Personalization, Efficient Issue Resolution, 24/7 Availability, Data-Driven Insights, Enhanced Communication Channels, Cost Efficiency.

AI-driven chatbots and virtual assistants have become instrumental in handling routine queries and providing instant support. These intelligent systems leverage natural language processing to understand customer inquiries, offering real-time responses and assistance. Chatbot can troubleshoot common problems, offering quick solutions and freeing up

human agents for more complex issues. It will available for 24/7, Unlike human agents chatbots operate 24/7 by enables businesses to provide support across different time zones, ensuring customer assistance whenever it is needed [2]. The continuous availability reduces customer wait times, contributing to a more positive customer experience. AI-driven virtual assistants can analyse customer data to provide personalized recommendations and assistance. It automates routine tasks, streamlining processes and allowing human agents to focus on high-value interactions.

AI has personalized support to customers. It anticipating customer requirements by analyse customer data to predict preferences and behaviour, enabling businesses to proactively address customer needs. It provides personalized experiences, the predictive analytics allows for personalized recommendations, improving the overall customer experience and satisfaction. AI also helps in targeted marketing by identifying and reaching out to specific customer segments with relevant promotions. It improves communication through multichannel support, ensuring consistency across platforms like chat, email, and social media. Adhering to predefined guidelines, AI maintains a unified brand voice for seamless interactions. Biometric AI utilizes algorithms to identify human facial features and voices for authentication. AI programs comprehend voice commands, supporting customer service agents in task execution.

Indeed, the accessibility of AI technologies has revolutionized user experiences on platforms like Snapchat, TikTok, and Instagram. The minimal financial burden allows widespread adoption, enabling intelligent filters powered by machine learning to create immersive features like beautification and virtual accessories in video feeds. The advanced capabilities of AI contribute significantly to shaping novel and engaging interactions for users across social media.

In essence, AI applications such as chatbots, virtual assistants, and predictive analytics are transforming customer service. They deliver effective, personalized, and available for 24/7 support, elevating customer satisfaction while concurrently enhancing operational efficiency and optimizing resources for businesses.

AR in Customer Service

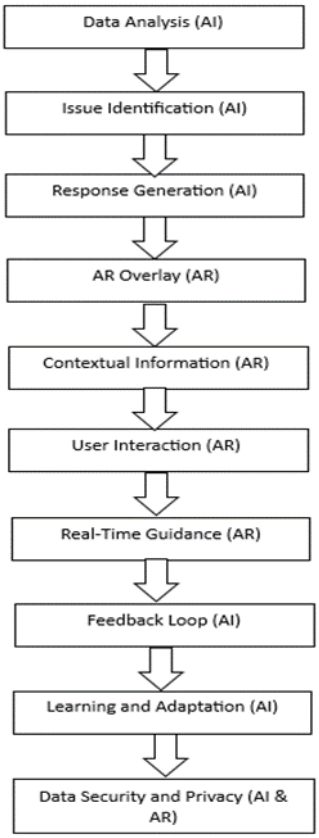
Augmented Reality, is a technology that superimposes digital content, such as images, information, or 3D models, onto the real-world environment. Utilizing devices like smartphones, tablets, or specialized glasses, users can seamlessly integrate virtual elements and information into their physical environment for an immersive experience.

Integrating augmented reality (AR) into customer experiences enhances engagement, providing visually appealing presentations of products or services. In contrast to Virtual Reality, which entirely generates a digital environment, Augmented Reality overlays virtual elements onto the real-world setting, blending the viewer's surroundings with electronically generated content [3]. Hence, AR offers greater advantages than VR for consumers and retailers, allowing customers to virtually try on a diverse range of products without the necessity for physical fittings in a store. [4]. This technology improves product comprehension, saves time, and holds potential for widespread adoption in e-commerce. Interactively inspecting vivid virtual product images is crucial for consumer immersion. Despite potential technological constraints, AR's effectiveness relies on prompt responses and lifelike visualizations. Virtual try-ons using AR provide step-by-step guidance, simplifying tasks for customers. AR empowers agents to offer real-time guidance and demonstrations, personalizing support experiences. Integrating AR into training programs elevates knowledge retention and expedites onboarding for service teams by simulating real-life scenarios. AR contributes to enhanced overall performance through interactive learning experiences.

Integration of AI and AR

The integration of artificial intelligence (AI) and augmented reality (AR) in the context of customer interaction represents a powerful combination. AI's cognitive capabilities enhance AR applications, providing intelligent responses and personalized experiences. This synergy ranges from AI-driven product recommendations in AR shopping to virtual guides offering context-aware information. However, navigating this integration requires addressing technical challenges and ethical considerations. By exploring successful cases and emerging trends, we gain insights into the transformative potential of AI and AR, shaping the future of customer engagement.

The integration of AI and AR in customer service typically involves the following algorithmic



AI algorithms process customer data, including preferences, past interactions, and relevant information to understand user needs. The system uses AI to identify the customer's issue or query by analysing input data and historical context. Based on the identified issue, AI generates appropriate responses or suggestions. Natural Language Processing (NLP) may be used for understanding and generating human-like text. AR technology overlays relevant information or instructions onto the user's real-world environment through a device like a smartphone or smart glasses. AR incorporates contextual information from AI, ensuring that the augmented content is personalized and addresses the user's specific needs. Users interact with the AR interface, following visual cues or instructions provided by the augmented content. AR dynamically updates the guidance based on the user's actions and feedback, providing real-time assistance. AI analyses user interactions and feedback received through AR, continuously improving the system's understanding and response capabilities. The system employs machine learning to adapt and learn from each interaction, enhancing its ability to handle a wide

range of customer queries. Both AI and AR algorithms ensure the secure handling of customer data and compliance with privacy regulations. By combining these steps, AI and AR create a seamless and intelligent customer service experience that is both responsive and personalized.

The convergence of AI and AR yields numerous advantages:

AI personalizes user engagement by analysing customer data for preferences, while AR offers personalized experiences like virtual try-ons. This combination ensures tailored content and recommendations, enhancing satisfaction. AI predicts and resolves potential issues efficiently with remote assistance, analysing customer journeys to identify touchpoints. AR provides real-time visual guidance, offering personalized content at key touchpoints, leading to quicker problem-solving and increased satisfaction. The synergy of AI and AR enhances adaptive learning for employee training, tailoring programs based on individual performance and providing immersive scenarios. This impacts employee satisfaction and performance positively. Dynamic FAQs and real-time assistance by AI, along with AR's on-screen guidance during customer interactions, offer up-to-date information, improving overall satisfaction. Collaborative decision-making with AI insights and AR visualizations allows informed decisions, involving customers and increasing satisfaction. The combined impact of AI and AR extends ac Embracing ross user engagement, issue resolution, employee training, and collaborative decision-making, ultimately leading to enhanced satisfaction in various business contexts.

CHALLENGES AND CONSIDERATIONS

The challenges associated with AI and AR encompass the demand for specialized skills, coupled with technical limitations such as performance and speed issues, storage capacity constraints, and connectivity issues. Additionally, there are challenges in accurately understanding context, leading to less reliable responses. Security concerns, including the risk of malicious attacks, further underscore the complexities. Addressing these challenges necessitates ongoing adjustments and a proactive approach to ensure the seamless integration and optimization of AI and AR technologies. Another significant challenge lies is high implementation costs attributed to software and hardware maintenance. Specialized skills are essential, demanding additional investments in training. Moreover, the need for expert technicians further intensifies the financial

commitment required for the successful integration of AI and AR technologies. Balancing these factors becomes crucial for organizations aiming to navigate and overcome the challenges associated with the adoption of these advanced technologies. The potential loss of human touch, particularly the absence of friendliness in customer interactions, can significantly impact customer satisfaction. Striking a balance between technological efficiency and maintaining a warm, human connection becomes essential to ensure a positive and fulfilling customer experience. Achieving a balanced integration that prioritizes customer-centricity is crucial for long-term success.

CASE STUDIES

The convergence of AI and AR is yielding innovative applications. AI plays a pivotal role in enhancing navigation within AR applications by integrating real-time data such as traffic updates and points of interest, elevating the overall user experience. Furthermore, AI-driven AR apps enable users to virtually try on clothing or accessories, injecting interactivity and personalization into the online shopping journey. This synergy between AI and AR is shaping immersive and dynamic digital experiences .AR and AI synergize to provide real-time instructions and data visualization for maintenance tasks in industries, effectively reducing errors and boosting operational efficiency. This integration empowers workers with accurate guidance, enhancing their ability to perform tasks with precision and facilitating a more streamlined and error-resistant industrial maintenance process. AI-driven AR apps go a step further, enabling users to virtually try on clothing or accessories, creating an interactive and personalized dimension to online shopping [5] . Cosmetic giants such as Sephora and L'Oréal have introduced AR mirrors, allowing customers to virtually experience facial makeup [6] . Some of the real-world examples of integration of AI and AR are:

L’Oréal Paris has explored AR technologies to offer virtual try-on experiences for cosmetics, empowering customers to visualize how various products on their faces in real-time and provides a more interactive and personalized online shopping experience, allowing customers to virtually test products before purchasing. L’Oréal has shown interest in using AI for personalized skin analysis. AI algorithms can analyze customer images to understand skin types, concerns, and recommend suitable skincare products. L’Oreal offers two online augmented reality applications which are free to all users. One is Vincky Skin is a skincare application with AI consultation capabilities, a tool that

combines technology with beauty and healthcare. Other is L'Oréal Paris Makeup Genius App: The Makeup Genius app utilizes augmented reality (AR) technology to enable users to virtually try on a wide range of L'Oréal Paris makeup products in real-time. Users can experiment with various looks and styles without physically applying the products.

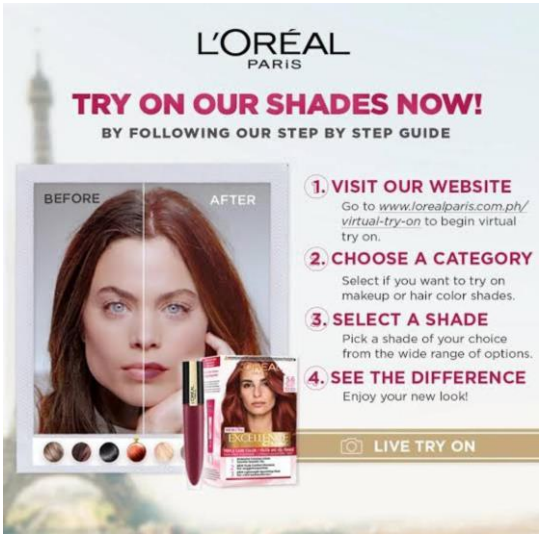


figure 1. L'Oreal Virtual Try On

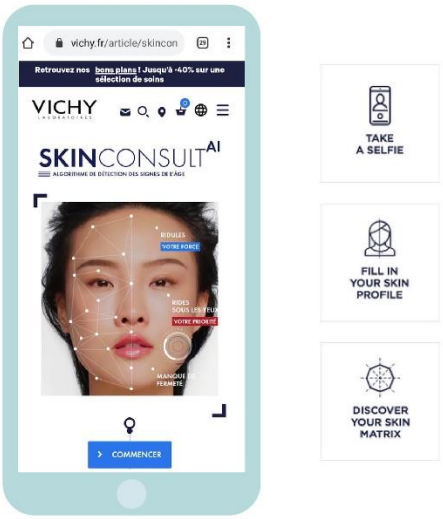


figure 2. Vichy Skin Consult AI website

IKEA, a global leader in home furnishings, stands as the world's largest retailer of furniture, kitchen appliances, decorations, and various household essentials.IKEA Place is an AR application that allows users to virtually place and visualize IKEA furniture in their homes using their smartphones.Enable users to scan their surroundings, virtually bring items into their homes.Pre-purchasing visualization within this app significantly contributes to minimizing returns.It has increased customer confidence in making online furniture purchases.

figure 3.Proccessing

figure 4. IKEA App

Sephora is a renowned multinational beauty retailer and cosmetics brand based in France, allowing customers to virtually try on makeup products. This AR experience empowers users to visualize how different products will look on their faces in real-time. Sephora leverages AR in virtual beauty classes, enabling customers to learn and experiment with new makeup techniques through immersive simulations. The Colour IQ system employs artificial intelligence (AI) to analyse customers' skin tones and recommend suitable makeup shades.

Amazon, the world's largest online retailer, has strategically integrated AI and AR to redefine the online shopping experience. Amazon employs advanced AI algorithms to analyze customer browsing and purchase history. This data is used to provide highly personalized product recommendations, enhancing the overall shopping journey.Amazon uses AI in its customer support systems to analyze and respond to customer inquiries efficiently. Chatbots and automated systems leverage natural language processing to provide quick and accurate assistance.

FUTURE SCOPE

Recent advancements in Conversational AI have propelled the field forward. These include achieving more human-like interactions through enhanced natural language processing (NLP). In the realm of predictive customer service, the key lies in continuous learning and adaptation based on real-time feedback and evolving customer preferences. This involves a commitment to improving the FAQ system by staying up-to-date with rapid advancements in AI and AR. By ensuring that FAQs reflect the latest feature updates, the goal is to encourage customer engagement with the system. Establishing an efficient feedback loop becomes paramount, enabling continuous improvements to the FAQ system based on user interactions and evolving needs. This iterative process forms the foundation for a responsive and customer-centric support system. A paramount emphasis is placed on safeguarding data security and privacy within our framework. This involves implementing robust end-to-end encryption protocols to secure the transmission of sensitive data, ensuring that only authorized parties can access this information. Strengthening control measures, biometric verification is integrated for added security. Continuous monitoring is a proactive strategy to stay ahead of emerging threats, fortifying our commitment to maintaining the highest standards of data security and privacy.Real-time language translations empowered by AI will effectively break down language

barriers. Augmented Reality (AR) further enhances this capability by providing visual translations or subtitles, ensuring seamless communication within customer service. Emotional recognition technology enables the analysis of customer emotions during interactions, empowering agents to respond empathetically. This capability enhances customer support by allowing agents to better understand and address emotional nuances, fostering a more empathetic and personalized response. Voice and speech analytics, including voice biometrics for secure customer authentication, utilize AI to analyse unique voice patterns for verification. This enhances security by adding an additional layer of authentication. Additionally, Augmented Reality (AR) serves as a visual indicator, typically signalling a successful authentication process, providing users with a clear and intuitive confirmation of their secure access.

CONCLUSION

Advancements and potential innovations in AI and AR for customer service are aligning with the evolving expectations of customers. As technology continues to progress, meeting and exceeding these expectations will be crucial for businesses aiming to provide exceptional and customer-centric service. Certainly, incorporating descriptive and expressive virtual objects in AR systems enhances user experience and ensures optimal utilization of the system's capabilities. Indeed, real-time creation of 1D, 2D, and 3D augmentations during AR application usage provides users with dynamic and adaptive experiences [7]. The adaptability inherent in this approach enables on-the-fly customization, broadening the creative horizons within augmented reality environments. The dynamics of AI and AR in customer service unfold through continuous advancements, successful implementations, and a steadfast commitment to meeting evolving customer expectations. This commitment is realized through the delivery of personalized, efficient, and innovative experiences, shaping the ever-evolving landscape of customer service.

REFERENCES

1. Mark Yi-Cheon Yim, Shu-Chuan Chu, Paul Sauer (2017) "Is Augmented Reality Technology an Effective Tool for E-commerce? An Interactivity and Vividness Perspective" Journal of Interactive Marketing

2. Newell & Marabelli (2015) “AI-based services provide greater convenience for consumers as they are faster at handling service requests than humans and are available 24/7”

3. Milgram, Paul, Haruo Takemura, Akira Mtsumi, and Fumio Kishino (1994) “Augmented Reality: A Class of Displays on the Reality–Virtuality Continuum,” Telemanipulator and Telepresence Technologies, 2351, 282–92

4. Verhagen, Tibert, Charlotte Vonkeman, Frans Feldberg, and Pløn Verhagen (2014) “Present It Like It Is Here: Creating Local Presence to Improve Online Product Experiences,” Computers in Human Behaviour, 39, C, 270–80

5. Baek, Tae Hyun, Chan Y. Yoo, and Sukki Yoon (2015) “The Impact of Augmented Reality on Self-brand Connections and Purchase Intentions,” in Proceedings of the 2015 Conference of the American Academy of Advertising. Michelle R. Nelson, editor. Chicago, IL: American Academy of Advertising

6. Jaekel, Brielle (2016) “Sephora's Virtual Artist Brings Augmented Reality to Beauty Audience”

7. Chandan K. Sahu , Crystal Young & Rahul Rai (2020): Artificial intelligence (AI) in augmented reality (AR)-assisted manufacturing applications: a review, International Journal of Production Research.

CLOUD COMPUTING: MEETING SCHEDULING USING ACO AND PSO ALGORITHMS

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Abstract

Meeting scheduling is a common task in both professional and personal settings, and finding a suitable time that accommodates all stakeholders can be challenging. Metaheuristic algorithms are optimization algorithms that can be applied to a wide range of optimization problems. In this paper, we discuss about two heuristic algorithms named as Ant Colony Algorithm (ACO) and Particle Swarm Optimization (PSO). ACO is stimulated via way of means of the foraging conduct of ants. PSO is inspired by social behavior, such as the flocking of birds or schooling of fish. Applying PSO and ACO in meeting scheduling, and comparing them. PSO in meeting scheduling make some advantages such as simplicity of implementation, fewer hyperparameters, convergence speed, etc. more than ACO. Also, we compared the variants of PSO to give highest accuracy in meeting scheduling. This paper illustrates the huge role of cloud computing in professional field and also presents some future lines.

Keywords: meeting scheduling, ACO, PSO, EPSO

1. Introduction

Scheduling is the technique of organizing, controlling and optimizing paintings and workload in a manufacturing technique or production technique. It is used for planning plant and machinery resources, human resources, planning production processes, and purchasing materials. It is an important tool for manufacturing and engineering and can have a huge impact on the productivity of a process. Meeting scheduling, a scheduling process is a common task in both professional and personal settings. In meeting scheduling finding a suitable time that accommodates all stakeholders can be challenging. So, in this paper, an eminent approach based on the paradigms of computational

intelligence such as Particle Swarm Optimization (PSO), and Ant colony Optimization (ACO) for solving meeting scheduling problem is proposed to optimize the feasible schedule with minimum, make span, which comes under the branch of cloud computing. Due to its excessive overall performance and dispensed computing capabilities, cloud computing is extensively used. The benefits of cloud computing include virtualization, high scalability, high dependability, on-demand service, huge size, and low cost. As a result, increasingly more researchers are starting to cognizance in this field. The dependability, availability, and aid utilization of cloud computing is most importantly impacted through the effectiveness of activity scheduling. ACO algorithm is a distributed algorithm which is extensively used to solve NP-hard combinatorial optimization problems. Its original model is based on the foraging behavior real ants who find an approximately shortest way to the food by detecting the density of pheromone deposited on the route. Pheromone for the actual ants is a chemical substance deposited via way of means of ants as they walk, but while solving optimization problems it acts as something that lures the artificial ants. As a kind of optimization algorithm based on iteration, PSO algorithm has some advantages such as convergent, robust etc. on obtaining dynamic object excellent solutions through Enhanced Particle Swarm Optimization (EPSO) and it is suitable for the research of the population behavior. Task scheduling withinside the cloud computing surroundings particularly refers to workflow venture scheduling. In the case of a meeting scheduling, there are earliest and latest possible dates and start times. The proposed work is an attempt to address how efficiently cloud computing can be used to schedule meetings. In this paper we analyzed performance evaluation of both the scheduling algorithms and the PSO technique is found superior.

2. Model formulation

Scheduling a meeting is similar to scheduling a meeting. The date and time fields for scheduling a meeting are different from the meeting date and time fields. In the case of a meeting, the earliest and latest possible start dates and times will be specified. The scheduler uses these date and time ranges to specify a range of acceptable dates and times for which the meeting can be scheduled. For recurring meetings, the oldest and newest appointments are enabled. Once you have entered your details, arrange a one-off IT staff meeting. The earliest and latest dates are Monday and Friday of the week of September 20th. The first and last departure times are from 8:00 a.m. to 6:00 p.m. The category is

empty and there are no reminders. To continue the scheduling process, the user presses the Time List button... button. In response, the system displays a list of possible meeting dates. To select one of the possible meeting dates, the user clicks on the desired entry in the list and presses the ‘Confirm’ Button... which becomes active when the user makes a selection from the list. For example, on September 23, the planner selected the 8:00 a.m. to 9:00 a.m. time slot. When the scheduler presses confirm... the system responds by displaying a confirmation dialog for the meeting. Scheduler modified the appointment confirmation dialog to add a reminder and correct a typo in the original Details' data field. After editing in the meeting confirmation dialog, the organizer confirms the meeting by pressing the 'OK' button. PSO and ACO are swarm-based algorithms.

3. Methodology

3.1 Ant Colony Optimization (ACO)

First, the ACO algorithm generates a number of artificial ants and randomly distributes them to each coordinate. Artificial ants choose the next city according to the probability function and complete their respective tours. Based on the principle of probability (also called roulette), ants choose the next city.

In the next round, when the artificial ants make decisions, they depend on the concentration of pheromones and the probability principle. Artificial ants leave pheromones on the trail, mimicking the foraging behavior of ants. The pheromone lasts for a while and then disappears. Therefore, more pheromones are retained in the shorter path. Other ants choose a path based on pheromone concentration. Because of this positive feedback,they are likely to follow a path with a higher pheromone concentration trial. Therefore, it is important to update the pheromones after completing a round tour and evaporate the pheromones for the ACO algorithm. The results are updated for each tour until the maximum number of iterations is reached.

Pseudocode for ACO

Procedure ACO

1. Initialization:

i. Initialize the pheromone value between tasks and resources as a positive constant

ii. Optimal solution=null

iii. Place m ants on random resources

2. Solution Construction of each ant:

Repeat for each ant

i. Put the starting resource in tabu list of this ant (for the first task).

ii. For all the remaining tasks

a. Choose next resource r_i for the next task t_i by applying following transition rule

$$P_{ij} = \frac{(\tau_{ij})^{\alpha}(\eta_{ij})^{\beta}}{\sum_{k \in allowed} (\tau_{ik})^{\alpha}(\eta_{ik})^{\beta}}$$ if j is ε allowed, allowed means not in tabu list

else 0

b. Put the selected resource in previous step into tabu list of this ant

End For

Until each ant builds its solution

3. Compute the fitness value of the solution of each ant

4. Replace the Optimal solution with the ant's solution having best fitness value if its fitness value is better than Optimal solution.

5. Pheromone Updating:

i. Update local pheromone for each edge

ii. Update global pheromone

6. Empty tabu lists of all ants

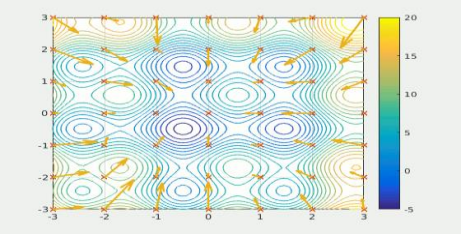
7. Repeat steps 2 to 6 until stopping condition is met. Stopping condition may be the maximum number of iterations or no change in fitness value of ants' solutions in consecutive iterations

8. Print Optimal solution

End Procedure

Validation versions of ACO are based on a discretization process to manipulate the frequency of calling the local search algorithm along with continuous domain design variables, various pheromone evaporation and investment strategies.

3.2 Particle Swarm Optimization (PSO)



3.2.1Pseudocode for PSO

In the PSO algorithm, each particle is relatively independent and has two properties: velocity and position, which represent the speed and direction of movement, respectively. Each particle searches individually in space for the optimal solution and saves the current individual extreme value. The particles share an individual best position with the entire particle swarm and find a corresponding individual best value for the entire particle swarm. All particles in the particle swarm adjust their speed and position based on the current best individual position, and the current best global position is shared by the entire particle swarm. For each iteration, the current personal best position and the current world best position are updated once. The iteration process ends when the maximum iteration time is reached.

Procedure PSO

1. Initialize position vector and velocity vector of each particle.

2. Convert the continuous position vector to discrete vector.

3. Calculate the fitness value of each particle using fitness function.

4. Each particle's pbest is assigned its best position value till now. If particle's current fitness value is better than particle's pbest, then replace pbest with current position value.

5. Select the particle with best fitness value from all particles as gbest.

6. Update each particle's position vector and velocity vector using following equations:

$V_{i+1}=\omega V_i+c_1\ rand_1 * (pbest-x_i)+c_2\ rand_2 * (gbest-x_i)$

$X_{i+1}=X_i+V_{i+1}$

where

ω=interia

c_1, c_2=acceleration coefficients

$rand_1$, $rand_2$=uniformly distributed random numbers and ε [0, 1]

pbest=best position of each particle

gbest= best position of entire particles in a population

i=iteration

7. Repeat steps 2 to 6 until stopping condition is met. Stopping condition may be the maximum number of iterations or no change in fitness value of particles for consecutive iterations.

8. Print best particle as the final solution.

End Procedure

This paper improves the PSO algorithm's task scheduling, and the proposed algorithm is called Enhanced Particle Swarm Optimization (EPSO)

3.2.2 ESPO

Algorithm 1: EPSO Algorithm

1. According to the directed acyclic graph describing the task and the condition $comp\_time \geq trans\_time$, it is judged whether the task is computationally intensive or IO-intensive;
2. According to the different types of tasks, the tasks are processed by the workflow task model to obtain several sets of "independent tasks"
3. Use the set of "independent tasks" as input to the algorithm;
4. Initialize the particles;
5. Repeat
6. Traverse the particle swarm;
7. Calculate the adaptive function value of the particle according to Equation $F'(x)=\frac{1}{\text{makespan}}$, the adaptive function $F'(x)$ to ensure that the particle optimization process meets the user's requirements for the completion time of task execution;
8. Update the historical best position p_{best} and the global best position g_{best} of the particle according to Equations

$$p_{besti}^{k+1} = \begin{cases} p_{besti}^{k}; F(x_i^{k+1}) < F(p_{besti}^{k}) \\ x_i^{k+1}; F(x_i^{k+1}) \geq F(p_{besti}^{k}) \end{cases} \quad \text{and} \quad g_{best} = \begin{cases} p_{besti}^{k}; F(p_{besti}^{k+1}) \leq F(g_{best}) \\ x_i^{k+1}; F(p_{besti}^{k+1}) > F(g_{best}) \end{cases}$$

The global best position of the particle is updated according to the comparison between the adaptive function value $F(p_{besti}^{k})$ of the best position in the history of the particle and the adaptive function value $F(g_{best})$ of the global best position.

9. Update the particles' position and velocity information according to Equations
10. $v_i^{k+1} = v_i^k + \varphi_1 rd_1(p_{besti}^k - x_i^k) + \varphi_2 rd_2(g_{best} - x_i^k)$ and $x_i^{k+1} = x_i^k + v_i^{k+1}$;
11. until the number of iterations reaches the maximum

EPSO's algorithm shows significantly better results as the number of sessions increases. The EPSO algorithm initialization process for the particle swarm ensures that it contains high quality particles, thereby ensuring that the particles are of relatively high quality. Maybe you can find a better solution. These algorithms are tested under applications containing 10, 20, 50, 100, 150, 200, 250, and 300 workflows and independent tasks. Each algorithm was run 20 times under different task types and different task numbers, and the average value was taken as the experimental result. This experiment uses the cloud environment simulation tool Cloud Sim to simulate the cloud environment.

Task	1	2	3	4	5	6	7	8
Resource	7	5	4	3	6	2	1	2

Table 1: Scheme for allocating tasks.

Table2 shows the experimental data of the time spent by the EPSO algorithm, the HPSO algorithm, and the PSO algorithm for scheduling workflow tasks with different numbers of tasks.

Number of Task	ESPO	HPSO	PSO
10	102.485	104.485	105.416
20	110.215	115.475	116.125
50	124.596	139.156	145.156
100	170.123	198.417	221.152
150	196.482	232.156	265.478
200	204.151	256.482	298.985
250	235.156	354.545	398.121
300	255.145	394.156	459.562

Table2: Time performance under different number of workflow tasks

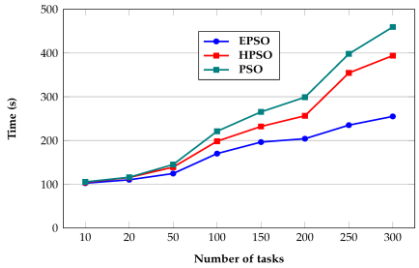
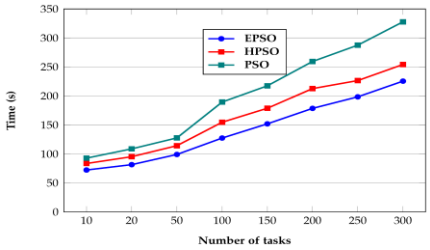


Figure 1: A graphical representation of the results given in Table 2.

Table 3 shows the experimental data of the time spent by the EPSO algorithm, HPSO algorithm, and PSO algorithm on the scheduling of independent tasks with different numbers of tasks, and Figure 2 shows the line chart of Table 3.

Figure 2: A graphical representation of results given in Table 2

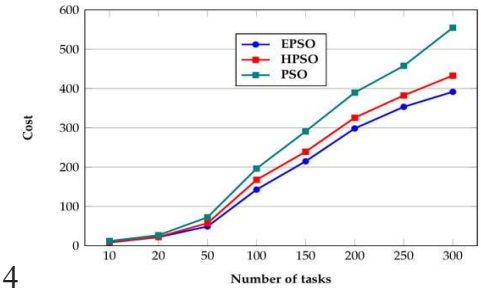


Number of Tasks	EPSO	HPSO	PSO
10	72.325	83.534	92.785
20	81.563	95.265	108.783
50	99.125	114.255	127.678
100	127.425	154.678	189.425
150	151.897	178.787	217.454
200	178.578	212.673	259.425
250	198.435	226.524	287.542
300	225.523	254.246	327.789

Table 3: Time performance under different number of independent tasks

According to Figure 2, it can be seen that when dealing with independent tasks, the EPSO algorithm is slightly better than the HPSO algorithm and obviously better than the PSO algorithm.

Table 4 shows the experimental data of EPSO algorithm, HPSO algorithm, and PSO algorithm on the cost of different task numbers, and Figure 3 shows the results ofTable



4

Figure 3: A graphical representation of the results given in Table 4

Number of Tasks	EPSO	HPSO	PSO
10	8.2	9.3	11.9
20	21.7	22.4	26.8
50	49.1	57.4	72.3
100	142.8	167.7	196.4
150	214.7	239.1	290.9
200	298.3	325.7	389.5
250	353.3	382.4	457.5
300	391.5	432.8	554.7

Table 4: Cost performance under different numbers of independent tasks.

Figure 3 While the EPSO algorithm achieves a shorter completion time, it also optimizes the cost to a certain extent.

4 Proposed Work

The selection of functions is the most important issue. Feature classification problems are one of the main operations in data mining. All search methods require a performance evaluation to decide how effective the function is for a particular data set. This article uses PSO and ACO to optimize meeting scheduling solutions. ACO is inspired by the age of an ant colony. At the heart of this behavior is indirect communication between ants, which allows them to find short routes between the nest and food sources. This feature of real ant colonies is used in the ACO algorithm to solve discrete optimization problems. The PSO technique, which is based on the observed social behavior of animals or insects, is becoming increasingly popular in PSO research. Trainers represent a powerful and efficient technique for solving difficult, robust, population-based optimization problems. Both ACO and PSO are data clustering algorithms that implement swarm behavior, while ACO is more suitable for problems where the source and destination are predetermined and are specific. Meanwhile, PSO is a clustering algorithm for dynamic multi-objective optimization and restriction area management. ACOs are more appropriate to problems that require crisp results, and the type of PSOs are intended for ambiguous problems.

5 Results and Discussion

The choice between EPSO and ACO for meeting scheduling depends on the specific characteristics of the problem and the goals of optimization. The main advantages of applying EPSO to ACO for meeting scheduling are convergence speed and Exploration-Exploitation Balance. EPSO often converges faster than ACO. The swarm-based approach allows particles to share information and explore the solution space more efficiently, potentially leading to quicker convergence to a solution. EPSO naturally balances exploration and exploitation. The particles in the swarm share information, facilitates exploration of the solution space. It can be beneficial to find multivariate and globally optimal solutions. The other advantages are Simplicity of Implementation, Fewer Hyperparameters, Flexibility in Representation, Adaptability to Dynamic Environments and Less Sensitivity to Parameter Settings.

6 Conclusion

In this study, we proposed a cloud computing approach for meeting scheduling using ACO and PSO algorithms. Based on previous research on task scheduling of ACO and PSO algorithms, considering the time cost problem of processing workflow tasks, a workflow task model processing algorithm is proposed, which proposes the optimization of PSO algorithm under the premise that execution times and costs be optimized. The performance results show that the EPSO algorithm proposed by effectively reduces delays and costs. Based on our results, we believe that it will help professionals make decisions about the meeting schedule due to its high efficiency. In order to plan meetings early, this study provides information on the possibilities of using cloud computing methods. The adaptive function may be improved in the future depending on the application scenario.

Acknowledgment

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7 References

1) https://iopscience.iop.org/article/10.1088/2631-8695/ac3e13/meta

2) https://www.semanticscholar.org/paper/Optimize-Workflow-Scheduling-Using-Hybrid-Ant-(ACO)-Rai-Lala/d7d2fbb96583d6c47f26f6b83dc09d26b478dbc5

3) B. Booba. T.V. Gopal, 'Comparison of Ant Colony Optimization & Particle Swarm Optimization in Grid Environment' International Journal of Advanced Research in Computer Science and Applications Vol.1, Issue 5, November 2013.

4) https://en.m.wikipedia.org/wiki/Particle_swarm_optimization.

5) https://arxiv.org/abs/2203.12239

6) Van den Bergh, F., Analysis of particle swarm optimization. Ph.D. thesis, University of Pretoria, South Africa, 2002

7) Dorigo M., Ant Colony Optimization, Scholarpedia, 2007.

8) https://www.ijcaonline.org/volume5/number4/pxc3871286.pdf

9) Marston, S.; Li, Z.; Bandyopadhyay, S.; Zhang, J.; Ghalsasi, A. Cloud computing—The business perspective. Decis. Support Syst. 2011, 51, 176–189.

10) Ibrahim, I.M.; Zeebaree, S.R.M.; M. Sadeeq, M.A.; Radie, A.H.; Shukur, H.M.; Yasin, H.M.; Jacksi, K.; Rashid, Z.N. Task Scheduling Algorithms in Cloud Computing: A Review. Turk. J. Comput. Math. Educ. (TURCOMAT) 2021, 12, 1041–1053. [Google Scholar] [CrossRef]

11) Hamed, A.Y.; Alkinani, M.H. Task scheduling optimization in cloud computing based on genetic algorithms. Comput. Mater. Contin. 2021, 69, 3289–3301. [Google Scholar] [CrossRef]

12) Sharma, P.; Shilakari, S.; Chourasia, U.; Dixit, P.; Pandey, A. A survey on various types of task scheduling algorithm in cloud computing environment. Int. J. Sci. Technol. Res. 2020, 9, 1513–1521. [Google Scholar]

13) Xue, S.J.; Wu, W. Scheduling Workflow in Cloud Computing Based on Hybrid Particle Swarm Algorithm. Telkomnika Indones. J. Electr. Eng. 2012, 10. [Google Scholar] [CrossRef]

Deep learning: empowered COVID-19 patient monitoring using non-contact sensing

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Abstract

Coronavirus disease 2 (SARS-CoV-2), which caused the coronavirus disease 2019 (COVID-19) pandemic, has afflicted more than 400 million of population worldwide. With the recent emergence of the new Delta and Omicron variants, vaccine effectiveness has become an important issue. Various studies aim to limit the spread of the virus by using automatic prediction technology to prevent person-to-person interactions, especially between healthcare workers. Thanks to, the extraordinary success of deep learning of

various kinds is possible to achieve better performance, architectures of this technique are used. The purpose of this article is to examine recent work on automatic detection of the SARS-CoV-2 virus using deep learning. Also, this article helps to guide researchers by reviewing previous works and providing insights into upgrade in the field. COVID-19 is an effective screening test for infected patients, and one of the main screening methods is radiological examination using chest X-ray. Early studies found that patients had chest

X-ray abnormalities typical of people infected with Covid-19. In this article, we designed a CNN project capable of detecting COVID-19 cases from chest X-ray (CXR). Step up the expansion of highly accurate and pragmatic deep learning solutions for detecting COVID-19 cases. This article highlights the enormous role of deep learning in medicine and also presents some future development directions.

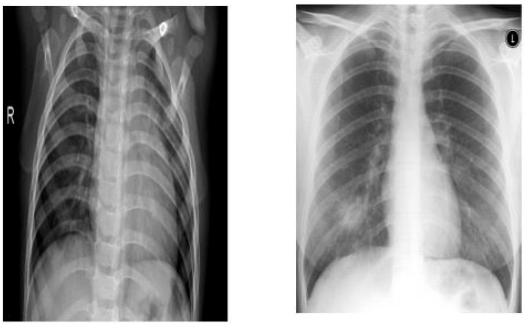
Index terms - Covid-19, XCeption, Inception V3, ResNext , ResNet50 , Deep-learning , Chest X-ray images , CNN.

1. Introduction

The novel coronavirus disease (known as COVID-19) emerged in Wuhan, China in December 2019 and had a significant impact on the world soon after. To date, this has resulted in millions of confirmed cases and thousands of deaths worldwide. Therefore, early and accurate diagnosis of COVID-19 is of great importance to control the spread of the disease and reduce its mortality rate. Currently, the gold standard for diagnosing Covid-19 is reverse transcription polymerase chain reaction (RT-PCR). This test detects viral nucleic acid in sputum or a nasopharyngeal swab There are several problems with this testing mechanism. Radiological imaging of the chest, such as an X-ray, plays a key role in the early detection and treatment of this condition. Due to the low sensitivity of RT-PCR (60-70%), symptoms can be detected from the patient's X-ray images even if the result is negative. Deep learning techniques have been successfully applied to many problems such as: Such as arrhythmia detection, skin cancer classification, breast cancer detection, brain disease classification, pneumonia detection from chest X-ray, fundus image segmentation, and lung segmentation. Deep learning technology could make it possible to use X-rays to clearly distinguish intangible features that could reveal infection. The proposed work attempts to determine how well a Deep Convolutional Neural Network (CNN) can learn this pattern from radiological data. In this study, a deep learning model was proposed for automatic diagnosis of COVID-19. The most commonly used feature extractor is a Convolutional Neural Network (CNN). Classification of features obtained from various convolutional neural network (CNN) models using support vector machine (SVM) classifier using X-ray images. The proposed model has an end-to-end architecture and does not use features and requirements of a feature extraction method Raw chest X-ray images for diagnosis.

From Kaggle’s repository consists of 2159 total chest X-ray images. This data set is further divided into training (i.e., 1835) and validation (i.e., 324) set of normal and covid. In the training set, 1345 is normal and 490 are covid. In the validation phase, 238 samples of a normal case, 86 covid were considered for this analysis. Fig.1 shows the X-ray images of normal and Covid-19. We implemented three models i.e., Inception V3, Xception, ResNeXt, and ResNet50 on a collected dataset of chest X-ray images. We have

compared Inception V3, Xception, ResNeXt and ResNet50 models and examined their accuracy. In result analysis, ResNet50 model gives the highest accuracy (i.e., 99.98%) among the other four models.



Normal Covid-19

Fig. 1.

2. Materials and methods

2.1 Dataset

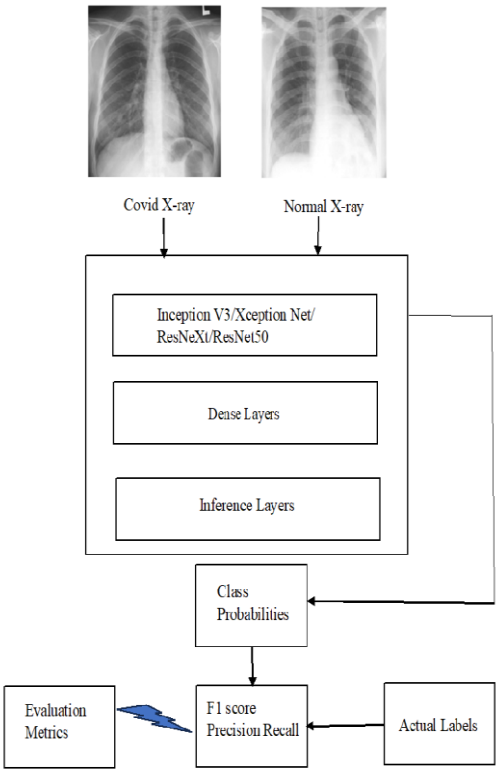
The dataset for this task was downloaded from the Kaggle library, which contains the images of chest X-rays of various people with and without Covid-19. Our dataset includes 2,160 chest X-rays. This data set is then split into training (i.e. 1834) and validation (i.e. 325) normal and covid together. In the training set, 1335 is normal and 500 is Covid. In the time of validation phase, 240 samples from normal cases and 84 samples from Covid cases were examined for the analysis.

2.2 Model formulation

The data obtained from the Kaggle repository was cleaned as compulsory. Implementing a deep learning method requires a large amount of data to obtain reliable results. However, particularly in the medical field, it may happen that there is not enough data for every problem. Collecting medical data can sometimes be time-consuming and expensive. The increase can be used to solve this type of difficulty.

Augmentation can overcome the overfitting problem and increase the accuracy of the proposed model. In addition, the collected dataset was expanded to avoid overfitting. Improvements included rotation, zoom, image sharing and more. Then, the prepared dataset was used to train the proposed model. For better analysis, four different models

were implemented and then their performance was compared to calculate the accuracy using different equations. In the given models, here we have implemented LeakyReLU activation instead of the ReLU activation function we used originally, making it a new method. This process helps us speed up our training and also avoids the problem of dead neurons. Figure 2 shows the proposed model for analysing chest X-ray images.



Trained model

Fig. 2 Proposed model

2.2.1 Inception V3

Inception v3 is an image recognition model that has been proven to achieve an accuracy rate of over 78.1 on the ImageNet dataset. It is a convolutional neural network that supports image analysis and object recognition and was developed as a module for GoogLeNet. It has a depth of 48 layers. We can load a pre-trained version of the network trained on over a million images from the ImageNet database. A pre-trained network can classify images into different object classes containing thousands of words. In this way we can reduce the number of parameters and increase the training speed. Figure 3 shows the architecture of the Inception V3 model.

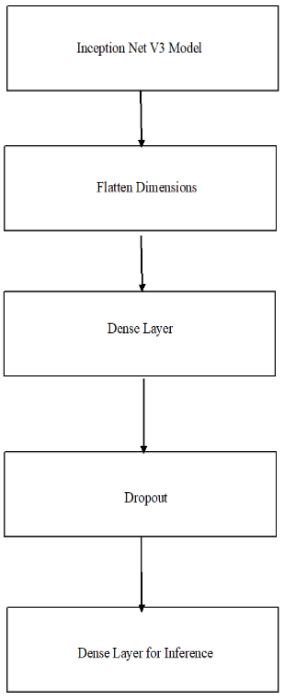


Fig.3 Architecture of Inception V3

2.2.2 XCeption

Xception is a modification of the inception net. It is a deep convolutional neural network architecture that involves Depth wise Separable Convolutions. Google conferred an interpretation of Inception modules in convolutional neural networks as being a transitional step in-between regular convolution and the depth wise divisible convolution operation (a depth wise convolution followed by a point-by-point convolution). Its parameter size is cognate to the Inception V3, but it performs slightly better as compared to the inception V3. The engrossed form of the Xception model. Fig.4 shows the architecture of Xception model.

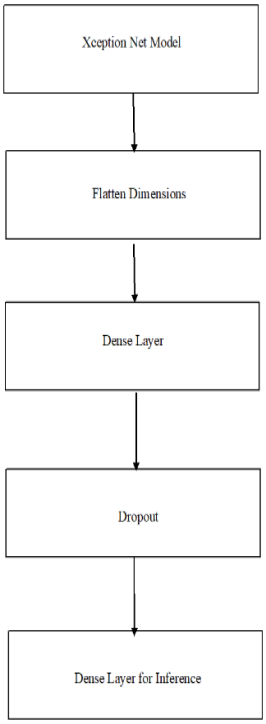


Fig.4 Architecture of Xception

2.2.3 ResNeXt

ResNeXt is an extension architecture for deep residual networks. In this model, the remaining standard blocks are replaced with a block that utilizes the split-transform-merge strategy used in Inception models. ResNeXt models were proposed in the article Aggregated Residual Transformations for Deep Neural Networks. Here we have 2 versions of the ResNeXt models containing 50 and 101 layers respectively. Figure 5 shows the architecture of the ResNext model.

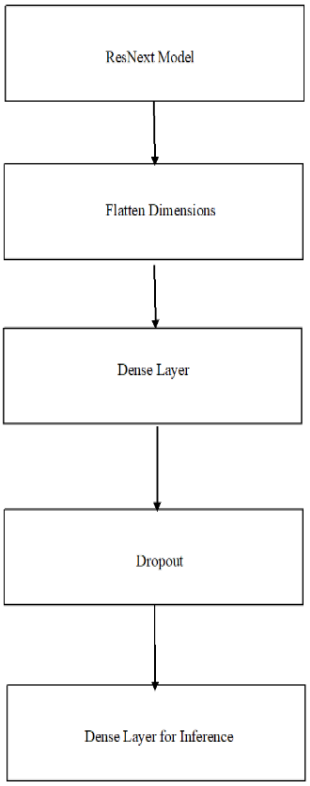


Fig.5 Architecture of ResNext

2.2.4 ResNet50

ResNet, an abbreviation for Residual Network, represents a distinctive category of Convolutional Neural Network (CNN). ResNet50 specifically denotes a 50-layer network that has been trained using the ImageNet dataset. ImageNet serves as a comprehensive image database and it is initially designed for competitions focused on image recognition. Moreover, the ResNet50 model employs bottleneck blocks to enhance the training process. The architecture of the ResNet50 model is illustrated in Figure 6.

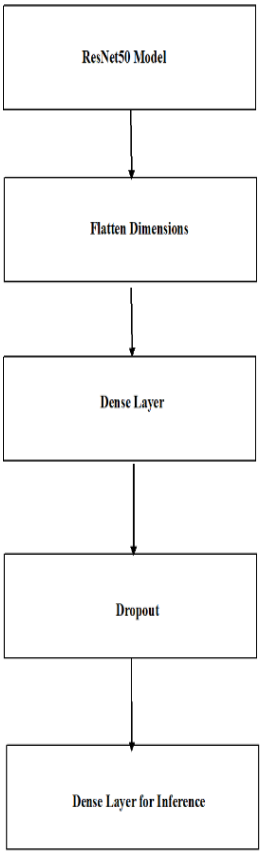


Fig.6 Architecture of ResNet50

2.3 Proposed algorithm

The approach used to implement the proposed model is clarified below.

Step 1: Preprocess the image, i.e. image=X

preprocessing applied (for this, we used the Keras data generator)

i.) Change the shape of the image (X) to (128, 128, 3)

ii.) Random rotation field = 10°

iii.) Horizontal Flip = True

iv.) Zoom range = 0.4

Note: form = (128, 128, 3) for fast processing form = (256,256,3) for better performance

Step 2: Apply the image to the pre-trained model as it's input

Step 3: Obtain the result of the last convolution layer of the specified model

Step 4: Reduce dimensions by reducing n dimensions to n1.

Step 5: Apply a thick layer

$$Z = W*A+b \quad (1)$$

where W = weight and b = deviation

Step 6: Apply activation

$$A=\text{LeakyReLU}(Z) \quad (2)$$

Step 7: Apply Dense Layer for inference

$$Z=W*A+b \quad (3)$$

Step 8: Apply SoftMax for classification SoftMax=

$$\sigma(\vec{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}} \quad (4)$$

The proposed model has been evaluated with the help of different parameters such as precision, recall, F1 score and its accuracy, sensitivity as shown in Eqs. (5) to (9).

Precision = True Positive /True Positive + False Positive (5)

Recall (or Sensitivity) = True Positive/True Positive + False Negative (6)

F1 Score = 2* Precision*Recall/Precision + Recall (7)

Accuracy = True positive + True Negative /True positive + False Negative + True Negative + False Positive (8)

Specificity = True Negative / True Negative + False Positive (9)

3.Experimental results and discussions

In the final scrutiny of result, regular chest X-ray images have been compared with Covid-19 troubled people. Inception Net V3, Xception Net, ResNeXt and ResNet50 are analysed based on accuracy matrices. The results were then contradictory to determine the best model. Although the model accuracies are high, we recommend validating the performance using future updates on the dataset.

3.1 Inception net V3

It is a state-of-the-art CNN for classification. It has a depth of 48 layers and uses starting modules consisting of a simply connected layer with 1×1, 3×3 and 5×5 contractions. In this way we can reduce the number of parameters and increase the training speed. It is also called the GoogLeNet architecture. Tables 3 and 4 show the f1-score of the training and testing sets for the Inception V3 model.

Table 3 Training Data

Label	Precision	Recall	fl-score
Normal	1.00	0.97	0.99
Covid-19	1.00	1.00	1.00
Accuracy			1.00

Table 4 Testing Data

Label	Precision	Recall	fl-score
Normal	0.98	0.87	0.92
Covid-19	0.95	0.95	0.96
Accuracy			0.94

3.2 Xception net

It is a alteration of the inception net. In this model, the inception modules are replaced with depth wise separable convolutions. Its parameter size is same to the Inception net, but it performs lightly better as compared to the inception net. Tables 1 and 2 depict the f1-score for training and testing set for XCeption Net Model.

Table1 Training Data

Label	Precision	Recall	fl-score
Normal	1.00	0.99	1.00
Covid-19	1.00	1.00	1.00
Accuracy			1.00

Table2 Testing Data

Label	Precision	Recall	fl-score
Normal	0.98	0.93	0.95
Covid-19	0.99	0.92	0.95
Accuracy			0.95

3.3 ResNext

This architecture is an extension of the deep residual network. In this exemplary, the standard remaining blocks are recouped with one that leverages a split - transform - merge strategy used in the Inception models. Tables 5 and 6 show the f1-scores for the training and testing sets for ResNeXt Model.

Table 5 Training Data

Label	Precision	Recall	fl-score
Normal	0.99	0.98	0.98
Covid-19	1.00	0.90	0.95
Accuracy			0.97

Table 6 Testing Data

Label	Precision	Recall	fl-score
Normal	0.91	0.89	0.90
Covid-19	0.97	0.78	0.86
Accuracy			0.89

3.4 ResNet50

ResNet, an abbreviation for Residual Network, represents a distinctive category of Convolutional Neural Network (CNN). ResNet50 specifically denotes a 50-layer network that has been trained using the ImageNet dataset. ImageNet serves as a comprehensive image database and it is initially designed for competitions focused on image recognition. Moreover, the ResNet50 model employs bottleneck blocks to enhance the training process. Tables 7 and 8 show the f1-scores for the training and testing sets for ResNet50 Model.

Table 7 Training Data

Label	Precision	Recall	fl-score
Normal	0.99	1.00	0.99
Covid-19	1.00	1.00	1.00
Accuracy			1.00

Table 8 Testing Data

Label	Precision	Recall	fl-score
Normal	0.98	0.99	0.98
Covid-19	0.99	0.98	0.98
Accuracy			0.98

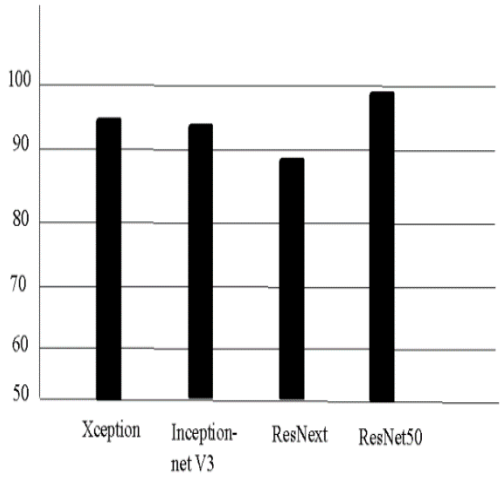


Fig. 7.

Accuracy using ResNet50

4. Conclusion

In this study, we proposed a deep learning-based approach using chest X-ray images obtained from COVID-19 patients and normal to predict COVID-19 patients automatically. Performance results show

that the ResNet50 pre-trained model yielded the highest accuracy of 99.98% among the four models. Figure 7 shows the accuracy of the models as a graph. In the light of our findings, it is believed that it will help doctors to make decisions in clinical practice due to the high performance. In order to detect COVID-19 at an early stage, this study gives insight on how deep learning methods can be used. In subsequent studies, the classification performance of different CNN models can be tested by increasing the number of images in the dataset.

Acknowledgment

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References

[1] Aras M. Ismael a, Abdulkadir S¸engür [2021]: Deep learning approaches for COVID-19 detection based on chest X-ray images.

[2] Shayan Hassantabar a, Mohsen Ahmadi b, Abbas Sharif [2020]: Diagnosis and detection of infected tissue of COVID-19 patients based on lung x-ray image using convolutional neural network approaches.

[3] Chaimae Ouchichaa, Ouafae Ammor a,Mohammed Meknassi [2020]:CVDNet:A novel deep learning architecture for detection of coronavirus (Covid-19) from chest x-ray images.

[4] R. Karthik, R. Menaka, Hariharan M [2021]: Learning distinctive filters for COVID-19 detection from chest X-ray using shuffled residual CNN.

[5] L. Wang and A. Wong, "COVID-Net: a tailored deep convolutional neural net- work design for detection of COVID-19 cases from chest X-Ray images," Mar. 2020.

[6] A. Narin, C. Kaya, and Z. Pamuk, "Automatic detection of coronavirus disease (COVID-19) using x-ray images and deep convolutional neural networks," Mar. 2020.

[7] M. Barstugan, U. Ozkaya, and S. Ozturk, "Coronavirus (COVID-19) classification using CT images by machine learning methods," Mar. 2020.

[8] E. E.-D. Hemdan, M. A. Shouman, and M. E. Karar, "COVIDX-Net: a frame-work of deep learning classifiers to diagnose COVID-19 in x-ray images," Mar. 2020.

[9] Rachna Jain1 & Meenu Gupta2 & Soham Taneja1 & D. Jude Hemanth [2021]: Deep learning-based detection and analysis of COVID-19 on chest X-ray images.

[10] Mehmet Sevi, İlhan AYDIN [IEEE][2020]:COVID-19 Detection Using Deep Learning Methods.

[11] E. E.-D. Hemdan, M. A. Shouman, and M. E. Karar, "COVIDX-Net: a frame-work of deep learning classifiers to diagnose COVID-19 in x-ray images," Mar. 2020.

[12] A. Narin, C. Kaya, and Z. Pamuk, "Automatic detection of coronavirus disease (COVID-19) using x-ray images and deep convolutional neural networks," Mar. 2020.

[13] Kaggle(2020a) Covid-19 X-ray chest and CT [dataset]. Retrieved April 20, https://www.kaggle.com/bachrr/covid-chest-Xray.

[14]https://www.mathworks.com/help/deeplearning/ref/resnet50.html.

[15]https://www.mathworks.com/help/deeplearning/ref/inception.html.

[16]https://www.mathworks.com/help/deepl5arning/ref/xception.html.

[17]https://www.mathworks.com/help/deeplearning/ref/resnext.html.

Smart Traffic Management System Using IoT

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Abstract

The quantity of cars on the road has increased significantly in recent years. Every day, the problem of traffic congestion affects all of us more and more. It is necessary to undermine the effectiveness of traffic police's manual traffic control. Neither did the predefined set time for a signal fix this problem. In addition, neither the current nor the future generations can benefit from the current urban transportation management system. Additionally, there is an increasing need for an effective traffic control system. An efficient approach to addressing the previously described problems makes use of the Internet of Things (IoT). It improves the idea of the smart city with features like anti-theft security systems, smart parking, and serves as middleware on the foundation of the Internet of Things.The sole use of IoT is the use of embedded sensors, actuators and smart unique devices that help with the management of traffic with ease and tranquility thereby reducing the congestion and other problems faced by the people around.

Keyword – Internet of Things, Actuators, Sensor.

I. INTRODUCTION

In the world where urban development is at its peak,the road infrastructure has alsp been increased to a greater extent which has led to extensive traffic,incidents relating accidents ,collisions etc. In this, it has been seen that the manual traffic system is not reliable and is also causing a lot of sustainability issues such as causing a lot of pollution and so on. The traffic police system is now not reliable as in means that it is becoming impossible to manage such a heavy load of traffic. In this case the traffic management system should be changed and there is a huge need for that.With the help of smart technologies that we see in our day to day lives, this traffic problems can be solved and adjusted within just the tip of our fingers.With the help of such smart sensors and pins which communicate with each other and gives the exact traffic points our manual traffic managing system can be thereby solved easily.

With the help of hall effect sensors and the raspberry gpio pins they enable the smart technologies in such a way that they communicate with another and thereby provide a way to help enable a smooth trafficking system.

The amount of time that the traffic signals flash green or red should vary depending on how many cars are in the area. Green lights should remain on longer when there is a lot of traffic in one way; less traffic should signify the red lights should stay on for a longer period of time when there is less traffic.

It is anticipated that this method will reduce traffic and pollution, as well as decrease inefficiencies at crossings.

We are putting forth a potent method in this framework that makes use of radio wave flagging mechanism to identify the vehicles.

Vehicles will be able to be detected and included in a framework that emits an SOS signal. This signal is recognized by a sign detection unit, which delivers a crisis trigger to the traffic inside the executive's framework. As per this framework, the crisis vehicle can be identified approximately 500 meters from the sign. At that point, the control unit issues a green signal towards the path the vehicle is approaching. This prevents the vehicle from stalling out of an automobile overload and gives a sign free hall. Even the signaling of each vehicle is given by the order of precedence. The order of the precedence is as follows:

- AMBULANCE
- FIRE TRUCK
- POLICE VEHICLES.

The element that comprises a combination of more than two types of emergency vehicles approaching the signal is also taken into consideration by the order of precedence.

The trigger is pulled when the source is in the same direction as the oncoming emergency vehicle, and this way is given priority over the other.

For emergency vehicles that do not currently have the necessary infrastructure for the signal-free movement of emergency vehicles, this offers an efficient means of supplying a signal-free path automatically.

Traffic congestion is a major problem for residents of smart cities like Delhi, Bangalore, Mumbai, Hyderabad, and others in the current situation. In the modern era, this has become a daily issue. Road congestion has increased the number of accidents in the city, making the lives lost in these incidents even more important. Emergency vehicles, fire trucks, ambulances, and other vehicles are unable to arrive on time because of this traffic congestion. This leads to a significant loss of life. We offer a method in this work to address these problems to a large degree.

II. DESCRIPTION

The Internet of Things (IoT), or sometimes the Internet of Everything (IoE), is the collective term for any web-enabled devices that capture, communicate, and act upon data they get from their surrounding surroundings using embedded sensors, processors, and communication hardware. These devices—which are frequently referred to as "connected" or "smart" devices—can occasionally interact with one another by exchanging data in a process called machine-to-machine (M2M) communication. The development of sensor networks, mobile networks, wireless communications, networking, and cloud technologies has sparked a new Internet revolution known as the "Internet of things," which is gaining speed quickly [2].

Although the gadgets perform the majority of the job without human assistance, people can still interact with them to program, view, or give directions.

Our networks, personal and professional, have enabled them to exist because of a number of modest, portable components that are readily available combined with their ongoing online presence. When linked gadgets link to the Internet, they also produce large amounts of data. Either the gadgets themselves or other applications may mine this data. With all of this new data, along with the gadgets' Internet accessibility, security and privacy concerns are raised. But because to technological advancements, we can now obtain a level of real-time knowledge that was previously unattainable. To keep them safe, we may keep an eye on our families and homes from a distance. Increasing output

while reducing costs is possible for firms through process optimization. The fundamental idea behind adjusting traffic light timing in accordance with current traffic circumstances is this. Data regarding the current number of vehicles on the road is gathered by the sensor.

- Sensor data is gathered and saved on cloud storage.
- The microcontroller receives this data and uses it to calculate the signal change for each lane.
- The microcontroller receives data directly in the event of an emergency, so it terminates the loop and changes the signalling immediately [2].

1. THE ESSENTIAL DUTIES FOR TRAFFIC MANAGEMENT USING THE IOT SYSTEM:

IoT Control Systems and Traffic Lights: Although they resemble traditional stoplights, smart traffic signals use a range of sensors to track traffic in real time. Generally, the goal is to help vehicles reduce idle time. Additionally, the signals may communicate with one another through Internet of Things technologies. All of this is done in real-time as they adjust to changing traffic conditions, resulting in reduced time spent stuck in traffic and even lower carbon emissions.

Parking Made Possible by IoT: Smart meters and mobile apps enable fast notifications for on-street parking spaces. When a spot becomes available, drivers are alerted so they can reserve it immediately. The app offers straightforward directions to the location.

IoT-Powered Traffic Monitoring System for Emergency Assistance: In the event of an accident late at night or in remote areas, emergency responders can act more quickly thanks to this IoT-powered traffic monitoring system. When an accident is detected by the road's sensors, the traffic management system is notified right away. The appropriate authorities are notified of this request and will take appropriate action. For improved responsiveness and prompt intervention, emergency response staff would include members of the fire, police, and medical departments.

2.KEY FEATURES OF A SMART TRAFFIC MANAGEMENT SYSTEM

The salient features are listed below, and they vary depending on the size of the city and the extent of government regulation. It can be included into a system of intelligent traffic management. They include:

Traffic Jam Detection: Experts can remotely monitor every street in real-time from the city's traffic control room by using sensors, cloud connectivity, and CCTV cameras to continuously monitor junctions.

Connected Vehicles: By linking roadside monitoring sensors to an Internet of Things-based smart traffic system, it is possible to provide direct communication between intelligent vehicles and intersections.

Modular Control: In the case of an auto accident or collision, the technologies in charge of traffic signals, express lanes, and entrance alarms dynamically adapt their capabilities. This allows for real-time congestion monitoring.

Road Safety Analytics: Systems that are able to recognize patterns can detect unsafe pedestrian behaviour, reckless driving, and high cruising speeds fast. [2].

III. APPLICATIONS USING IoT IN TRAFFIC MANAGEMENT SYSTEM.

1. SMART PARKING

It may be quite challenging to get a parking spot in a crowded city during rush hour, which can be time-consuming and irritating. Additionally, the careless drivers who hunt for parking spots exacerbate traffic congestion. This is the goal and practical use of smart parking techniques. Drivers may find parking spaces more easily and conveniently with the help of smart parking. The IoT technology that powers smart parking counts the number of available parking spaces and transmits the data to the back ends of smart parking applications via the internet. Drivers can use their smart phones, tablets, and in-car navigation systems to access these applications. Each parking space in smart parking has sensors to determine whether it is occupied or empty. This data is compiled by a local controller and then sent to the internet over the database.

Monitoring vehicle and pedestrian traffic in a parking lot is another responsibility that an IoT Smart parking management system handles. By restricting which vehicles are

allowed entry, video surveillance can be integrated into the system to enhance parking management and address possible issues like theft or traffic accidents [1].

2. SMART LIGHTING

Smart Lighting Systems using IoT, which is revolutionizing the way we illuminate and interact with our surroundings. Imagine a home where lights adapt to your needs, creating an atmosphere of comfort and efficiency. With IoT-enabled smart lighting, this is no longer a distant dream but a reality.

Smart lighting systems using IoT allow us to control our lights remotely through connected devices, such as smart bulbs or switches, which this system allow us to control our lights remotely through smartphones or other devices. Forget about manually switching off lights; now you can do it with a simple tap on your phone screen. Moreover, scheduling features enable lights to automatically adjust based on your routine, dimming and colour changing enhancing energy efficiency and user convenience reducing unnecessary consumption.

3. SMART ROADS

When a smart road is fitted with sensors, it may give information on the driving conditions, predict trip times, and send out alarms in the event of poor driving conditions, heavy traffic, or accidents. By providing this information, traffic congestion can be decreased and road safety can be increased. Drivers who subscribe to these programs might receive information gathered from the roadways over the Internet and shared with social media and cloud-based services. A distributed and autonomous sensor network node system is proposed in HTTP to increase driving safety on public roads. In order to enable them to respond to possible hazards before they arise, the system can give drivers and passengers a consistent view of the road conditions a few hundred meters or a few dozen miles ahead of them. The integration of IoT technology into our road infrastructure is reshaping the way we travel, ensuring safety, efficiency, and sustainability [1].

4. EMERGENCY RESPONSE

The way emergency response teams manage crises and disasters has been completely transformed by the Internet of Things (IoT) integration. IoT-enabled devices, sensors, and

real-time data analytics contribute to more efficient, timely, and coordinated emergency responses, enhancing overall public safety. The deployment of sensors, connected devices, and real-time data analytics enables emergency responders to act swiftly and intelligently. One of the key features of IoT to emergency response is in early detection and prediction. Sensors placed in vulnerable areas can detect environmental changes, such as rising water levels or seismic activity, triggering immediate alerts. This early warning system empowers authorities to evacuate areas at risk and mitigate potential disasters. The integration of IoT into emergency response is a beacome of hope in times of uncertainty. It transforms our approach from reactive to proactive and to save lives and minimize the impact of disasters.

III. SYSTEM ANALYSIS

A. EXISTING SYSTEM

Generally speaking, traffic police are in charge of the outgoing traffic system. The primary flaw in this traffic police-controlled system is that it lacks the intelligence to handle traffic congestion. An official in charge of traffic enforcement may decide to block a road for an extended period of time or to allow traffic on another road to pass; in other words, their decision-making may not be as sound as it could be and it will always be at their discretion. Furthermore, the duration of the green or red signal for a vehicle is set, even in the case of traffic lights being used. Consequently, it might not be able to address the issue of traffic congestion. It has been observed in India that even in the presence of traffic lights, traffic police officials are on duty, which means that in this system more manpower is required which is not economic in nature [4].

Disadvantages of Existing System

- Traffic congestion
- No means to detect traffic congestion
- Number of accidents are more
- It cannot be remotely controlled
- It requires more manpower
- It is less economical

B. PROPOSED SYSTEM

The wireless sensor nodes, which are made up of sensors, are the initial and most important component of this system. While the local server transmits the sensor data to the central microcontroller, the sensors interact with the actual environment—that is, the presence or absence of cars. The 4*2 array of sensor nodes is used in this system in every manner. This denotes two lanes in each direction and four traffic levels. The ultrasonic sensors are designed to provide status information based on the proximity of a vehicle. Every junction has a central microcontroller that receives transmissions from the sensor nodes at predetermined intervals. After receiving the signal, the microcontroller determines which lane and which road should be selected depending on the traffic density. Next, the microcontroller's computed data is sent to the local server through the Wi-Fi connectivity. The controller makes use of the collected data to perform the intelligent Traffic routing. In this system the primary aim is to gather the information of moving vehicles based on WSN to provide them a clear path till their destinations and traffic signals should switch automatically to give a clear way for these vehicles. In addition to reducing traffic congestion, the proposed system will provide an option for continuing traffic in the event of an emergency or other roadblock issue. This option will be based on the density of the traffic lanes, meaning that specific times will be allotted for vehicles to pass. Since lane one has a 100% density, other traffic lights are red and lane one's traffic light will remain green until the oncoming traffic is cleared, as can be seen from the image provided.

Advantages of Proposed System

- Minimizes number of accidents.
- Reduces fuel cost and saves time.
- Low budget.
- Easy implementation and maintenance.
- Remotely controllable.
- Minimizes hassle and cost of communication.

IV. METHODOLOGY

In order to identify the existence of the radio wave emitter located within the emergency vehicle, a radio waves detector is installed at every intersection.

Every intersection has a microprocessor that gathers data from numerous sensors positioned at different angles, calculates the resultant time, and activates the LED lights for the determined amount of time.

THERE ARE 2 PHASES AND THEY ARE:

PHASE 1: To simulate a four-direction intersection junction, we are assuming four separate breadboards and placed three sides have hall effect sensors, and each side has a single green and red light. The Raspberry Pi's gpio pins are connected to every terminal on the LED lights and the hall effect sensor. All of the sensors in every direction record the instantaneous data of a given moment. The program then compares and determines which side has the maximum volume of traffic; the side with the maximum volume receives the green light, while the other three sides stay red. The program begins as soon as the final operational sensor notices that a vehicle is missing when it pulls out.

PHASE 2:

Upon activation, the autonomous managing traffic management system gathers data from multiple sensors, including ultrasonic detectors and radio wave sensors. The control unit gathers data from the sensors (S1 S2 S3 S4), identifying the side with the most traffic as well as the separation between each side's traffic. The best moment to release the green signal to the side that has been determined to have the greatest traffic distance is then determined by the raspberry pi controller. When the microcontroller's allotted time runs out, all of the other sensors' sensor data is gathered, and the side with the greatest traffic distance is determined to receive the green light. In the next case the last two sensor data is ignored and the other sensorsreadings are identified and green light signal preference is given to the side which has the highest traffic distance compared to the other sensor values. This process is continued till all the sides leading to an intersection has been given at least one green signal in the first loop.

When the second loop starts, all of the sensor data are collected once more, identifying the side with the most traffic and allowing the microcontroller to determine when it is best to release the green signal in that specific direction. This procedure keeps going until the system is manually shut off.

In the unlikely event that the radio wave detectors pick up an incoming radio signal indicating the arrival of an emergency vehicle.

As a result, the system detects the incoming emergency vehicle and fires a trigger. The control unit monitors this radio wave signal once more, and when the radio wave emitter gets 500 meters away from the junction, the microcontroller fires the last trigger, activating all the running process is cancelled and the preference is transferred in the direction of emergency vehicle is approaching. The microcontroller immediately changes the other direction signals to red and provides green signal to the direction in which the emergency vehicle is approaching. If there are emergency vehicles approaching in more than one direction then the order of preference is as follows: Ambulance> Fire Truck > Police trucks In the condition in which there are two emergency vehicles approaching in one direction and single emergency vehicle in another direction, the preference is given to the direction in which there are 2 or more than 2 emergency vehicles are approaching [5].

V. CONCLUSION

Smart traffic management system has proven to be an effective way to prevent large amount of traffic on roads and also reduces the causes behind accidents and collisions. The main criteria is its sustainability as it prevents pollution and conserves energy thereby reducing the amount of energy consumed. There are much more updations to be brought about such as android and IoS based applications which will help us navigate real time bus parking systems and also bus tracking as we see these days on train. The further upgradations will be brought about in future which will be sure be known to be as useful as the management of traffic enabled by IoT.

VI. REFERENCES

[1] https://www.scribd.com/document/513453064/Internet-of-Things-a-Hands-On-Approach-by-Arshdeep-Bahga-Vijay-Madisetti

[2] https://www.rishabhsoft.com/blog/smart-traffic-control-using-iot

[3] https://www.researchgate.net/publication/354303484_IOT_Based_Traffic_Management_System

[4] http://centrallibrary.cit.ac.in/

[5] https://www.jetir.org/papers/JETIR2104274.pdf

CREDIT CARD SCORING ANALYSIS USING MACHINE LEARNING AND DEEP LEARNING

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Abstract: In today's world, credit scores are essential to determine credit worthiness for lending institutions, and they impact everything from getting a mortgage to renting an apartment. This thesis addresses key challenges in credit scorecard development, focusing on three main contributions. Firstly, it evaluates the performance of supervised classification techniques on imbalanced credit scoring datasets. Secondly, it explores the low-default portfolio problem, a severe form of class imbalance in credit scoring. Thirdly, it quantifies differences in classifier performance across various implementations of a real-world behavioral scoring dataset. Additionally, the thesis demonstrates the use of artificial data to overcome challenges associated with real-world data, while acknowledging the limitations of artificial data in evaluating classification performance.

Keywords: Credit scoring, Machine learning, Deep learning, FE-Transformer, Feature selection.

Introduction

Credit scoring models play a crucial role in the business landscape, providing a numerical assessment of an individual's creditworthiness based on diverse financial factors. Lenders and credit card companies heavily rely on these scores to make informed decisions on loan approvals or credit extensions. Typically ranging from 300 to 850, higher scores signify better creditworthiness. Scores above 700 are generally considered good, while those below 600 are seen as poor. Despite meticulous verification processes, there's no absolute assurance that credit cards are granted only to deserving candidates, emphasizing the ongoing importance of refining credit assessment strategies. Credit scoring serves as a conventional decision model, primarily focusing on risk assessment related to credit

products like credit cards and loans. Financial institutions are increasingly embracing diverse risk assessment tools, including statistical analysis, to minimize potential risks. The utilization of deep learning algorithms, specifically transformers, based on online behavioral data has demonstrated superior performance compared to LSTM and traditional machine learning models. Our innovative end-to-end deep learning credit scoring framework incorporates both credit feature data and user behavioral data. The framework comprises a wide part and a deep part, enabling automatic learning from user data to enhance decision-making in credit granting.

Credit scoring process: Credit scoring which is a conventional decision model and it is mainly focusing on risk approximation approach associated with credit products such as credit card, loans, etc. and is estimated based on applicant's historical data which helps credit lenders in granting credit products. Probability of Default (PD) analysis is carried out for generating credit scores for individual customers to identify default when he visited a bank for a loan and check their credit score. The credit score is used by banks for credit bureaus.

Internal rate of Return (IRR): IRR is a crucial method for assessing investment profitability. While there are alternative strategies to gauge expected returns, the internal rate of return (IRR) stands out as the widely employed calculation. This rate plays a pivotal role in determining the interest assigned to loans for borrowers. It's noteworthy that IRR was historically associated with negative training examples.[3]

Credit risk components: Credit risk scoring involves various components to assess a borrower's creditworthiness: Credit history is used to examining the borrower's past credit behavior, including payment history, defaults and delinquencies. Credit utilization is the ratio of current credit usage to the total available credit, indicating the borrower's reliance on credit. Debt-to-Income Ratio(DTI) is assessing the borrower's ability to manage additional debt based on their income compared to existing debt obligations [5]. Length of credit history is the duration of the borrower's credit accounts, as a longer credit history provides more data for evaluation. New Credit is used to monitoring recent credit applications, as multiple applications within a short period may signal financial stress. Types of credit in use in considering the variety of credit accounts, such as credit cards, mortgages and installment loans, in the borrower's portfolio. Public records for to identifying any bankruptcies, liens or legal judgements that may impact creditworthiness.

Payment behavior is to assessing the consistency and timeliness of payments on existing credit accounts. Income stability is to evaluating the stability and reliability of the borrower's income source. Employment history be the stability and continuity of the borrower's employment can provide insights into their financial stability. Combining these components through statistical models, machine learning or deep learning techniques helps create a comprehensive credit risk score, aiding lenders in making informed decisions. Regular updates and refinements to the scoring model are crucial to adapt to changing economic conditions and borrower behaviors.

1. Credit Scoring System

In credit scoring system two phases are being used to find out the best practices for filtering the customers' matches for a particular credit score. In the first phase, application scoring is an initial assessment made based on the information provided by the borrower in their credit application. Commonly used models in this stage include rule-based systems or simpler analysis models to quickly filter and categorize applicants. In the second phase, behavioral scoring is done after passing the initial stage, borrowers undergo a more in-depth evaluation based on their behavior and credit history. This stage involves more sophisticated models such as machine learning or neural networks, to analyze historical data and predict future credit behavior. Our research is to build a reliable predictive model for credit scoring which helps lenders to allocate funds in financial institutions based on the credit score. The accurate outcome is produced by the model even if the dataset is imbalanced and improves the feature selection process by adopting a deep neural network which makes a balanced dataset. In this scheme, the decision tree classifier is used to assign new weight for every class in the predictive model with respect to accuracy. The model is validated on different credit scoring dataset in real-world scenarios and which is capable of improving the effectiveness and accuracy for training data and ensures that the training data is balanced.

2. Machine Learning and Deep Learning

Machine learning algorithms have transformed credit scoring, offering enhanced accuracy in assessing creditworthiness. Trained on extensive datasets, these models excel in pattern recognition, outperforming traditional credit scoring methods. A key advantage of machine learning lies in its capacity to mitigate bias. Unlike traditional models, which may exhibit

biases based on factors like race or gender, machine learning algorithms are designed to be unbiased, relying solely on data without incorporating preconceived biases. This contributes to fairer credit-scoring decisions. Moreover, machine learning excels in efficiency compared to traditional models. Rapid analysis of vast data sets enables near-instantaneous credit-scoring decisions, streamlining the lending process for both borrowers and lenders. In recent years, deep learning has demonstrated its efficacy across various applications such as text sentiment classification, image classification, and recommendation systems. Applying deep learning to credit scoring has shown promise, particularly in automatically learning features from data. The large volume, high dimension, and sequential nature of user online behavioral data pose challenges for traditional machine learning algorithms, motivating researchers to explore deep learning methods. Notably, Hidasi et al. enhanced recommendation systems using a recurrent neural network based on user online behavioral data, showcasing an improvement over existing methods. Long Short-Term Memory network (LSTM) to analyze consumer activity on e-commerce websites, yielding favorable experimental results. Existing models, such as the LSTM, exhibit long-term dependence but lack parallelization capabilities, warranting further exploration of deep learning algorithms. Notably, there is a research gap in the development of end-to-end neural network models for credit scoring, combining both user behavioral data and feature data.

3. Methods

LSTM: LSTM is widely used for processing sequential data like text classification and machine translation. It addresses long-term dependencies through gate structures, making it suitable for credit scoring analysis to capture temporal patterns. LSTMs find applications in various areas like time series prediction, handling variable-length sequences, feature representation, and default prediction. The forget gate, input gate, and output gate play key roles in managing information flow. However, LSTMs have limitations in parallel processing due to sequential calculations and may not entirely eliminate long-term dependency issues.

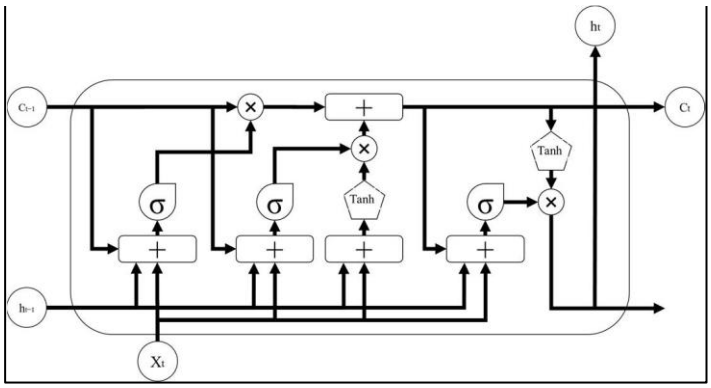

Figure : Structure of the LSTM model.

Transformer: The transformer model, initially employed by Google for machine translation, adopts an encoder-decoder structure with six layers in total—consisting of an encoder and a decoder. Unlike traditional models, it doesn't utilize a recurrent structure. Through a 6-layer encoder, input data progress to the decoder for attention calculation. The transformer comprises four modules: input, encoding, decoding, and output. Leveraging self-attention and parallel processing, it excels in machine translation, surpassing RNNs and CNNs as the current mainstream feature extractor. Addressing LSTM limitations, it utilizes attention to reduce sequence position distances and allows parallel computation, showcasing superior feature extraction capabilities in machine translation tasks. Consequently, attention-mechanism-based LSTM has transitioned to the transformer model's network structure [1,4].

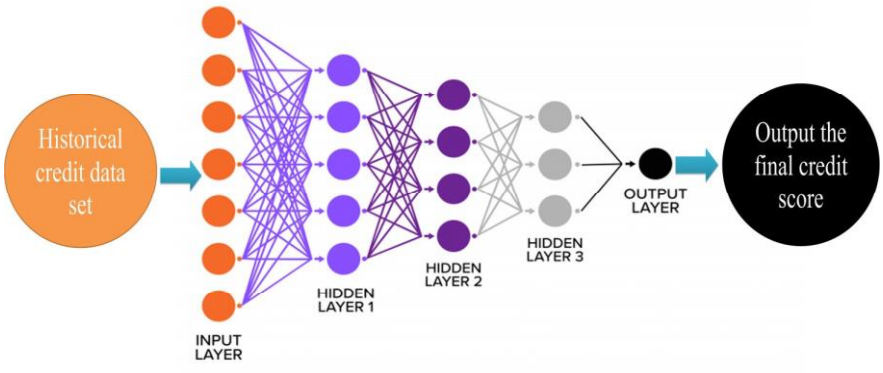

Figure: Deep neural network with hidden layers used in proposed approach.

The model effectively predicts new instances even with missing data, employing the ReLU activation function as a threshold mechanism. This boolean method classifies instances based on input and weight vectors, with a cost function minimizing squared

error. Additionally, a decision tree contributes to classification, resulting in optimal predictions for credit rating. [3]

Feature Embedded Transformer: In this research study, we integrate a transformer into credit scoring, presenting an end-to-end deep learning credit scoring framework known as the Feature Embedded Transformer (FE-Transformer). A FE-Transformer in credit scoring would involve incorporating both the temporal aspects of a borrower's financial history and the static features into a unified model. The model contains joint representations for both sequential and static features, leveraging the strengths of transformers in capturing long-term dependencies and feature embedding in handling categorical or numerical aspects.

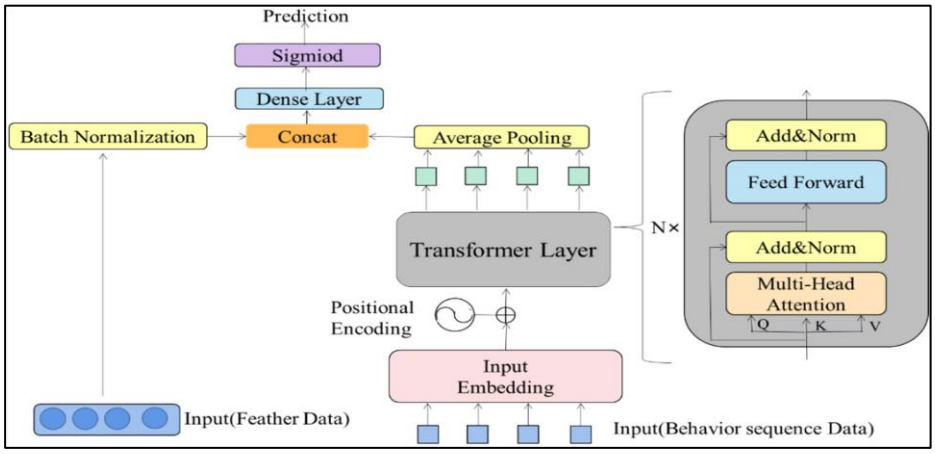

Figure: Network architecture of the FE-Transformer.

Input Data and Data Coding: The input data models consist of two types: feature data and behavioral data. Feature data containing gender, age, credit record, and other credit-related information, undergo processing before serving as model input. Behavioral data is inspired by NLP treats each behavior event as a word, forming a sequence resembling a sentence. Raw online operation behavior records are transformed into chronological event sequences. Through embedding and position encoding, behavioral data is encoded for model input. Events are converted to vectors using word embedding, and positional encoding is employed to capture event positions within the sequence. The resulting position vectors are added to the event vectors, creating the model input**.**

Transformer Encoding Layer: Layer consists of stacked encoders, each containing a multi-head attention layer and connected feed-forward layer. The embedding layer's output is processed through the multi-head attention and feed-forward layers in the encoder. The resulting encoding information matrix for all events in the behavior sequence is obtained after one or more encoders. The transformer architecture employs a self-attention mechanism, improving the model's ability to capture internal correlations without relying heavily on external information. Scaled dot-product attention is used in the attention layer, offering faster computation and space efficiency. The self-attention mechanism calculates the relatedness between events by projecting each event into query (Q), key (K), and value (V) vectors. These vectors are used to query candidate positions, and the dot products are scaled, normalized using softmax, and weighted to determine the final self-attention result.

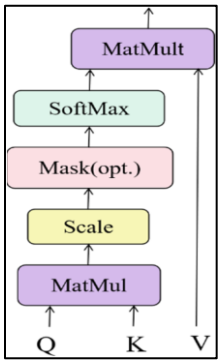

Figure: Scaled dot-product attention.

The multi-head self-attention mechanism in transformers allows the model to simultaneously capture diverse information from various positions and representation subspaces, enhancing its ability to understand the structure and relationships within sequences of events. This feature plays a crucial role in enriching the model's comprehension of both semantic and syntactic information.

Evaluation Metrics: In evaluating the model's performance for credit scoring, commonly used indicators include AUC and KS. AUC measures the model's ability to discriminate between defaulters and non-defaulters, with a higher value indicating better performance. KS assesses the maximum difference between cumulative distributions of good and bad credit applicants, emphasizing the model's ability to distinguish between defaulting and on-time borrowers. Precision and recall offer insights into positive predictions, and

accuracy, while assessing overall correctness, may be misleading in imbalanced datasets. The ROC curve, based on true positive rate (TPR) and false positive rate (FPR), visualizes model performance, with a curve closer to the upper left corner indicating better classification. The AUC value quantifies the ROC curve's proximity to perfection, offering a more precise evaluation [1,2].

4. Data Preparation

The initial phase involves collecting and preparing data from diverse sources, including credit bureaus, financial statements, and loan applications. This study utilizes a dataset from an anonymous P2P lending company in China, encompassing 100,000 borrowers with feature and behavioral data. Labels (1 or 0) indicate borrower default. Sorting loans by date, the last month's data form the test set (20% of the dataset) to assess model stability. The remaining data constitute training sets for model development. User behavioral data, varying in sequence length, is standardized to fixed-length sequences through preprocessing and coding.

5. Experimental Results

In the proposed credit scoring model, the FE-Transformer utilizes 2 transformer coding layers with 4 heads in the multi-head attention mechanism. To mitigate overfitting, a dropout of 0.3 is applied to neural units in the transformer coding layer. Model training utilizing adaptive motion estimation rules for parameter updates. The training process incorporates an early stopping strategy to address potential overfitting issues in deep learning model training.

Feature Selection is the method involves choosing a subset of the most pertinent features from the initial se, eliminating redundant, irrelevant, or noisy ones to enhance model efficiency and interpretability. To demonstrate the performance superiority of the FE-Transformer approach suggested in this study, three types of experiments were conducted using different datasets. The first type focused on feature data only, employing traditional models like logistic regression and XGBoost due to the low dimensions unsuitable for training deep learning models. The second type used a dataset exclusively with behavioral data, where deep learning models directly utilized user event sequences as input, while traditional models (LR and XGBoost) required manual feature extraction. The third type utilized a dataset with all available data, employing LR, XGBoost, LSTM, AM-LSTM,

and Feature Selection. Experimental results indicate that the FE-Transformer model outperforms LR, XGBoost, LSTM, and AM-LSTM in terms of AUC and KS. This suggests that the FE-Transformer deep learning model accurately predicts user default risk, contributing to reduced loan default rates and credit risk for financial enterprises, fostering their healthy and sustainable development, especially in scenarios where user behavior events may change post-APP upgrades.

6.Conclusions

The advancement of big data and artificial intelligence technology has shifted the research focus towards machine learning and deep learning models in credit scoring. This study delves into the credit scoring methods of financial enterprises, highlighting the significance of the FE-Transformer neural network model. Key findings include the innovative use of user online behavioral data as a credit scoring source, enhancing the effectiveness of user default analysis models. The FE-Transformer model outperforms other comparison methods, affirming its efficiency and feasibility in credit scoring. The model's output of user default probabilities serves as a foundation for the loan approval decisions and risk solving, empowering financial institutions to enhance their credit risk management capabilities. As machine learning and deep learning continue to progress, the model's accuracy in risk analysis is expected to improve, along with enhanced interpretability.

For future research, several considerations emerge. Firstly, addressing the challenge of data acquisition, this experiment relies on the datasets of a single enterprise. Future work aims to explore datasets from various enterprises to enhance the generalizability of findings. Secondly, the credit scoring model in this study is static, and there is a growing interest in dynamic updates. Leveraging blockchain technology for secure, transparent, and efficient sharing of credit-related information among financial institutions is a potential avenue. This not only aids in reducing fraud but also contributes to improved model accuracy through dynamic updates. Additionally, there is a need to emphasize cybersecurity measures to safeguard sensitive credit-related data, given the rising sophistication of cyber threats in the financial sector.

References:

1 DR D Shanti ,Pranava Bhattacharya Amity ,"Credit Score Prediction System using Deep Learning and K-Means Algorithms", August 2021

2 C. Liberati and F. Camillo, "Personal values and credit scoring: new insights in the financial prediction, "Journal of the Operational Research Society, vol. 69, no. 12, pp. 1–21, 2018.

3 Ashwani Kumar et al 2021 J. Phys.: Conf. Ser. 1998 012027, Credit Score Prediction System using Deep Learning and K-Means Algorithms

4 TSAI, C. & WU, J. (2008). Using neural network ensembles for bankruptcy prediction and credit scoring. Expert Systems with Applications, 34, 2639–2649. 126

5 WEST, D. (2000). Neural network credit scoring models. Computers & Operations Research, 27, 1131–1152. 5, 7, 105, 113, 126

Unlocking The Power of Blockchain in Education: Opportunities, Applications, and Challenges

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ABSTRACT - Blockchain is an innovative technology that has the potential to revolutionize several industries, such as supply chain management, banking, education, and healthcare. Blockchain technology has the ability to contribute to the development of a more transparent and safe educational system by facilitating the recording and authentication of students' academic achievements. This would enable students to more easily demonstrate their abilities and knowledge to prospective employers. The discussion of Blockchain technology's potential applications in education wraps up the study. It contends that while blockchain technology has the ability to completely transform education, more study and advancement are required to fully understand its limitations.

KEY WORDS: Blockchain, Education, Sustainability, Machine learning, Credential verification

I. INTRODUCTION

Blockchain, a revolutionary digital ledger, has redefined how transactions are recorded, ensuring security, transparency, and immutability. The structure of block-chaining is designed in such a way that it ensures safety and provides full protection and encryption along with the concerns of tampering that is performing any sort of illegal activities can be thereby prevented using this technology. With features providing cryptographic algorithms and data security Block-chaining technology has raised its bars in cybersecurity and privacy providing trustworthy solutions and results. Beyond security, its potential to enable real-time transactions without intermediaries promises significant gains in efficiency, marking a paradigm shift in transaction processing[1].

Education is one sector in which the blockchain is only now starting to gain traction. Very few educational institutions have embraced blockchain technology, therefore its application in the field is still in its infancy. Merely 2% of higher education institutions

were utilizing blockchain, according to a 2019 poll conducted by the research firm Gartner, while another 18% intended to do so in the following two years[2].

In the realm of education, blockchain technology is not merely a tool for storing and sharing academic records; it's a catalyst for transformative change. Imagine a student seamlessly taking an exam on a laptop, their responses securely recorded through blockchain. While current blockchain adoption focuses on record-keeping, researchers envision a future where blockchain reshapes education in profound ways.

Leveraging blockchain can revolutionize online education, offering secure and transparent systems for delivering and tracking courses and certifications. This breakthrough has the potential to elevate the credibility and recognition of online learning, making it an appealing choice for both students and employers. The shift towards blockchain-powered platforms addresses fundamental challenges in the online education landscape, providing a robust solution to issues of trust and verification.

The Educational institutions can lower expenses, expedite administrative procedures, and improve the credibility of credentials and certifications by utilizing the decentralized and transparent characteristics of blockchain technology. Making education more trustworthy and accessible for both companies and students is one of the main advantages of implementing blockchain in the classroom. Students may confidently display their qualifications by using blockchain technology to help prevent fraud and guarantee that credentials are authentic.

PROPOSED WORK

The forthcoming research on the transformative impact of blockchain technology in the education sector sounds promising and addresses critical areas such as distance learning, data security, and certification processes. By exploring these dimensions, this research can contribute valuable insights and practical recommendations that guide educational institutions and specialists in effectively harnessing the transformative potential of blockchain technology.

This research aims to contribute substantially to the evolving landscape of blockchain in education. As an integral part of the growing body of research in this domain, this work stands as a influence for future, providing a foundation for informed decision-making and effective integration of blockchain technology in education[3].

II. LITERATURE REVIEW

Blockchain technology, originally designed for secure value transfer, has evolved into a decentralized powerhouse with applications across diverse sectors. In education, it offers a paradigm shift in the management of records, fostering interoperability and decentralized control. This literature review aims to dissect the existing landscape, identify challenges faced by educational institutions, and explore how specific blockchain features can address these issues.

Blockchain's distributed ledger system, free from third-party control, forms the cornerstone of its applications. Beyond its initial use in value transfer, blockchain has found its way into healthcare, banking, and the internet of things. In education, it presents opportunities for decentralized record management within an interoperable framework.

The analysis reveals three major challenges faced by educational institutions: manipulation risk, difficulties in verification, and the exchange of records between institutions. These issues, spanning physical, digital, and financial realms, underscore the need for transformative solutions in the educational landscape.

In conclusion, this literature review unveils the transformative potential of blockchain in addressing prevalent challenges faced by educational institutions. By systematically categorizing issues and exploring blockchain features as viable solutions, this research contributes to the ongoing discourse on the intersection of blockchain and education. However, it also underscores the importance of addressing technical challenges to ensure a seamless integration and maximize the benefits of this revolutionary technology.

During COVID-19 Period

The education sector has undergone several tremendous changes. From traditional classrooms to digital learning, this industry has encountered extensive growth, especially after the COVID-19 pandemic. The trend of e-learning has escalated during the COVID-19 pandemic and accelerated a new wave of revolution in the sector. Besides the introduction of the eLearning system, the education sector also experienced significant growth with Blockchain adoption. Although Blockchain has not disrupted the education sector completely, its impact can be experienced in the coming years.

According to Business Research Insights in 2021, the global Blockchain technology in education market size was valued at $118.73 million in 2021 and is expected to reach $1055.98 million by 2027, expanding at a CAGR of 43.94% during the forecast period. Many education institutions are planning to integrate the Blockchain into their existing system for increased transparency, streamlined processes, and easy record management[4].

Benefits for students

Blockchain technology empowers students by allowing them to own and manage their academic achievements. Unlike traditional models where universities control records, students now have the ability to independently access and share their academic history. Blockchain eliminates barriers like fees and bureaucratic processes associated with accessing physical records. Students can access their diplomas seamlessly at any time and from anywhere, offering convenience and immediate availability during job searches or further education pursuits. The decentralized and immutable nature of blockchain reduces the risks associated with physical records. Students no longer face the threat of loss or destruction of their diplomas, ensuring the perpetual existence and integrity of their academic credentials. Graduates can easily share accurate and tamper-proof credentials with employers during job searches.

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Blockchain In the Education System: Advantages

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Storing student data on the blockchain allows for easy and secure access to credentials and skills learned. Decentralized nature removes the need for a central administrator (e.g., a university), giving students control over their information throughout their lives. Ownership and control of data can enhance credibility with employers, as the information on resumes is verifiable.

Enhanced Security and Efficiency:

Blockchain provides potential solutions for protecting student data, ensuring identity, privacy, and security. Hashing and encryption can be employed to enhance data privacy and security.

Trust and Transparency Between Job Seekers and Employers:

The most durable feature of blockchain technology is that it performs its working in such a way that it provides a way to protect the exact grades, marks and credentials in such a way that it cannot be altered by anyone. It acts as a building factor of maintaining trust and transparency in the employment sector, providing employers with a reliable and accurate means of verifying the educational backgrounds of job applicants. This can lead to more consistent and useful talent assessment, improved hiring decisions, and increased overall confidence in the hiring process meeting the selection criteria and making the job much easier.

III. OPPORTUNITIES OF APPLYING BLOCKCHAIN IN EDUCATION

Blockchain technology offers several opportunities for application in the field of education. Here are some potential benefits :-

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E-Transcripts: Blockchain technology can streamline the process of issuing and verifying transcripts, reducing delays and costs associated with traditional methods. The use of distributed ledger technology minimizes the risk of fraudulent educational credit claims.

Automated Learning Platforms: Teachers and students can use smart contracts on the blockchain to create digital agreements for tasks and assignments. These agreements can include all the necessary details such as instructions, conditions, due dates, and deadlines, providing transparency and accountability.

Publishing & Copyright Protection: Blockchain facilitates secure and transparent publication of research work, protecting it from plagiarism. Academic institutions can use blockchain to ensure the integrity of their students' and staff's research, allowing for a more trustworthy and accessible academic environment.

Payment via Cryptocurrencies: Cryptocurrencies enable faster and more efficient international transactions. Students, especially international ones, can make payments to universities using cryptocurrencies, reducing transaction times and costs. Some universities, such as Simon Fraser University, the University of Nicosia, and King's College in New York, already accept cryptocurrencies as a form of payment from students.

IV. CHALLENGES OF BLOCKCHAIN IN EDUCATION

Blockchain technology is often surrounded by plenty of hype, which makes many business leaders keenly interested in adopting it but also concerned about blockchain challenges and risks. Some of the challenges that are facing in education while using blockchain are:

Rate of Adoption

Success depends on widespread acceptance and trust from educational institutions and employers. The legitimacy of blockchain credentials is contingent on the recognition by schools and firms. Building trust and making blockchain credentials the norm rather than the exception is crucial.

Scalability

Educational institutions handle large volumes of data, potentially posing scalability issues for blockchain. Peer-to-peer verification for each transaction can lead to slower transaction speeds as the volume of data grows. Permissioned blockchains may offer better transaction rates compared to permissionless ones.

Cost

Adoption and implementation of new technology, including blockchain, can be expensive. Costs may include computer power, infrastructure modifications, and training for administrators. The financial investment needs to be weighed against potential savings in other areas.

Security

While blockchain is known for its security features, the sensitive nature of educational records requires careful consideration. Compliance with state and federal data protection rules can be challenging. Institutions may need to use private or Permissioned blockchains and implement encryption for added privacy safeguards.

V. BLOCKCHAIN APPLICATIONS

1. Record keeping

Blockchain simplifies the management of student records by storing credentials and certificates on a distributed ledger, eliminating the need for intermediaries in the verification process.

2. Courses and Certificates

Blockchain facilitates certification of course contents and academic achievements, streamlining the process of obtaining complete, verified documentation.

3. Credential Verification

Academic credentials which include degrees, diplomas, and certifications that can be securely stored and verified on the blockchain, ensuring authenticity and preventing fraud.

4. Fraud Prevention

Blockchain helps prevent fraud by ensuring that academic qualifications are genuine, reducing the risk of unqualified individuals being hired based on fake credentials.

5. Decentralized Online Learning

Introducing blockchain in online learning enhances real-time data exchange and interactions between students and teachers, providing a more dynamic and engaging educational experience.

6. Plagiarism Check

Blockchain technology with advanced encryption allows for secure storage of academic information, preventing plagiarism by enabling content creators to track, access, verify, and control the usage of their content.

7. Better Online Platforms

Blockchain enthusiasts are exploring the development of online learning platforms that leverage blockchain applications to connect students and teachers, facilitate token-based interactions, and make education more convenient and engaging.

8. Student Data Privacy

Blockchain can establish a decentralized and secure system for storing student data, ensuring data privacy and protecting against data breaches.

VI. MACHINE LEARNING AND BLOCKCHAIN IN EDUCATION

Combining Machine Learning and Blockchain technologies can unlock innovative solutions, particularly in area where data security, transparency, and decentralized control are critical. Some of the ways where machine learning and blockchain technology can be used in education:

Secure and private E-Learning environment:

Blockchain Ensures secure and tamper-proof storage of student data. Machine Learning Enhances security by identifying patterns of unusual access or behaviour, providing an additional layer of protection.

Personalized Learning Experiences:

Machine Learning Analyses vast amounts of data to understand individual learning patterns, preferences, and strengths and weaknesses. Blockchain Safely stores this personalized learning data, maintaining its integrity and privacy.

Verification of Educational Achievements:

Blockchain Creates a tamper-proof record of degrees and certifications, making it easier for employers and institutions to verify credentials. Machine Learning Could assist in analyzing patterns in the educational achievements data, ensuring accuracy and detecting anomalies.

Improved Evaluation and Assessment:

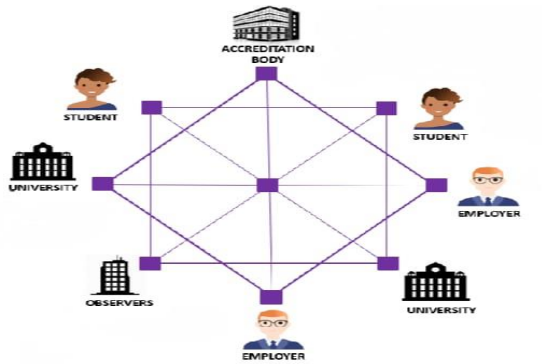
Machine Learning Automates grading processes, providing quicker and more consistent evaluations. Blockchain Secures the integrity of grades and assessments, preventing unauthorized changes.

Data-Driven Decision-Making:

Machine Learning Analyses large datasets to provide insights into effective teaching methods and materials. Blockchain Safely records and stores the data used for decision-making, ensuring its accuracy and transparency.

VII. BLOCKCHAIN IN CREDENTIAL VERIFICATION

"Blockchain-Based Credential Verification" is a cutting-edge course that equips students with the knowledge and skills to transform traditional credential verification processes. By embracing blockchain technology, educational institutions, employers, and other stakeholders can revolutionize the way academic credentials are verified, ensuring a more secure, efficient, and transparent educational ecosystem.



ACCREDIATION BODY

- Accredit academic credentials issued by issuing authorities.
- Eliminate accreditation fraud in the process.

- Provide verification service to employers.
- Provide transparency in the process.
- Administer network.

STUDENT: Offer proof of credentials to prospective employees.

EMPLOYER: Ensure prospective employee has genuine credentials through verification.

OBSERVERS: Act as a neutral watchdog body.

UNIVERSITY: Issue/revoke academic credentials to student.

VIII. SUSTAINABILITY AND BLOCKCHAIN

An education needs to be long-lasting. In general, sustainable education (SE) is an important idea that encourages employability and incorporates equitable, inclusive, and continual learning. New techniques, technology, and practical abilities in instruction and evaluation could benefit from a digital transversal. Furthermore, all parties involved in SE are included: communities, universities, instructors, students, etc. When we take into consideration the disruptive forces, constantly shifting geopolitical powers, and the ongoing epidemic that has impacted over 1.6 billion learners, we can see that there has been a significant learning loss. Furthermore, compared to just 20% in high-income nations, 86% of students in low-income countries are effectively absent from school as a result of school closures. However, every crisis has fresh chances for teaching about sustainable development. Artificial intelligence (AI), robotics, 5G, machine learning, blockchain, e-learning, educational platforms, virtual classrooms, and other cutting-edge technology can provide genuine support.[5].

IX. CONCLUTION

In summary, the integration of blockchain development in the education sector has emerged as a transformative force. Moreover, its decentralized nature facilitates more inclusive and equitable access to educational resources, opening doors for learners in regions with limited traditional educational infrastructure. As we continue to explore the applications of blockchain in education, fostering innovation, collaboration, and adaptability becomes crucial. Embracing these principles will allow us to fully leverage the benefits of blockchain technology, creating a future where education is not only more

accessible but also more impactful for learners and institutions. Looking ahead, future studies could delve into the legal and ethical implications of implementing blockchain technology in education. Additionally, exploring the potential of blockchain to promote sustainability in other sectors could uncover novel ways in which this technology contributes to broader societal and environmental goals. Embracing such research avenues will further enrich our understanding and application of blockchain in shaping a more sustainable and inclusive educational landscape.

REFERENCES

[1] D. Yaga, P. Mell, N. Roby, et al. Blockchain technology overview arXiv (2019) Preprint. arXiv:1906.110782019

[2] How Blockchain is used in Education (2021) Online.maryville.edu/blog/blockchain-in-education

[3] P. Bhaskar, C.K. Tiwari, A. Joshi Blockchain in education management: present and future applications Interact. Technol. Smart Educ., 18 (1) (2020), pp. 1-17, 10.1108/ITSE-07-2020-0102

[4] Mourtzis Dimitris, et al. A hybrid teaching factory model for supporting the educational process in COVID-19 era. Procedia Cirp, 2021, 104: 1626-1631.

[5] Anto, J.M.; Marti, J.L.; Casals, J.; Bou-Habib, P.; Casal, P.; Fleurbaey, M.; Frumkin, H.; Jimenez-Moales, M.; Jordana, J.; Lancelotti, C.; et al. The Planetary. N. Wellbeing Initiative: Pursuing the Sustainable. O.Development Goals in Higher Education. P. Sustainability 2021, 13, 3372

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Blockchain technology is often surrounded by plenty of hype, which makes many business leaders keenly interested in adopting it but also concerned about blockchain challenges and risks. Some of the challenges that are facing in education while using blockchain are:

Rate of Adoption

Success depends on widespread acceptance and trust from educational institutions and employers. The legitimacy of blockchain credentials is contingent on the recognition by schools and firms. Building trust and making blockchain credentials the norm rather than the exception is crucial.

Scalability

Educational institutions handle large volumes of data, potentially posing scalability issues for blockchain. Peer-to-peer verification for each transaction can lead to slower transaction speeds as the volume of data grows. Permissioned blockchains may offer better transaction rates compared to permissionless ones.

Cost

Adoption and implementation of new technology, including blockchain, can be expensive. Costs may include computer power, infrastructure modifications, and training for administrators. The financial investment needs to be weighed against potential savings in other areas.

Security

While blockchain is known for its security features, the sensitive nature of educational records requires careful consideration. Compliance with state and federal data protection rules can be challenging. Institutions may need to use private or Permissioned blockchains and implement encryption for added privacy safeguards.

V. BLOCKCHAIN APPLICATIONS

1. Record keeping

Blockchain simplifies the management of student records by storing credentials and certificates on a distributed ledger, eliminating the need for intermediaries in the verification process.

2. Courses and Certificates

Blockchain facilitates certification of course contents and academic achievements, streamlining the process of obtaining complete, verified documentation.

3. Credential Verification

Academic credentials which include degrees, diplomas, and certifications that can be securely stored and verified on the blockchain, ensuring authenticity and preventing fraud.

4. Fraud Prevention

Blockchain helps prevent fraud by ensuring that academic qualifications are genuine, reducing the risk of unqualified individuals being hired based on fake credentials.

5. Decentralized Online Learning

Introducing blockchain in online learning enhances real-time data exchange and interactions between students and teachers, providing a more dynamic and engaging educational experience.

6. Plagiarism Check

Blockchain technology with advanced encryption allows for secure storage of academic information, preventing plagiarism by enabling content creators to track, access, verify, and control the usage of their content.

7. Better Online Platforms

Blockchain enthusiasts are exploring the development of online learning platforms that leverage blockchain applications to connect students and teachers, facilitate token-based interactions, and make education more convenient and engaging.

8. Student Data Privacy

Blockchain can establish a decentralized and secure system for storing student data, ensuring data privacy and protecting against data breaches.

VI. MACHINE LEARNING AND BLOCKCHAIN IN EDUCATION

Combining Machine Learning and Blockchain technologies can unlock innovative solutions, particularly in area where data security, transparency, and decentralized control are critical. Some of the ways where machine learning and blockchain technology can be used in education:

Secure and private E-Learning environment:

Blockchain Ensures secure and tamper-proof storage of student data. Machine Learning Enhances security by identifying patterns of unusual access or behaviour, providing an additional layer of protection.

Personalized Learning Experiences:

Machine Learning Analyses vast amounts of data to understand individual learning patterns, preferences, and strengths and weaknesses. Blockchain Safely stores this personalized learning data, maintaining its integrity and privacy.

Verification of Educational Achievements:

Blockchain Creates a tamper-proof record of degrees and certifications, making it easier for employers and institutions to verify credentials. Machine Learning Could assist in analyzing patterns in the educational achievements data, ensuring accuracy and detecting anomalies.

Improved Evaluation and Assessment:

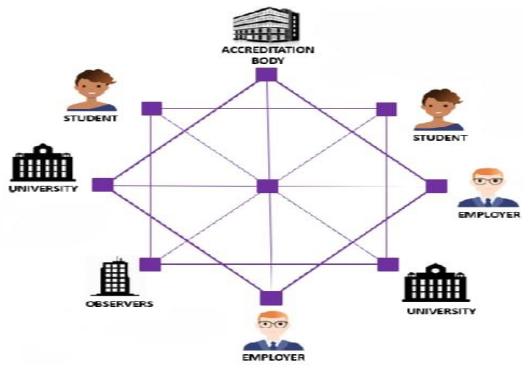
Machine Learning Automates grading processes, providing quicker and more consistent evaluations. Blockchain Secures the integrity of grades and assessments, preventing unauthorized changes.

Data-Driven Decision-Making:

Machine Learning Analyses large datasets to provide insights into effective teaching methods and materials. Blockchain Safely records and stores the data used for decision-making, ensuring its accuracy and transparency.

VII. BLOCKCHAIN IN CREDENTIAL VERIFICATION

"Blockchain-Based Credential Verification" is a cutting-edge course that equips students with the knowledge and skills to transform traditional credential verification processes. By embracing blockchain technology, educational institutions, employers, and other stakeholders can revolutionize the way academic credentials are verified, ensuring a more secure, efficient, and transparent educational ecosystem.



ACCREDIATION BODY

- Accredit academic credentials issued by issuing authorities.
- Eliminate accreditation fraud in the process.
- Provide verification service to employers.

- Provide transparency in the process.
- Administer network.

STUDENT: Offer proof of credentials to prospective employees.

EMPLOYER: Ensure prospective employee has genuine credentials through verification.

OBSERVERS: Act as a neutral watchdog body.

UNIVERSITY: Issue/revoke academic credentials to student.

VIII. SUSTAINABILITY AND BLOCKCHAIN

An education needs to be long-lasting. In general, sustainable education (SE) is an important idea that encourages employability and incorporates equitable, inclusive, and continual learning. New techniques, technology, and practical abilities in instruction and evaluation could benefit from a digital transversal. Furthermore, all parties involved in SE are included: communities, universities, instructors, students, etc. When we take into consideration the disruptive forces, constantly shifting geopolitical powers, and the ongoing epidemic that has impacted over 1.6 billion learners, we can see that there has been a significant learning loss. Furthermore, compared to just 20% in high-income nations, 86% of students in low-income countries are effectively absent from school as a result of school closures. However, every crisis has fresh chances for teaching about sustainable development. Artificial intelligence (AI), robotics, 5G, machine learning, blockchain, e-learning, educational platforms, virtual classrooms, and other cutting-edge technology can provide genuine support.[5].

IX. CONCLUTION

In summary, the integration of blockchain development in the education sector has emerged as a transformative force. Moreover, its decentralized nature facilitates more inclusive and equitable access to educational resources, opening doors for learners in regions with limited traditional educational infrastructure. As we continue to explore the applications of blockchain in education, fostering innovation, collaboration, and adaptability becomes crucial. Embracing these principles will allow us to fully leverage the benefits of blockchain technology, creating a future where education is not only more accessible but also more impactful for learners and institutions. Looking ahead, future

studies could delve into the legal and ethical implications of implementing blockchain technology in education. Additionally, exploring the potential of blockchain to promote sustainability in other sectors could uncover novel ways in which this technology contributes to broader societal and environmental goals. Embracing such research avenues will further enrich our understanding and application of blockchain in shaping a more sustainable and inclusive educational landscape.

REFERENCES

[1] D. Yaga, P. Mell, N. Roby, et al. Blockchain technology overview arXiv (2019) Preprint. arXiv:1906.110782019

[2] How Blockchain is used in Education (2021) Online.maryville.edu/blog/blockchain-in-education

[3] P. Bhaskar, C.K. Tiwari, A. Joshi Blockchain in education management: present and future applications Interact. Technol. Smart Educ., 18 (1) (2020), pp. 1-17, 10.1108/ITSE-07-2020-0102

[4] Mourtzis Dimitris, et al. A hybrid teaching factory model for supporting the educational process in COVID-19 era. Procedia Cirp, 2021, 104: 1626-1631.

[5] Anto, J.M.; Marti, J.L.; Casals, J.; Bou-Habib, P.; Casal, P.; Fleurbaey, M.; Frumkin, H.; Jimenez-Moales, M.; Jordana, J.; Lancelotti, C.; et al. The Planetary. N. Wellbeing Initiative: Pursuing the Sustainable. O.Development Goals in Higher Education. P. Sustainability 2021, 13, 3372

Innovations in Medical Technology: Bridging Nanoscience,Nanotechnology,Nanorobots and Computer Science for Advanced Healthcare Applications

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Abstract:

Nanotechnology & Computer Science-Based Nanorobotic in Medical Field Assistance refers to the integration of nanotechnology and computer science principles in the development and application of tiny robotic devices, often referred to as nanorobots, within the medical field. These nanorobots are designed to perform various medical tasks at the nanoscale level, with precision and efficiency, for diagnostic, therapeutic, or monitoring purposes. This comprehensive research endeavors to unveil the transformative impact of the amalgamation of nanotechnology and computer science in the realm of medical assistance through nanorobotic applications. Delving into the interdisciplinary nature of this cutting-edge field, the study explores the creation and deployment of nanorobots at the intersection of nanotechnology and computer science. These nanorobots are designed to operate within the medical field, undertaking tasks at the nanoscale level, ranging from diagnostics to therapeutic interventions. The research sheds light on the collaborative synergy between nanotechnology and computer science, unleashing a spectrum of innovative medical interventions such as targeted drug delivery, early disease detection, and intricate surgical procedures. This exploration seeks to deepen our understanding of the potential advancements, challenges, and transformative possibilities in the convergence of nanotechnology and computer science for the betterment of healthcare and medical practices. The collaboration between nanotechnology and computer science enables the creation of advanced and highly controlled medical interventions, offering promising possibilities for improving healthcare, including targeted drug delivery, minimally invasive surgery, and real-time monitoring of biological processes at the cellular or molecular level.

Keywords: Nanotechnology, Computer Science, Nanorobots, Machine Learning (ML), Artificial Intelligence(AI), Internet Of Things (IoT), Web Application.

I. INTRODUCTION

"Nanotechnology & Computer Science-Based Nanorobotic in Medical Field Assistance" refers to the application of nanotechnology and computer science principles to create and utilize extremely small robotic devices, known as nanorobots, in the field of medicine. These nanorobots are designed to perform various medical tasks at a nanoscale level, offering precise and efficient solutions for diagnostics, therapeutics, and patient care. This interdisciplinary approach harnesses the power of miniaturization and advanced computational capabilities to enhance medical treatments, such as targeted drug delivery, early disease detection, and other innovative medical interventions, ultimately improving patient outcomes and the practice of medicine.

Nanorobotics represents a cutting-edge frontier where robots operate at incredibly small scales, measuring in billionths of a meter. This field involves the creation of functional materials, devices, and systems by manipulating matter at the nanometer scale, allowing for unprecedented control over molecular gates, switches, and wires. Despite significant advancements in manufacturing precision at larger scales, our capabilities at the molecular level remain relatively crude, prompting the emergence of nanotechnology to address this limitation[1].

Nanorobots, the next evolutionary step in nanomachines, hold great promise in their ability to sense and adapt to environmental stimuli, perform intricate calculations, communicate, and collaborate. Advanced nanorobots could engage in molecular assembly, repair processes, and even partial self-replication. Nanotechnology, defined as the science and application of creating objects smaller than 100 nanometers, explores the extreme concept of bottom-up creation, assembling materials or objects atom by atom. While nanotech processes occur at the nanoscale[2], the resulting materials and objects can manifest on a much larger scale through synergistic nanoscale processes.

Purpose:

Contrary to fears of artificial intelligence threats, many nanorobots, especially those involved in cellular repair, possess limited processing power, with onboard

processors capable of around 1000 operations per second. This computing capacity is significantly below human-equivalent computing, making them non-threatening in terms of artificial intelligence concerns[3]. Moreover, medical nanorobots typically require computing capacities several orders of magnitude lower than human equivalents, emphasizing their specialization in specific tasks related to healthcare.

The implementation of nanorobotics in medicine, particularly in the realm of robotics, holds immense potential to revolutionize disease treatment and enhance overall human health. By leveraging robots in medical applications, nanorobotics has the capacity to significantly extend human life expectancy, opening up new possibilities for the future of healthcare.

Scope:

The collaboration between nanotechnology and computer science enables the creation of advanced and highly controlled medical interventions, offering promising possibilities for improving healthcare, including targeted drug delivery, minimally invasive surgery, and real-time monitoring of biological processes at the cellular or molecular level.

i. BioNanomatrix: Focuses on nanorobots for targeted drug delivery and cancer imaging, using magnetic guidance.
ii. Nanobiotix: Develops nanorobots for cancer therapy, combining nanoparticles and radiation therapy to minimize healthy tissue damage.
iii. Vyriad: Uses nanorobots for oncolytic virotherapy, selectively destroying cancer cells with viruses.
iv. LumaCyte: Develops label-free single-cell analysis technology for cancer diagnosis and treatment monitoring.
v. Academic Institutions: Universities like Rice University and the University of California, San Diego, are actively involved in nanorobot development for cancer treatment.

Objectives:

The healthcare revolution is witnessing a significant impact from nanotechnology, with a particular focus on preventive population health management. Nanotechnology addresses issues related to targeted treatment administration by minimizing side effects and optimizing therapeutic effectiveness. Its application extends

to the identification, treatment, and gene therapy for various cancers, making nanomedicine a promising field within nanorobotics[4]. This innovative technology spans across diverse areas, including vaccine creation, drug delivery, wearable devices, diagnostic and imaging tools, as well as antimicrobial products. Anticipated advancements in nanomedicine, with the development of more potent medications, improved gadgets, and early disease detection, are expected to revolutionize healthcare.

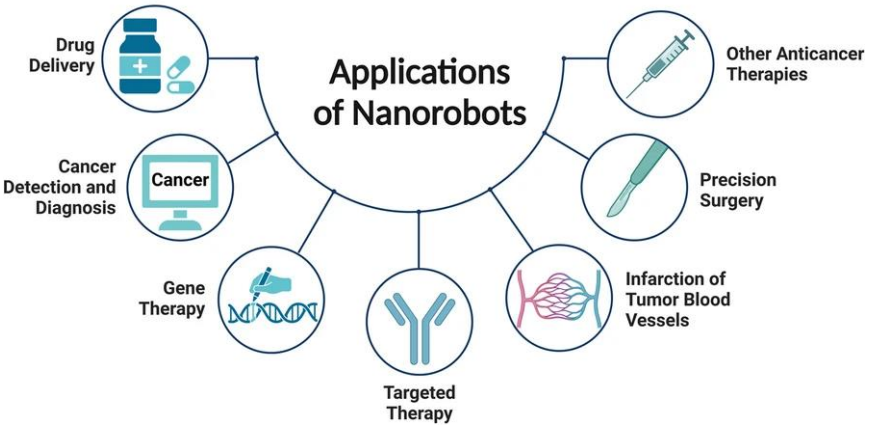

Fig 1: Applications Of Nanorobots In Medical Domain

Nanomedicine, crafted through the precise combination of manganese and citrate using nanotechnological methods, has the potential to usher in tailored mechanisms for medication administration, innovative diagnostic approaches, and the creation of nanoscale medical devices[5]. The integration of nanoscale technologies with conventional anti-cancer drugs allows for the effective delivery of treatments, even within the brain. The expansive possibilities of nanomedicine not only open up substantial market opportunities but also promise to transform entire categories of existing pharmaceuticals, showcasing the transformative impact of nanotechnology in the realm of healthcare.

i. Product Sales: Nanobot-based products can be sold directly to customers or businesses.

ii. Subscription or Service Model: Healthcare providers or research institutions can offer nanobot-based treatments or diagnostics on a subscription basis.

iii. Licensing and Royalties: Companies can generate revenue by licensing their nanobot technology or IP to other organizations.

iv. Partnerships and Collaborations: Companies can form partnerships or collaborations for joint research, co-marketing, or technology integration.

v. Grants and Funding: Seek funding from government agencies, foundations, or venture capital firms for research and development.

vi. Consultancy and Services: Offer consultancy services to organizations, providing expertise in nanobot technology.

II.LITERATURE SURVEY

Physicists at the University of Mainz in Germany have engineered the smallest-ever engine, consisting of just one atom. This groundbreaking creation converts energy into movement on an unprecedentedly tiny scale. The atom is confined within a cone of electromagnetic energy, and lasers are employed to heat it up and cool it down, causing the atom to oscillate within the cone like a piston in an engine.

Mechanical engineers at Ohio State University have harnessed the principles of DNA origami to design advanced nanoscale mechanical components. This achievement demonstrates that the fundamental design principles applicable to conventional machine components can now be extended to DNA, allowing for the production of sophisticated, controllable components for future nanorobots.

Researchers from ETH Zurich and Technion have developed elastic "nanoswimmers," specifically polypyrrole (Ppy) nanowires measuring around fifteen micrometers in length and two hundred nanometers in thickness[6]. These nanoswimmers can navigate through biological fluid environments at a speed of nearly fifteen micrometers per second. Potential applications include functionalization for drug delivery and magnetic control for targeting cancer cells in the bloodstream.

Scientists at the University of Cambridge have engineered an ant-like nanoengine capable of exerting a force nearly 100 times greater per unit weight than any existing motor or muscle. These nano-engines, termed "actuating nanotransducers" (ANTs), hold potential for developing nanorobots small enough to enter living cells for medical applications, offering a new avenue in the fight against diseases.

Researchers at the University of Twente and the German University in Cairo have created sperm-inspired microrobots that respond to periodic weak magnetic fields.

These microrobots are envisioned for use in advanced micro-manipulation and targeted medical procedures.

Engineers at Drexel University have devised a method to utilize electrical fields for aiding microscopic bacteria-powered robots in detecting obstacles in their environment and navigating around them[1]. Possible applications include delivering medication, manipulating stem cells for directed growth, or constructing microstructures.

In recent developments, multiple teams of scientists have successfully created nanorockets, high-speed, unmanned versions at the nanoscale, by integrating nanoparticles with biological molecules. The primary objective behind this innovation is to refine the nanorocket to be adaptable for deployment in various environments, particularly with the aim of delivering medicine to specific areas within the human body[2]. This breakthrough holds the potential to revolutionize targeted drug delivery, offering a promising avenue for precise and efficient medical interventions in diverse biological contexts[5].

III. EXISTING SYSTEM

The integration of nanoscience, nanotechnology, nanorobots, and computer science has led to innovative advancements in medical technology, fostering the development of advanced healthcare applications. Several existing systems showcase the collaborative efforts in bridging these fields for enhanced medical solutions.

One noteworthy innovation lies in the development of nanoscale drug delivery systems. Utilizing nanotechnology, researchers have created nanoparticles capable of targeted drug delivery, ensuring precise treatment to specific cells or areas within the body. These nanocarriers enhance drug efficacy, reduce side effects, and provide a platform for personalized medicine. Additionally, nanosensors integrated into these drug delivery systems enable real-time monitoring, allowing for adaptive and responsive healthcare interventions.

Nanorobotics has emerged as a transformative technology in medical applications. Nanorobots, operating at the nanoscale, exhibit the potential for performing intricate tasks within the human body, such as targeted drug delivery, microsurgery, and cellular-level diagnostics. These nanorobots are designed to navigate

through biological environments, providing a novel approach to medical interventions with unprecedented precision.

The synergy between nanotechnology and computer science has led to the development of intelligent diagnostic tools and imaging technologies. Computer-aided diagnostics, powered by machine learning algorithms, analyze vast datasets to enhance disease detection and diagnosis accuracy. Nanoparticle-enhanced imaging techniques[3], incorporating nanoscale contrast agents, offer high-resolution imaging capabilities, facilitating early detection of diseases and abnormalities.

In the realm of regenerative medicine, nanotechnology has played a crucial role in tissue engineering. Nanomaterials are utilized to create scaffolds that mimic the extracellular matrix, promoting cell adhesion, proliferation, and differentiation. This integration of nanoscience and tissue engineering holds promise for creating functional artificial organs and repairing damaged tissues.

Furthermore, wearable medical devices and sensors leverage advancements in nanotechnology to enhance monitoring and diagnostics. Nanoscale materials enable the development of flexible and lightweight sensors that can be integrated into wearable devices for continuous health monitoring. These devices provide valuable real-time data, contributing to preventive healthcare and remote patient monitoring.

In summary, the amalgamation of nanoscience, nanotechnology, nanorobots, and computer science has resulted in a spectrum of existing systems that advance medical technology. From targeted drug delivery and nanorobotics to intelligent diagnostics and wearable devices, these innovations collectively contribute to the evolution of healthcare towards more personalized, precise, and efficient solutions[6].

DRAWBACKS OF EXISTING SYSTEM

i. **Biocompatibility and Toxicity Concerns:** Nanomaterials used in medical applications may pose challenges in terms of biocompatibility and potential toxicity. Understanding the long-term effects of nanoparticles on biological systems is crucial to ensure patient safety.

ii. **Ethical and Privacy Concerns:** The integration of nanorobots and advanced monitoring technologies raises ethical concerns related to privacy and consent.

Continuous monitoring and manipulation at the nanoscale may intrude on personal autonomy and privacy, necessitating careful ethical considerations.

iii. **Technical Challenges:** The development of nanorobots and other nanoscale devices faces significant technical challenges, including the need for reliable power sources at the nanoscale, efficient navigation within complex biological environments, and the design of stable and functional nanomaterials.

iv. **Regulatory Hurdles:** The regulatory framework for nanotechnology in medicine is still evolving. The approval process for novel medical technologies incorporating nanomaterials or nanorobots may be lengthy and complex, hindering their timely translation from research to clinical applications.

v. **Cost and Accessibility:** Implementing advanced medical technologies often comes with high costs, making them less accessible in certain healthcare settings. The affordability and widespread availability of nanotechnology-based healthcare solutions remain significant challenges.

vi. **Limited Understanding of Nanotoxicology:** The potential health risks associated with exposure to nanomaterials are not yet fully understood. Nanotoxicology, the study of the toxicity of nanomaterials, is a developing field, and the long-term effects of prolonged exposure to nanoscale substances require thorough investigation.

vii. **Integration Challenges:** Integrating nanotechnology with existing medical infrastructure and practices poses challenges. Compatibility issues, training requirements, and the need for interdisciplinary collaboration may slow down the seamless adoption of these technologies.

viii. **Public Perception and Acceptance:** There may be skepticism and apprehension among the public regarding the use of nanotechnology in healthcare. Building trust and addressing concerns about safety, privacy, and potential unintended consequences are crucial for widespread acceptance.

ix. **Environmental Impact:** The disposal of nanomaterials and waste generated during the manufacturing process can have environmental consequences. The ecological impact of nanoparticles needs careful consideration to mitigate potential harm.

x. **Complexity of Data Interpretation:** Advanced diagnostic tools and imaging technologies generate vast amounts of complex data. Analyzing and interpreting this data accurately, while ensuring its relevance in clinical decision-making, poses a challenge that needs to be addressed for the effective implementation of these technologies.

xi. Despite these drawbacks, ongoing research and advancements in addressing these challenges hold the promise of mitigating risks and unlocking the full potential of nanotechnology in revolutionizing medical care.

IV. PROBLEM DISCUSSION

Nanotechnology plays a pivotal role in expediting diagnostic processes through the use of compact portable devices that can rapidly analyze small samples. This advancement enables almost instantaneous processing and analysis, contributing to the evolution of in vitro diagnostic testing. The incorporation of biosensors and the utilization of nanoparticles, particularly those involving iron oxides and specialty polymers, enhance the imaging capacity while allowing for lower and more effective doses of diagnostic compounds. This breakthrough facilitates early detection of genetic abnormalities, tumors, and a wide range of disease states, thereby significantly impacting the landscape of medical diagnostics.

Nanotechnology is making significant strides in various domains, including computer science, where it intersects with several cutting-edge technologies. In the realm of computer science, nanotechnology is contributing to the development of smaller and more efficient components. Nanoscale materials and structures are being integrated into computer hardware, enhancing performance and enabling the creation of more powerful and compact devices. This includes the utilization of nanomaterials in transistors, memory storage, and other essential components, leading to advancements in computational capabilities.

Nanorobots, another exciting application of nanotechnology, hold the promise of revolutionizing medical treatments and diagnostics. These miniature robots, operating at the nanoscale, could be designed for targeted drug delivery, precise surgical procedures, and even cellular-level repairs within the human body. The potential of nanorobots

extends beyond medicine and may find applications in environmental monitoring and other fields where precise manipulation at the nanoscale is beneficial.

In the realm of machine learning (ML) and artificial intelligence (AI), nanotechnology is playing a role in optimizing hardware for accelerated processing. Nanoscale components enable the development of faster and more energy-efficient computing architectures, contributing to the advancement of ML and AI algorithms. Moreover, the synergy between nanotechnology and AI can lead to innovations in the design and optimization of nanodevices[3], paving the way for intelligent systems at the nanoscale.

The Internet of Things (IoT) is another area where nanotechnology is making an impact. Nanosensors, for instance, can be embedded in various objects to enable real-time data collection and communication within IoT networks. These nanosensors can provide more precise and sensitive measurements, enhancing the capabilities of IoT devices in applications ranging from smart cities to healthcare[4].

In web applications, nanotechnology's influence may be less direct but still significant. The improved computational capabilities and energy efficiency resulting from nanotechnology advancements can contribute to faster and more responsive web applications. Additionally, nanotechnology's role in developing new materials could lead to innovations in areas such as flexible and transparent displays, which could find applications in web-enabled devices[6].

Overall, the convergence of nanotechnology with computer science, nanorobots, machine learning, artificial intelligence, IoT, and web applications holds great promise for shaping the future of technology, bringing about more powerful, efficient, and innovative solutions across various domains[5].

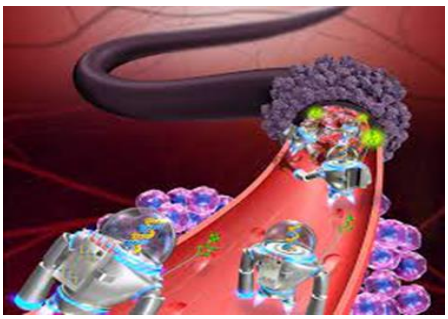

Fig 2: Cancer Tumors Killed By Nanorobots(Internal)

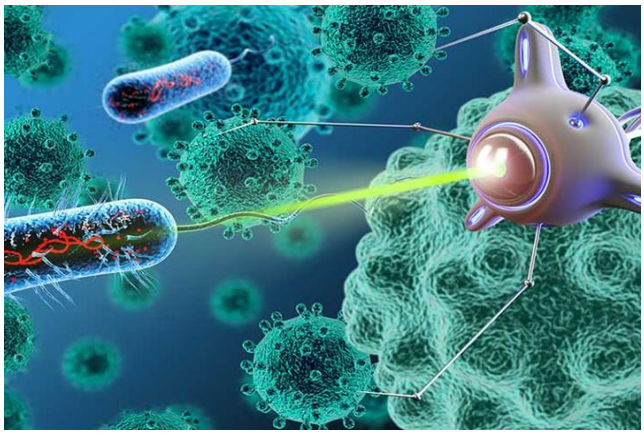

Fig 3: Cancer Tumors Killed By Nanorobots(External)

However, the application of nanomedicine, akin to biotechnology, raises concerns in certain areas, especially regarding safety and privacy. The use of immunoassays is identified as a suitable application due to the robust connectivity between antibodies and antigens, leading to excellent sensitivities[1]. A notable emerging challenge lies in regenerative immune sensors, providing repetitiveness for statistical rigor and semi-continuous monitoring. In the context of cancer, nanomedicine remains an immature subject, necessitating careful evaluation of its potential impact in clinical settings[5].

i. **Diverse Side Effects:** Cancer treatments like chemotherapy, radiation therapy, immunotherapy, and targeted therapy often lead to side effects such as fatigue, nausea, hair loss, pain, cognitive changes, gastrointestinal problems, and compromised immune function.

ii. **Development of Treatment Resistance:** Cancer cells can become resistant to treatments over time, driven by mechanisms like genetic mutations, altered signaling pathways, or changes in the tumor microenvironment, which can result in treatment failure.

iii. **Toxic Impact on Healthy Cells:** Certain treatments, particularly chemotherapy, may harm healthy cells and organs alongside cancer cells, causing short-term and long-term complications that affect a patient's overall well-being and quality of life.

iv. **Weakened Immune System:** Treatments like chemotherapy and radiation therapy can weaken the immune system, increasing the patient's vulnerability to

infections. Infections may lead to treatment delays, interruptions, and necessitate additional medical interventions.

v. **Financial Burden:** The cost of cancer treatments, encompassing medications, hospital stays, diagnostic tests, and follow-up care, can be substantial. This financial burden can induce stress on patients and their families, potentially limiting their access to care and overall well-being. Furthermore, some treatments can result in long-term effects such as cardiovascular issues, secondary cancers, hormonal imbalances, infertility, or cognitive impairments, even after successful treatment.

V. PROPOSED SYSTEM

The healthcare revolution is witnessing a significant impact from nanotechnology, with a particular focus on preventive population health management. Nanotechnology addresses issues related to targeted treatment administration by minimizing side effects and optimizing therapeutic effectiveness. Its application extends to the identification, treatment, and gene therapy for various cancers, making nanomedicine a promising field within nanorobotics. This innovative technology spans across diverse areas, including vaccine creation, drug delivery, wearable devices, diagnostic and imaging tools, as well as antimicrobial products. Anticipated advancements in nanomedicine, with the development of more potent medications, improved gadgets, and early disease detection, are expected to revolutionize healthcare[3].

Nanomedicine, crafted through the precise combination of manganese and citrate using nanotechnological methods, has the potential to usher in tailored mechanisms for medication administration, innovative diagnostic approaches, and the creation of nanoscale medical devices. The integration of nanoscale technologies with conventional anti-cancer drugs allows for the effective delivery of treatments, even within the brain. The expansive possibilities of nanomedicine not only open up substantial market opportunities but also promise to transform entire categories of existing pharmaceuticals, showcasing the transformative impact of nanotechnology in the realm of healthcare[6].

i. **Targeted Drug Delivery:** Nanobots are engineered to deliver chemotherapy drugs directly to cancer cells, reducing harm to healthy tissues. They navigate the bloodstream and locate tumors using surface markers or biochemical signals.

ii. **Early Detection Emphasis:** Early cancer detection is promoted through screening programs and healthy lifestyle advocacy, as cancers are more treatable in their early stages.

iii. **Mechanical Disruption of Cancer Cells:** Some nanobots physically disrupt cancer cells by attaching tiny appendages to them, exerting mechanical forces for damage or destruction, offering an alternative to conventional treatments like radiation or chemotherapy.

iv. **Biomarker Detection:** Nanobots with sensors can identify specific biomarkers linked to cancer, offering real-time information on disease progression and facilitating early recurrence detection.

v. **Immune Response Modulation:** Nanobots can influence the immune response against cancer by stimulating or suppressing specific immune cells, enhancing the body's natural defenses. Additionally, they can carry imaging agents for precise tumor visualization using technologies like MRI, PET, or near-infrared fluorescence imaging.

V. MATERIALS AND METHOD

Nanotechnology, a comprehensible concept in theory, encounters challenges in its evolution into a fully functional nanorobot. While considerable progress has been made by scientists, a finalized nanorobot purely based on electromechanical components has not been officially introduced. Many existing nanobot prototypes exhibit effective functionality but are predominantly biological in nature, deviating from the ultimate goal of creating nanorobots entirely composed of electromechanical elements. Designed as machine counterparts to bacteria, nanorobots operate on the same microscopic scale as bacteria and viruses, interacting with and repelling them[2].

The essential components of an ideal nanobot include a transporting mechanism, an internal processor, and a fuel unit enabling its functionality. However, the primary challenge lies in developing a suitable fuel unit, as conventional robotic propulsion

methods cannot be scaled down to the nanoscale with current technology. Although scientists have managed to reduce robot size to five or six millimeters, this still falls within the macro-robot category. Creating a nanobot using another nanobot is deemed the most effective approach, but the initial hurdle lies in initiating the process. Given the complexity and multitude of nano-functions required, it becomes imperative to develop specialized machine tools to expedite the construction and design of nanobots[5].

Nanosensors, essential components in nanotechnology, serve as sensory points conveying information about nanoparticles to the macroscopic world. They find diverse applications, particularly in medicine, and serve as gateways for developing other nanoproducts like nanorobots and nanoscale computer chips[4]. The medicinal use of nanosensors revolves around their ability to accurately identify specific cells or locations in the body by measuring various parameters such as volume, concentration, displacement, speed, velocity, gravitational forces, electrical and magnetic forces, pressure, or temperature changes in cells[6].

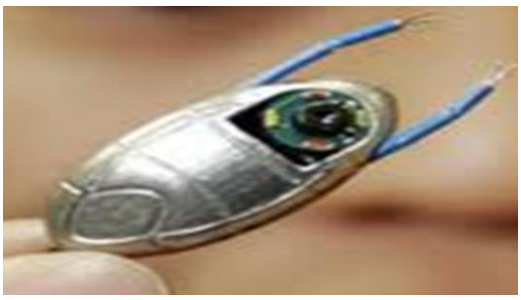

Fig 4: Physical Model of Nanorobot At Present

In the realm of nanorobotics, specific nano-mechanical devices, including molecular sorting rotors and fins for stability and movement, have been developed. Nanorobot navigation poses significant challenges, with a focus on external and onboard systems. External navigation involves methods like ultrasonic signals, Magnetic Resonance Imaging (MRI), radioactive dye tracking, X-rays, radio waves, microwaves, or heat detection. Onboard systems, utilizing internal sensors, play a crucial role in navigation, with chemical and spectroscopic sensors enabling pathfinding through the detection of specific chemicals[5].

Power sources for nanorobots are categorized into internal and external options. Internal power sources leverage the patient's body heat, utilizing the Seebeck effect or capacitors, while external power sources include tethered systems or those controlled

without a physical tether. Tethered systems require a wire between the nanorobot and the power source, which must navigate through the human body seamlessly. Experimentation in Montreal explores methods to manipulate nanorobots directly or induce electrical currents in closed conducting loops[6].

The procedure for nanorobotics involves manipulating objects at the nanometer scale, functioning at the atomic or molecular level in a process known as molecular manufacturing. Two primary approaches are employed: biochip-based nanorobots for medical applications like surgery and drug delivery, and self-reconfigurable modular robots, also known as Fractal robots, capable of adapting their shape to new circumstances or tasks. These approaches highlight the multifaceted nature and potential applications of nanorobotics in various fields[4].

i. Nanorobots can able to Deliver payloads (Drugs, genes, sensing molecules, etc.)
ii. Functions (diagnosis, therapeutic actions, etc)
iii. Ability to search for tumor/disease sites
iv. Able to receive external power sources (NIR light,ultrasound, magnetic driving force, etc.)
v. Utilize the mediums/blood flow existing in a biological system.

VI. IMPLEMENTATION

Implementation is the stage, which is crucial in the life cycle of the new system designed. The implementation phase is starting at process installing software and hardware and requirements. Installation hardware is setting up the PC desktop hardware requirements specification[5].

Understanding nanotechnology is relatively straightforward, but the transition from the overarching concept to the development of nanorobots has proven to be a complex journey. Despite significant advancements, scientists have not yet unveiled a fully functional nanorobot operating solely on mechanical principles. While existing nanobot prototypes excel in certain aspects, they often have biological components. The ultimate objective is to create nanorobots entirely composed of electromechanical components, essentially adapting machine-like characteristics to the microscopic scale[6].

Nanorobots can be considered as machine counterparts to bacteria, functioning on the same scale as bacteria and viruses to interact and counteract them. An ideal nanobot comprises a transporting mechanism, an internal processor, and a fuel unit for functionality. However, the challenge lies in miniaturizing the propulsion system to the nanoscale, as conventional forms of robotic propulsion are not easily scaled down with current technology. Scientists have achieved reductions in robot size, but even a five or six-millimeter robot still qualifies as a macro-robot.

Creating nanobots involves a significant hurdle related to fuel units. Since conventional robotic propulsion methods are challenging to shrink to the nanoscale, developing a nanobot becomes a multifaceted task. One effective approach is to use existing nanobots to create new ones. However, the initial challenge lies in starting the process. While humans can perform individual nano-functions, constructing an autonomous robot with thousands of varied applications would be excessively tedious without specialized machine tools. Therefore, the necessity arises to design and create an entire set of specialized tools to expedite the construction and design of nanobots

Nanotechnology In Computer Science:

i. **Quantum Computing as the Future:** As electronic devices reach their physical size limits due to the laws of physics, researchers are looking beyond traditional silicon processors and binary systems. Quantum mechanics, particularly quantum computers, are seen as a practical solution that will bring radical changes to both hardware and software, enabling unprecedented calculations.

ii. **Focus on Quantum-dot Cellular Automata (QCA):** Memory, a crucial component in circuit design, is a key area of investigation in Quantum-dot Cellular Automata (QCA). Researchers are working to optimize RAM cells in this context.

iii. **Nanotechnology Enhancing Computers:** The study emphasizes two main aspects of the interaction between computer science and nanotechnology. Firstly, nanotechnology is being used to enhance computer systems and devices, offering new possibilities as traditional silicon technology nears its limits.

iv. **Computer Science's Role in Advancing Nanotechnology:** Secondly, computer science plays a pivotal role in promoting nanotechnology. It aids in the development

of computational tools and techniques that are essential for designing new devices and applications in the nanotechnology realm.

v. **Emerging Computational Nanotechnology:** As silicon technology approaches its capacity, the study highlights the growing significance of computational nanotechnology as a crucial tool for engineering analysis in the creation of novel nano-computers and applications, representing a shift in the future of computing and technology[6].

Products and Services:

i. **Inhalable Nanobots Product:** Our product focuses on delivering nanobots through inhalation. These nanobots are engineered to reach the lungs and navigate through airways to specific locations within the body.

ii. **Minimally Invasive Surgery:** Nanorobots can be utilized in minimally invasive surgical procedures by navigating through blood vessels and tissues, enabling precise and targeted interventions.

iii. **Reduced Invasiveness in Cancer Surgery:** This technology has the potential to make cancer surgeries less invasive, resulting in quicker recovery times and fewer complications for patients.

iv. **Biomarker Analysis:** Nanorobots can be designed to analyze biomarkers found in bodily fluids like blood or urine. These biomarkers offer valuable insights into the presence, progression, and response to cancer treatments.

v. **Improved Personalized Treatment:** By offering rapid and accurate biomarker analysis, nanorobots can contribute to enhanced personalized treatment plans for patients, ultimately improving the effectiveness of cancer care.

Market Opportunity & Target Market:

i. **Pharmaceutical and Biotechnology Companies:** These companies can invest in nanorobot-based therapies, partnering with nanotechnology firms to advance technology.

ii. **Healthcare Providers and Hospitals:** Nanorobots can be adopted for cancer treatment, potentially reducing invasiveness and improving patient outcomes.

iii. **Research Institutions and Academia:** Collaboration with industry partners is essential for validating nanorobot-based therapies.

iv. **Regulatory Authorities:** Regulatory bodies like the FDA and EMA will evaluate nanorobot therapies' safety and efficacy.

v. **Patients and Healthcare Consumers:** Nanorobots have the potential to enhance cancer treatment, reducing side effects and improving quality of life.

vi. **Surgical Applications:** Nanorobots can improve surgical procedures, including targeted tissue removal and minimally invasive interventions.

VII. RESULTS AND DISCUSSION

The study exploring the integration of nanoscience, nanotechnology, nanorobots, and computer science in medical technology yielded promising results across various domains. Nanosensors, employing biological, chemical, or surgical sensory points, demonstrated substantial potential for conveying information about nanoparticles to the macroscopic world. Their application in medicine, particularly for targeted drug delivery, showcased advancements in precision and adaptability. The development of nanorobots, operating at the nanoscale, exhibited remarkable capabilities for tasks such as targeted drug delivery, microsurgery, and cellular-level diagnostics. These nanorobots showcased potential solutions for navigating through biological environments, offering a new dimension in medical interventions with unprecedented precision[2].

The integration of nanotechnology and computer science in diagnostic tools and imaging technologies emerged as a transformative aspect of this study. Computer-aided diagnostics, powered by machine learning algorithms, demonstrated enhanced disease detection and diagnosis accuracy through the analysis of extensive datasets. Nanoparticle-enhanced imaging techniques, incorporating nanoscale contrast agents, offered high-resolution imaging capabilities, facilitating early detection of diseases and abnormalities. The study emphasized the need for addressing ethical concerns associated with continuous monitoring and manipulation at the nanoscale[5], highlighting the importance of privacy and consent in the implementation of these advanced technologies.

The examination of nanorobot navigation systems presented a critical aspect of the study. External navigation systems, utilizing methods such as ultrasonic signals, Magnetic Resonance Imaging (MRI), and other detection techniques, showcased potential pathways for guiding nanorobots to their intended destinations within the human body. Onboard systems, incorporating internal sensors, played a pivotal role in navigation, with chemical and spectroscopic sensors allowing nanorobots to follow specific chemical trails, enhancing their pathfinding abilities. The study underscored the importance of addressing technical challenges[5], including power sources at the nanoscale, efficient navigation, and the design of stable nanomaterials for successful implementation in healthcare applications[6].

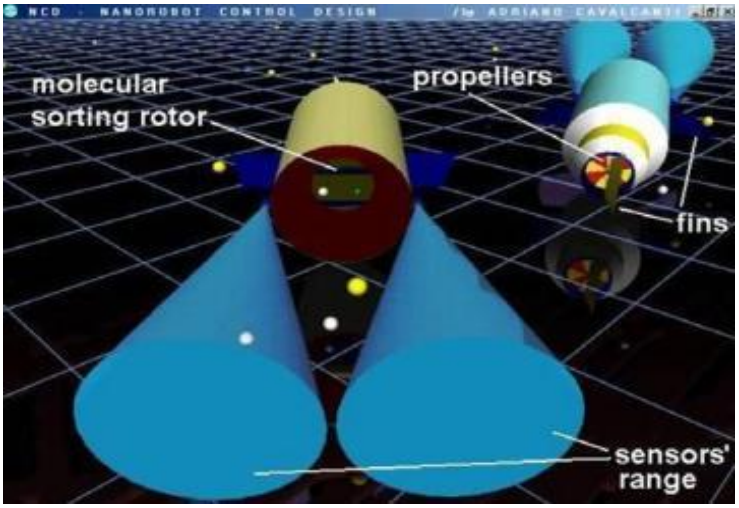

Fig 5: Nanorobot Design

VIII. CONCLUSION

Nanomedicine holds the promise of eradicating prevalent diseases from the upcoming century, alleviating medical pain and suffering, and enhancing human capabilities, particularly mental abilities[1]. The potential of nanotechnology is exemplified by the concept of a nanostructure data storage device, occupying a volume about the size of a human liver cell and smaller than a typical neuron. This device, measuring approximately 8,000 cubic microns, could store an amount of information equivalent to the entire Library of Congress. Implanting such a device in the human

brain, coupled with suitable interface mechanisms, could enable rapid access to vast amounts of information, revolutionizing cognitive capabilities.

Teams worldwide are actively engaged in developing the first practical medical nanorobot, with prototypes ranging from a millimeter to two centimeters in size. However, these robots are still in the testing phase and have not been used on humans. The deployment of nanorobots in the medical market is likely several years away, as current microrobots are merely prototypes without the capability to perform actual medical tasks. While these tiny robots hold immense potential, they are not yet ready for practical medical applications[5].

In conclusion, the results and discussion underscored the significant strides made in medical technology through the convergence of nanoscience, nanotechnology, nanorobots, and computer science. The study demonstrated the potential of nanosensors and nanorobots in precise drug delivery and intricate medical interventions, while the integration with computer science offered intelligent diagnostic tools and advanced imaging technologies. The discussion emphasized the ethical considerations, technical challenges, and the need for further research to optimize the implementation of these innovations in healthcare applications[6]. Overall, the study contributes to the evolving landscape of medical technology, paving the way for more personalized, efficient, and advanced healthcare solutions.

IX. FUTURE SCOPE

Nanorobotics emerges as a pivotal field in technology and robotics, focusing on creating machines or robots at the nanometer scale. Specifically, nanorobotics involves designing and constructing nanorobots devices made of nanoscale or molecular components. The application of nanorobots in medical procedures, such as heart bypass surgery, is highlighted in a seminar report. Traditional heart bypass surgery poses risks, and while highly trained specialists minimize dangers, nanorobots offer a safer, faster, and more effective alternative[4].

The future outlook for nanorobots in medicine is revolutionary. Envisioned applications include the treatment of conditions like heart disease and cancer using robots at a scale much smaller than current technologies. Nanorobots could operate individually or in teams to eradicate diseases and address various health conditions.

Another potential future application involves the deployment of semiautonomous nanorobots that patrol the human body, responding to emerging issues. Unlike acute treatment methods, these nanorobots could remain within the patient's body permanently[6].

Beyond medical treatment, nanorobot technology might be applied to re-engineer the human body, making it resistant to diseases, enhancing strength, and even improving intelligence. Dr. Richard Thompson emphasizes the importance of ethical discussions surrounding nanotechnology, urging communication among communities, medical organizations, and governments while the industry is still in its early stages. The possibilities presented by nanotechnology, including the idea of microscopic robots performing healing functions within our bodies, highlight the transformative potential of this emerging field[5].

These microscopic machines can remove plaque from internal artery walls without invasive surgical procedures, presenting an efficient method for plaque removal. Although the technology and its application to the human body are in preliminary stages, the potential for putting these ideas into action is on the horizon, promising transformative advancements in healthcare within the foreseeable future[6].

i. **Continued Research:** Ongoing research is crucial to enhance nanorobot design, functionality, biocompatibility, and safety.

ii. **Funding and Investment:** Adequate funding from government agencies, private investors, and venture capital firms is vital for development.

iii. **Clinical Trials:** Well-designed clinical trials are necessary to establish safety and efficacy, requiring collaboration between researchers, healthcare institutions, and pharmaceutical companies.

iv. **Scalable Manufacturing:** Developing scalable nanorobot manufacturing processes to meet healthcare demand is essential.

v. **Efficient Production:** Establishing cost-effective production methods for widespread availability and affordability of nanorobot-based treatments.

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REFERENCES

[1]. Adrino Cavalacnti, et al. (2008). Nanorobot hardware architecture for medical defense. Sensors, 8: 2932–2958.

[2]. Alfadul, S.M. and Elneshwy, A.A. (2010). Use of nanotechnology in food processing, packaging and safety review. African Journal of Food, Agriculture, Nutrition and Development, 10(6): 2719–39.

[3]. Annabelle, Hett. (2004). Nanotechnology: Small matter, many unknowns, Swiss Reinsurance Company (http:// www. swissre.com)

[4]. Cavalcanti, A., Freitas Robert, A.Jr. and Kretly Luiz, C. (2004). Nanorobotics control design: A practical approach tutorial. ASME 28th Biennial Mechanisms and Robotics Conference, Salt Lake City Utah, USA.

[5]. Cavalcanti, B., Shirinzadeh, R.A., Freitas, Jr. and Kretly, L.C. (2007). Medical nanorobot architecture based on nanobioelectronics, recent patents on nanotechnology, Bentham Science, 1(1): 1–10.

[6]. Davis, S.S. (1997). Biomedical application of nanotechnology-implications for drug targeting and gene therapy. Trends in biotechnology, 15: 217–24.

DATAMINING APPROACH FOR THE CRM APPLICATION IN THE BANKING DOMAIN

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Abstract

Customer Relationship Management" (CRM) is an important and commonly used Data mining application in the banking domain to interact with customers in proper and effective way. As banking is considered as a service industry, the purpose of maintaining a strong and effective CRM is a critical issue [1]. Datamining algorithms play a significant role in creating different types of models that can be used for the prediction of loan credibility behaviour of a customer. The approach is a step by step process that includes data collection, data preprocessing and the mining technique called classification. The data preprocessing involves different pre processing techniques especially feature selection. The loan credibility prediction is implemented by evaluating the classification accuracy. The datamining approach for the CRM application is demonstrated here using the credit data set . The classification models accuracy to identify behavior related to loan credibility is evaluated in this paper.

Keywords: *Data preprocessing, Classification, CRM, Random Forest, Feature Selection*

INTRODUCTION

In this era, the most important application of data mining is "customer relationship management" (CRM). Customer relationship management deals with how a company interacts with its customers, both current and potential customers. Since banking is considered a service industry, maintaining strong and effective customer relationship management is critical [1]. CRM has become an integral part of banks in today's global complex environment [2]. The main areas where data mining tools can be used in banking are customer segmentation, bank profitability, credit evaluation and approval, marketing, fraud detection and cash management and forecasting functions [2]. Banks provide numerous credit options and loans., so it is quite common for customers to turn to banks for loans to fulfill their shopping needs. This practice has increased day by day especially in business, education, marriage and agriculture, but the downside is that

many people take advantage and abuse the services provided by banks. Credit evaluation and approval processes are evident to understand the eligibility of a person or corporate entity. The main purpose of a bank is to lend money from various sources. Lending money to customers is very easy, but getting it back is a complicated process. The main objective of banks as lenders is thus to ensure profitability of sanctioned loans and advances. To maintain your CRM, give credit to trusted customers who can reasonably pay it back within the agreed time frame from trusted sources. Banks have a huge amount of customer transaction data every day. Data mining tools help analyze this data and turn it into information that are able to predict a customer's borrowing behavior. In banking domain CRM can be maintained by predicting the lending behavior of the customer. Data mining analyzes the huge data collected from banking transactions and finally aggregates it into meaningful information. This information helps the bankers to take the right decisions and leads to the smooth functioning of the organization. After formulating the problem, collect the relevant data and use some pre-processing techniques to transform the raw data into a suitable form for use in the mining process. Finally, use the data mining function, especially the classification, to classify the customer into two groups, such as those who can pay the loan amount quickly or not.

LITERATURE REVIEW

The literature survey includes the basic concept of data mining, different data mining techniques, the concept of classification, different classification algorithms and various feature selection methods. . H. Abdou et.al in [10] stated that loan officers took judgmental and subjective decisions based on their experience and analysis of data. C. R. Abrahams et.al in [11] stated that traditionally, decisions related to credit evaluation were made by banking officials based on past experiences, historical performances, and some of the measures of the credit especially character, capacity, capital, collateral, and conditions. Strahan et.al stated in [12] the lending business in Banks is too risky and hard. The borrower risk was affected by bank loans' price as well as non-price terms. Borrowers can be riskier borrowers, smaller borrowers, fewer cash borrowers, and borrowers pay higher interest rates on their loans. A. Mukherjee in [13] stated even though it is risky, granting several types of loans is an important service that provides more income to commercial banks and other lending organizations.

In Classification process, an instance of the given dataset has to be classified into one of the target classes which are already known or defined [14,15]. According to L. C. Thomas, and J. N. Crook in [16,17] credit scoring has included both modern concept of mining the data and conventional statistical methodologies in recent years., such as Linear Discriminant Analysis (LDA), Logistic Regression(LR), Classification And Regression Tree (CART), Multivariate Adaptive Regression Splines (MARS), Expert System, Genetic Programming Model neural network, and its latest development Support Vector Machines (SVM). Wiginton J.C stated in [18] the method of logistic regression and discreminent analysis are the most broadly established statistical techniques used to classify applicants as "good" or "bad". In [19] Berson et al stated that Classification aims to map a data item into one of several predefined categorical classes. Feature selection is a dimensionality reduction technique that reduces the number of attributes to a manageable size for processing and analysis [20].

DATA COLLECTION

The data were collected from a UCI depository. The attributes are listed in Table -1

SI	**Name of attribute**
1	Checking_Status
2	Duration
3	Credit_History
4	Purpose
5	Credit_Amount
6	Savings_Status
7	Employment
8	Installment_Commitment
9	Personel_Status
10	Other_Parties
11	Residence_Since
12	Property_Magnitude
13	Age
14	Other_Payment_Plans
15	Housing
16	Existing_Credits
17	Job
18	Num_Dependents
19	Own_Telephone
20	Foreign_Worker
21	Class

Table 1 – List of Attributes

DATA PRE PROCESSING

It is possible for the client transaction data gathered from the banking domain to include noise, inconsistencies, missing values, or duplicates. This has an impact on the mining process' dependability. If the input data that the user collected are not perfect then they will not get the accurate results of the mining process that has been applied on this data [5]. Accurate results of data mining process can be obtained from high quality input data.. So data preprocessing is mainly focused to improve the quality of data and consequently the mining results. Preprocessing data is a crucial stage in datamining which deals with preparation and transformation from the initial data set to the final data set[4]. The below mentioned categories of data pre processing are utilized to change initial data set to final data set.

- Data cleaning
- Data integration
- Data transformation
- Data reduction and Dimensionality reduction

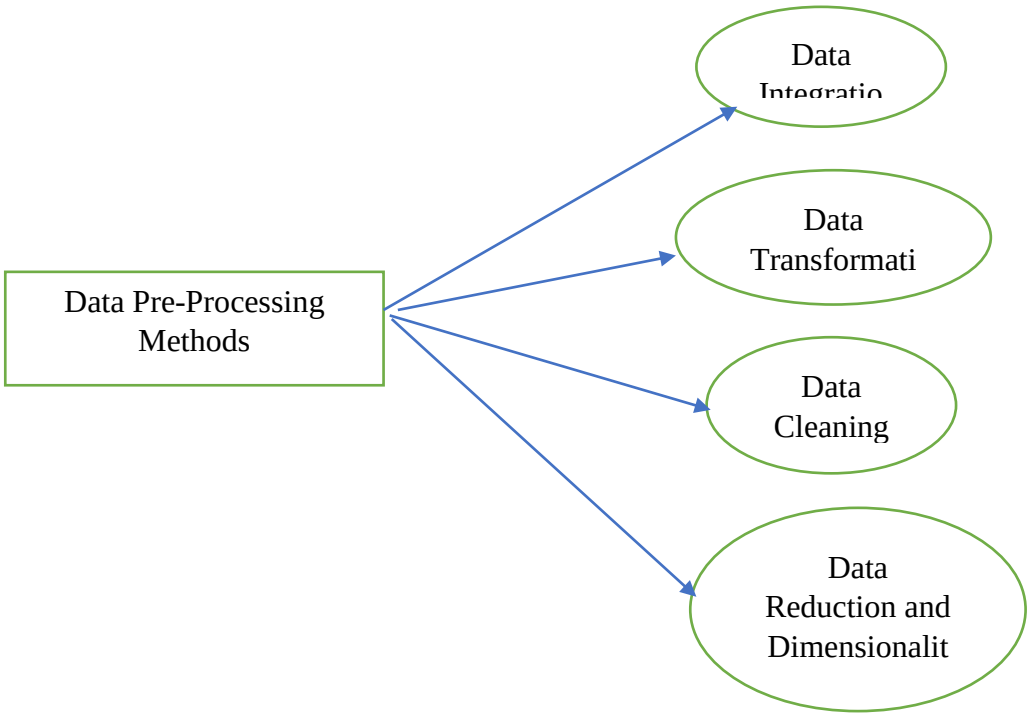

Figure - 1: Data Pre-processing methods

In computer science, data mining is a process for gleaning knowledge and patterns from massive amounts of data. To make sure the raw data is in an appropriate format for analysis, preprocessing is necessary before applying the modelling . Preprocessing data is a crucial stage in the data mining process that has a big impact on the final results' precision and effectiveness. The excel format has to be converted into respective formats (.csv,.arff) required for the processing of various data mining models. Data cleaning involves the processing of duplicate and missing values. A other calculated value, such as the mean, median, or mode, is used to manage the missing numbers. For example, all the missed “Jobs” in the dataset are swapped out for the term “Business” as it is the most occurred job. Label Encoding is a method for data transformation. It will convert labels in the credit data set into the numeric form in order to easily transformed into a machine-readable form. Data reduction is a method to reduce the volume of initial data set and should produce the same performance [5].

Feature selection is an important data reduction method. Feature selection has been shown to be beneficial in improving learning efficiency, raising predicting accuracy, and decreasing the complexity of learned results. [6,7] . Table 2 represnts the accuracy obtained both prior to and following the feature selection procedure .

Classifiers	**Accuracy (%) Before Feature Selection**	**Accuracy (%) After Feature Selection**
Jrip	74.3	75.6
ZeroR	70	70
SMO	78.4	78.5
Adaboost	73.7	73.7
Random Forest	99	99.6
Ridor	76	78.3
DTNB	71.1	74.9

Table- 2**:** Performance metric of feature selection algorithms

DATA MODELLING

Classification is used in scenarios where we need to identify the category or class into which a new observation might belong. Classification is is among the data analysis methods that predict class labels [7]. There are more classification methods such as Statistical-based, Distance-based, Decision tree-based, Neural network-based, Rule-based [8]. Choosing the correct classification method thus becomes very important for obtaining accurate results. Random Forest is now known to be one of the most efficient classification methods [9]. In order to classify a customer as "eligible customer" or "not eligible customer" using credit dataset binary classification method is used. The process of classification divides the dataset into two parts , one for creating the model called training dataset and other for testing the model called testing dataset.

ZeroR, Adaboost, JRip, SMO, Kstar, Random Forest, Ridor, and DTNB are the various classification algorithms that can be applied on the credit data set . The efficiency can be measured by evaluating the accuracy of each classifier. Kappa Statistic, and, Mean Absolute Error are also evaluated. These metrics are used to evaluate better classification algorithmr for the loan credibility prediction. The classification performance based on the above measures is described in the table 3 and the implementation is demonstrated in the Figure 2. TheTable 3 shows that the Random Forest classification algorithm produced better accuracy on the credit data set.

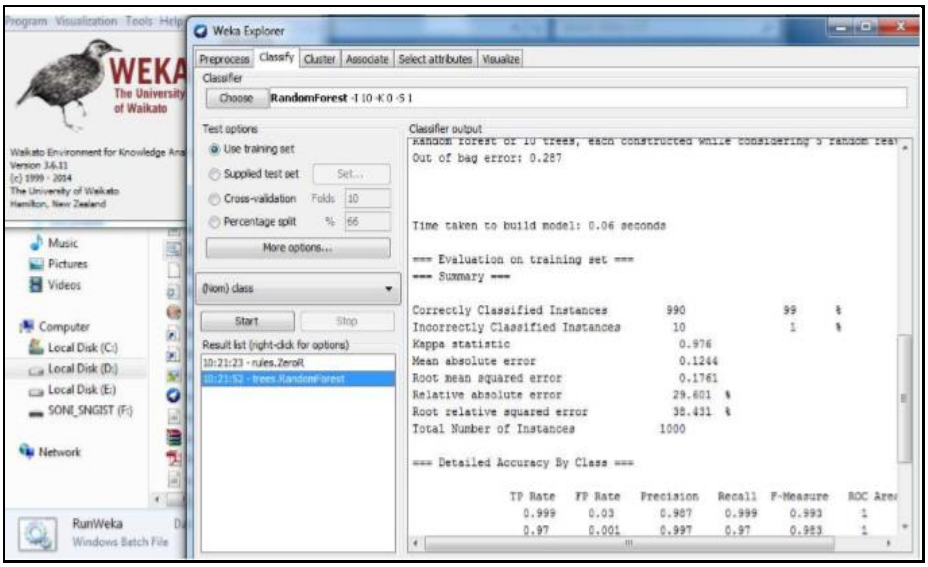

Figure 2: Classification using Weka

Classifiers	Accuracy (%)	Kappa	MAE
JRip	74.3	0.346	0.366
ZeroR	70	0	0.42
SMO	78.4	0.45	0.216
Adaboost	73.7	0.225	0.342
Random Forest	99	0.976	0.124
Ridor	76	0.2701	0.24
DTNB	71.1	0.394	0.362

Table 3: Classification Accuracy

The figure 3 represents the classification accuracy, figure 4 represents classification Kappa metric and figure 5 represents Classification MAE metric. From the above graphs , it is clear that Random Forest algorithm can perform better for classifying the customer as “eligible customer “ or “not eligible customer” for issuing the loan.

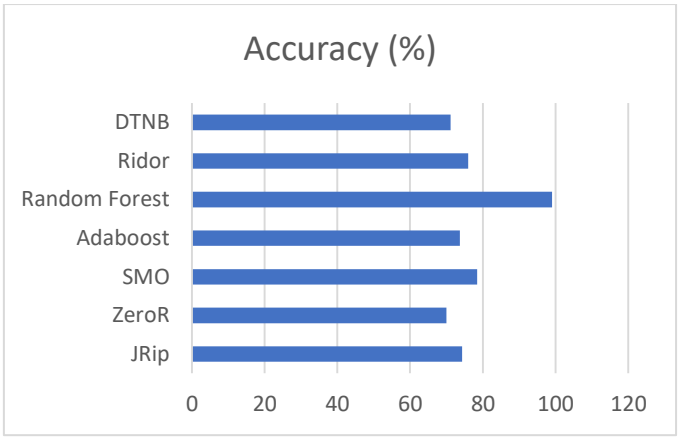

Figure 3: Classification Accuracy

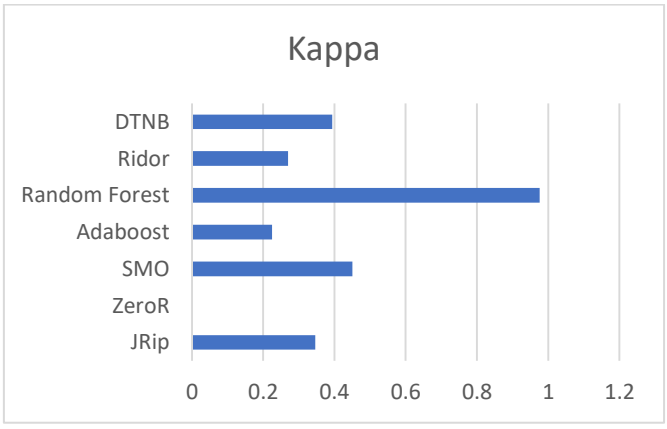

Figure 4: Classification Kappa metric

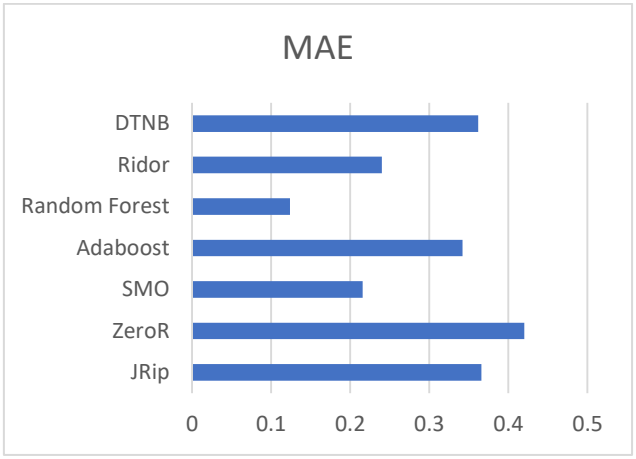

Figure 5: Classification MAE metric

ABOUT TECHNOLOGY

Weka is a powerful tool for handling the operations of data mining such as data preparation, classification, regression, clustering, association rules mining, and visualization. . The graphical user interface (GUI) of Weka 5 makes working with data simple for both novice and expert users. Through its Java API, it also facilitates scripting and interaction with other computer languages, including R and Python. The numerous 29 operations that can be carried out in Weka are shown in figure 5.

Figure **5:** Operations of Weka

The process start with the raw data set and apply preprocessing tools to clean the raw data set into preprocessed dataset and it can be used for mining operations. The data mining algorithms were applied on this preprocessed dataset. The different data mining operations are **Classiffication ,Clustering** and **Assoiciation Rule Mining.** Using the

data preprocessing technique known as attributes selection, six features can be automatically chosen to produce a smaller dataset. Weka offers a number of data visualization tools for the model's statistical output. Moreover, many models can be used on the same dataset. As a result, WEKA causes data mining models to develop quickly overall.

CONCLUSION AND FUTURE SCOPE

The paper is concluded that the Customer Relationship Management application can be implemented using data mining approach . The datamining technique involved in the process is classification . The accuracy before and after data preprocessing method called feature selection is also examined. From the experiment it is clear that the classification algorithm Random Forest produced better accuracy after applying the feature selection methods. The future enhancement of the work can be applied to handle large amount of data using some big data technologies .

REFERENCES

[1] Frawley, W. J., Piatetsky-Shapiro, G., and Matheus, C. J. (1992). Knowledge discovery in databases: An overview. *AI Magazine*, 13(3):57.

[2] Dileep B. Desai, Dr. R.V.Kulkarni “A Review: Application of Data Mining Tools in CRM for Selected Banks”, (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 4 (2) , 2013, 199 – 201

[3] S. Kotsiantis, D. Kanellopoulos, P. Pintelas, "Data Preprocessing for Supervised Leaning", *International Journal of Computer Science*, 2006, Vol 1 N. 2, pp 111–117.

[4] Soni P M, Varghese Paul, Sudheep Elayidom “An Efficient Data Preprocessing Frame Work for Loan Credibility Prediction System “IJRET: International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308

[5] Ms. Neethu Baby1, Mrs. Priyanka L.T “Customer Classification And Prediction Based On Data Mining Technique”, International Journal of Emerging Technology and Advanced Engineering, (ISSN 2250-2459, ISO 9001:2008

Certified Journal, Volume 2, Issue 12, December 2012)

[6] Almuallim and T. G. Dietterich. “Learning boolean concepts in the presence of many irrelevant features,” Artificial Intelligence, vol. 69, no. 1-2, pp. 279–305, 1994

[7] Sudhamathy G (2016), “Credit Risk Analysis and Prediction Modelling of Bank Loans Using R”, Vol 8 No 5.

[8] K. Chitra, B.Subashini (2013), “An Efficient Algorithm for Detecting Credit Card Frauds”, Proceedings of State Level Seminar on Emerging Trends in Banking Industry

[9] Bernard, S., Heutte, L., Adam, S. (2009), “On the selection of decision trees in Random Forests”, International Joint Conference on Neural Network , pp. 302–307.

[10] H. Abdou and J. Pointon, " Credit Scoring , Statistical Techniques and Evaluation Criteria : A Review of the Literature, " Intelligent Systems in Accounting, Finance & Management., 2011. 18(2-3): p. 59-88.

[11] C. R. Abrahams, M. Zhang, Fair lending compliance: Intelligence and implications for credit risk management, John Wiley & Sons, 2008

[12] Strahan, Philip E. "Borrower risk and the price and nonprice terms of bank loans." FRB of New York Staff Report 90 (1999).

[13] A. Mukherjee, “Credit scoring model using data mining techniques-a pragmatic approach.” 2010, Germany: VDM Verlag Dr. Müller

[14] S. Dudoit, J. Fridlyand, and T.P. Speed, “Comparison of discrimination methods for the classification of tumours using gene expression data,” Journal of the American Statistical Association, 97(457), pp. 77–87, 2002

[15] Elizabeth Murray, “Using Decision Trees to Understand Student Data,” In Proceedings of the 22nd ICML, Bonn, Germany, 2005.

[16] L. C. Thomas, A survey of credit and behavioural scoring: Forecasting financial risk of lending to consumers. International Journal of Forecasting. 16(2000) 149-172.

[17] J. N. Crook, D. B. Edelman, L. C. and Thomas, Recent developments in consumer credit risk assessment. European Journal of Operational Research. 183(2007) 1447-1465

[18] Wiginton, J. (1980). A Note on the Comparison of Logit and Discriminant Models of Consumer Credit Behavior. Journal of Financial and Quantitative Analysis, 15(3), 757-770. doi:10.2307/2330408

[19] D. J. Hand, W. E. Henley, "Statistical classification methods in consumer credit scoring: a review", Journal of the Royal Statistical Society: Series A (Statistics in Society), Vol. 160, No. 3, pp. 523-541, 1997

[20] Girish Chandrashekar, FeratSahin, (2014). "A survey on feature selection methods". Computers and Electrical Engineering

REAL TIME IMPLEMENTATION OF IOT BASED ROBOTIC CAR AND AUTOMATIC SOLAR POWERING STREET LIGHTS WITH SOLAR TRACKER

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ABSTRACT:

The main objective of this paper to achieve conservation of energy , a sustainable development goal stated by United Nations. Nowadays energy sources are limited and energy consumption has increased in our daily life. The increase in the demand for energy can be maintained by applying renewable energy like solar energy. Based on this idea, in this article we are implementing a solar-powered LED street light with automatic on and off . Also a mobile controlled car is running on the road by using solar energy and the battery of the car is recharged by recharging station of solar energy. The system helps to save energy in both ways such as to use in the street lights and also for charging the battery of the car on the road.. It maintain maximum utilization and minimum loss of available energy. The large amount of solar energy obtained through solar tracker during the day time is stored in a lithium cell and the stored energy is used to power the street lights during the whole night. The same stored solar energy is used to charge the battery of the car.

Keywords: LDR sensor, Ardino nuo, Ardino nano, Solar energy, LED , LDR

INTRODUCTION: Without rapid action the amount of energy used for lighting will be 80% higher in 2030 than today; however, if we simply make better use of today's efficient lighting technologies and techniques, the demand for global lighting energy can be reduced [1] . At present, the controlling of streetlights in almost areas is done by manually through a control switch set that helps to turn on or off . This is the traditional method of street light control, which is considered to be an inefficient method [2]. The gradually growing requirement of energy and the limited resource of traditional energy sources has become a challenge for both developed and developing countries. For this reason, establishing efficient energy and sustainability are the first

priority that is to be given before installing any project. Powering street lights using solar energy is an effective way to decrease the consumption of energy and maintain CO2 impact on the environment. Solar energy refers to the renewable energy obtained from the Sun's radiation. It is a sustainable source of power that can be harnessed through various technologies such as solar panels or solar thermal systems. Since solar energy is not produce green house effect , Solar energy can be considered as environment friendly. It can be used for a wide range of applications, including generation of electricity , powering and heating of various devices.

The adoption of solar energy has been increasing globally due to its potential to reduce reliance on fossil fuels and mitigate climate change. Saving power is very important, instead of using the power in unnecessary times it should be switched off. Major power consuming factor of any country is the usuage of street lights.. Electric street lighting consumes 114 TW h annually, leading to the emission of 69 million tones of CO2 [1]. By PV (Photovoltaic) effect the solar radiation can be directly converted into electrical energy. This energy is stored in a rechargeable battery and supplied to the luminary when it is required to glow. The system is designed to provide an automatic control facility. LDR sensor is used to automatically turn “ON” the street lights in the night and turn “OFF” automatically in the morning, The street light glow in the night is too bright and it leads to wastage of energy [2]. The figure shows the model of solar street light . The system is actually IoT based application and a Bluetooth controlled car use solar energy for the power.

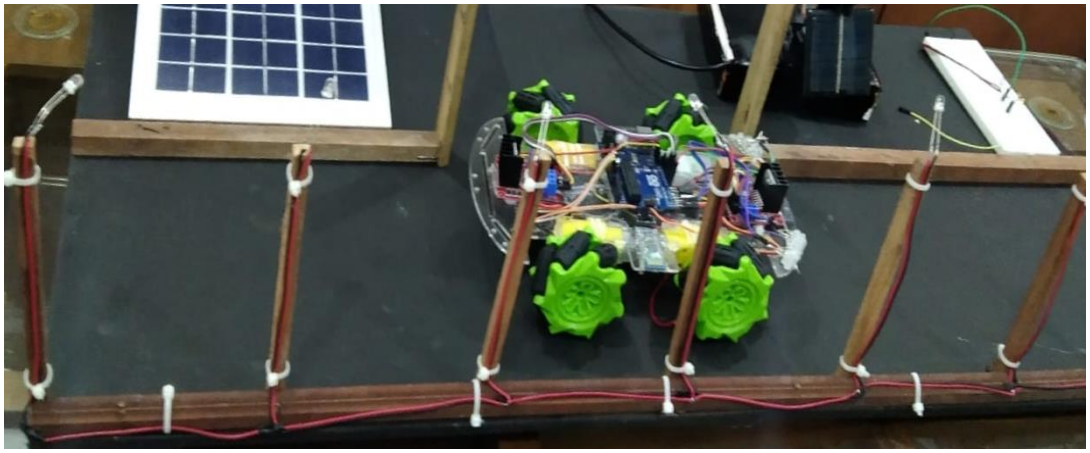


Figure 1 Model for Solar Automatic Powering Streetlight and IoT based Robotic Car

CIRCUIT DIAGRAMS

The designing of automatic solar powered street light and IoT based robotic car is describer here using the corresponding circuit diagrams.A circuit diagram can be defined as the combination of batteries, switches, and cables connected into a motherboard in which signals can be communicated with each other for a specific purpose. The main objective of this paper is to design the circuit for the an IoT based robotic car and automatic powering street lights with solar tracker.

ROBOTIC CAR

The circuit of IoT based robotic car includes the following components

- Motor Driver L298N x2
- Ardino Uno
- Gear motor x 4
- Tyre x 4
- Bluetooth Module HC-05
- Battery x 4

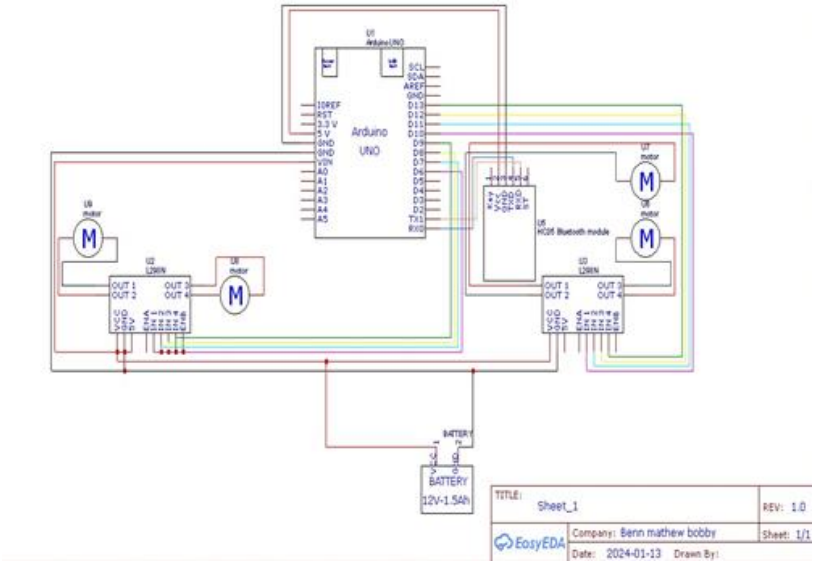


Figure 2 : Circuit diagram of IoT based Robotic car

The circuit of IoT based robotic car is represented in the figure 2. The explanation of each component is as follows. The Motor Driver L298N is an dual H-bridge motor driver integrated circuit. It is widely used in robotic and automotive applications to control the speed and direction of DC motors. The L298N can drive motors with a voltage range of 5 to 35 volts and a peak current of 2A. The Arduino Uno is a popular microcontroller board with ATmega328P processor. It features digital and analog input/output pins that can be used to connect to various sensors, displays, and other electronic components. The board also includes a USB connection for programming and power. A gear motor is a type of motor that incorporates a gear mechanism to transmit torque from the motor to an output shaft. This gear mechanism helps to decrease the motor speed while increasing the torque. Gear motors are commonly used in various applications where precise control of speed and torque is required. To control a gear motor with Arduino, a motor driver module such as the L298N can be used. This module provides the necessary circuitry to interface the Arduino with the gear motor and allows to control its speed and direction. By writing code in the Arduino IDE, it is possible to send commands to the motor driver module, which in turn controls the gear motor. The Bluetooth Module HC-05 is a wireless communication module and can be used in both master and slave configurations, making it versatile for different projects. The HC-05 module is used in conjunction with microcontrollers like Arduino to add Bluetooth functionality to projects. The HC-05 module is used in robotics, automation systems, and other electronic projects. For example, it can be used to control an Arduino board via Bluetooth .

AUTOMATIC POWERING STREET LIGHT

The circuit of automatic solar powering street light includes the following components

- Solar panels,
- LED light,
- Ardino nano ,
- LDR Sensor ,
- Rechargeable battery
- Jumper cables.

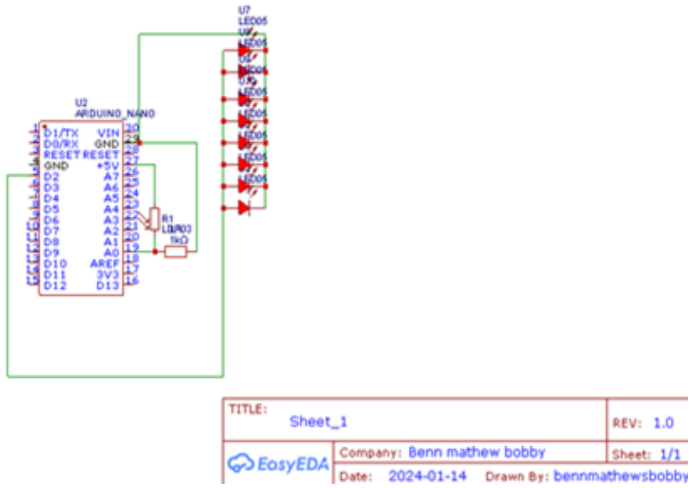


Figure 3: Circuit diagram of Automatic powering street light

The detailed explanation of the components of automatic solar powering street light is as follows. A solar panel is a device that converts sun's solar energy into electricity by using photovoltaic cells or to heat. These are mainly used in airports ,metro etc. Solar panels can be used for a wide variety of applications including telecommunications, remote sensing, and residential and commercial solar electric systems.

LED lights, or Light Emitting Diode lights, are a popular and energy-efficient lighting option.They are also highly energy-efficient, consuming less electricity while providing the same level of brightness.LED lights are available in various forms, including LED strip lights, RGB LED, etc. The advantages of using LED street lights are low energy consumption, long and predictable life time, immediate turn on and off[4].

The Arduino Nano is a small, complete, microcontroller board with ATmega328 processor. The Nano is designed to be easily integrated into projects and is ideal for those with limited space. It features a wide range of input and output pins, making it suitable for various applications. The Nano is commonly used in projects such as robotics, home automation, and wearable devices.

An LDR sensor, also known as a Light Dependent Resistor is a resistor that helps to control the intensity of light passing on it.

SOLAR TRACKER

The circuit of solar tracker includes the following components.

- Servo motor

- LDR sensor
- Arduino nano
- Jumper Cables
- 1K resistor

A servo motor in Arduino is a of motor that is controlled with high precision using pulses of varying lengths. servo motors can be easily controlled using the Servo library, which simplifies the process of interacting with the motor and allows for smooth and precise movement.

A 1K resistor, also known as a 1000-ohm resistor, is a passive two-terminal electrical component that limits the electric current flow . It is widely used in electronic circuits for various purposes such as voltage division, current limiting.

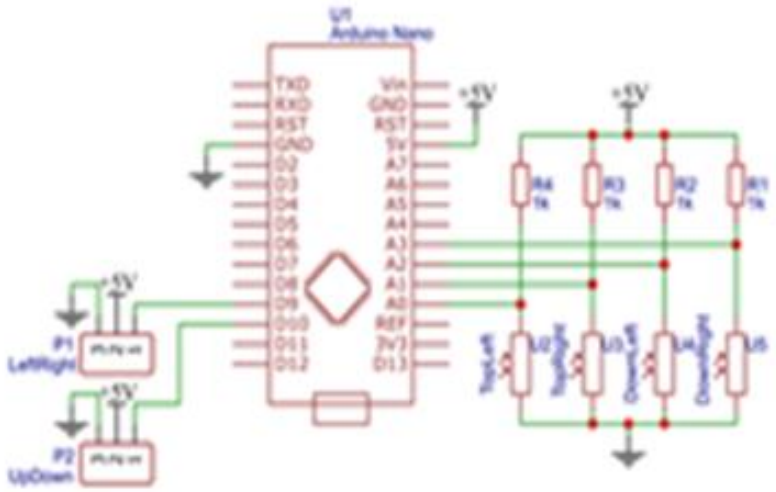
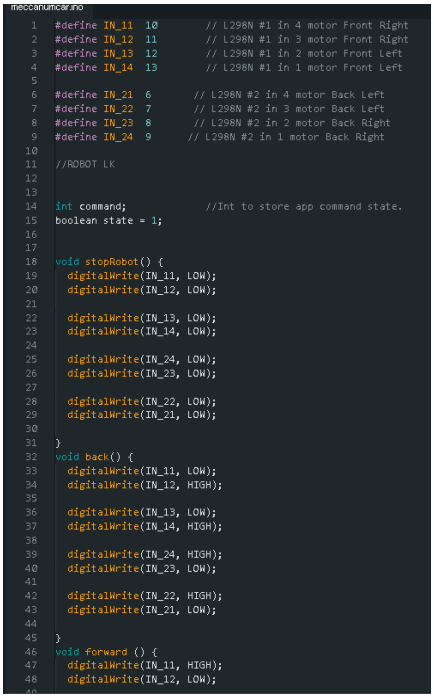


Figure 4 : Circuit for Solar Tracker

IMPLEMENTATION

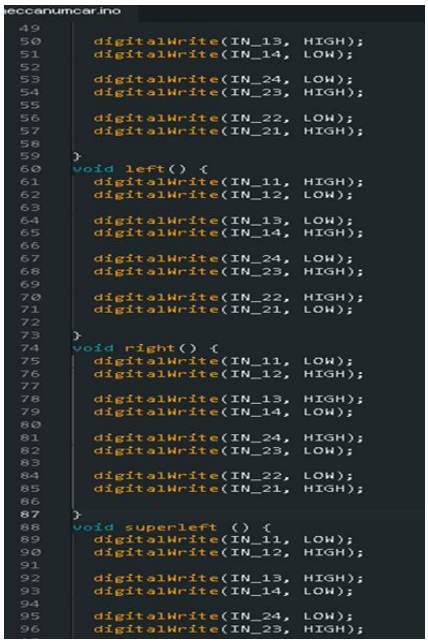
The implementation of this paper is done by using Ardino nano and Ardino uno. The IoT based Robotic Car is implemented using Ardino Uno. The main operations for the robotic car are move forward, backward, side ways and rotate. The operations are controlled by using an interface called Bluetooth RC controller. Figure 7 shows the interface that controls all the operations of the robotic car. All the operations can be

implemented smoothly using this interface. The sample code for robotic car operations are explained in figure 5 and figure 6.



```
#define IN_11  10       // L298N #1 in 4 motor Front Right
#define IN_12  11       // L298N #1 in 3 motor Front Right
#define IN_13  12       // L298N #1 in 2 motor Front Left
#define IN_14  13       // L298N #1 in 1 motor Front Left

#define IN_21  6       // L298N #2 in 4 motor Back Left
#define IN_22  7       // L298N #2 in 3 motor Back Left
#define IN_23  8       // L298N #2 in 2 motor Back Right
#define IN_24  9      // L298N #2 in 1 motor Back Right

//ROBOT LK


int command;            //Int to store app command state.
boolean state = 1;


void stopRobot() {
  digitalWrite(IN_11, LOW);
  digitalWrite(IN_12, LOW);

  digitalWrite(IN_13, LOW);
  digitalWrite(IN_14, LOW);

  digitalWrite(IN_24, LOW);
  digitalWrite(IN_23, LOW);

  digitalWrite(IN_22, LOW);
  digitalWrite(IN_21, LOW);

}
void back() {
  digitalWrite(IN_11, LOW);
  digitalWrite(IN_12, HIGH);

  digitalWrite(IN_13, LOW);
  digitalWrite(IN_14, HIGH);

  digitalWrite(IN_24, HIGH);
  digitalWrite(IN_23, LOW);

  digitalWrite(IN_22, HIGH);
  digitalWrite(IN_21, LOW);

}
void forward () {
  digitalWrite(IN_11, HIGH);
  digitalWrite(IN_12, LOW);
```

Figure 5 : Sample code for robotic car



```
eccanumcar.ino

    digitalWrite(IN_13, HIGH);
    digitalWrite(IN_14, LOW);

    digitalWrite(IN_24, LOW);
    digitalWrite(IN_23, HIGH);

    digitalWrite(IN_22, LOW);
    digitalWrite(IN_21, HIGH);

}
void left() {
    digitalWrite(IN_11, HIGH);
    digitalWrite(IN_12, LOW);

    digitalWrite(IN_13, LOW);
    digitalWrite(IN_14, HIGH);

    digitalWrite(IN_24, LOW);
    digitalWrite(IN_23, HIGH);

    digitalWrite(IN_22, HIGH);
    digitalWrite(IN_21, LOW);

}
void right() {
    digitalWrite(IN_11, LOW);
    digitalWrite(IN_12, HIGH);

    digitalWrite(IN_13, HIGH);
    digitalWrite(IN_14, LOW);

    digitalWrite(IN_24, HIGH);
    digitalWrite(IN_23, LOW);

    digitalWrite(IN_22, LOW);
    digitalWrite(IN_21, HIGH);

}
void superleft () {
    digitalWrite(IN_11, LOW);
    digitalWrite(IN_12, HIGH);

    digitalWrite(IN_13, HIGH);
    digitalWrite(IN_14, LOW);

    digitalWrite(IN_24, LOW);
    digitalWrite(IN_23, HIGH);
```

Figure 6 : Sample code for robotic car

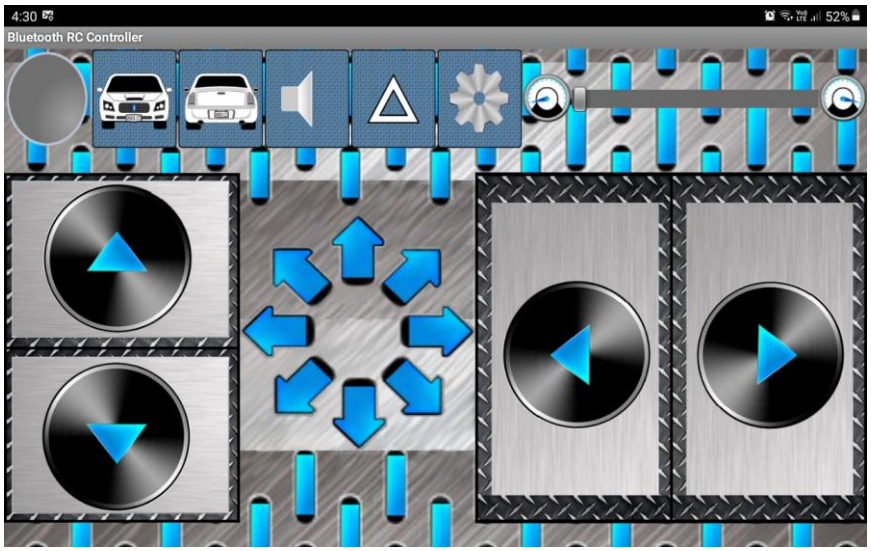


Figure 7: Bluetooth RC Controller interface

Implementation of automatic powering street lights using solar energy is done by using the micro controller Ardino nano. It is not necessary for the lights to glow with same intensity all the time and the lights to glow in a high intensity also consume more energy than a light glowing with a relatively lower intensity [3] . The micro controller program code controls the automatic powering of street lights according to the intensity of light in LDR sensor. The LDR resistance is inversely proportional to the intensity of the sun light . Based on this principle there will be no current passing through LDR during the night time. Obviously street lights will turn off automatically. During day time, maximum current will passing through the LDR sensor and it allows to turn on street lights automatically.

```
#include <SoftwareSerial.h>
int sensorPin = A0; // select the input pin for the LDR
int sensorValue = 0; // variable to store the value coming from the sensor
int led = 3;
void setup() { // declare the ledPin as an OUTPUT:
pinMode(led, OUTPUT);
Serial.begin(9600); }
void loop()
{
sensorValue = analogRead(sensorPin);
Serial.println(sensorValue);
if(sensorValue < 100)
{
Serial.println("LED light on");
digitalWrite(led,HIGH);
delay(1000);
}
digitalWrite(led,LOW);
delay(sensorValue);
}
```

Figure 8: Sample code for Automatic street Lights

Solar tracker is implemented by using ardino uno along with the components servo motor , LDR sensor and IK resistor . Based on the intensity of sun light , the LDR sensor give signals to ardino uno and it helps to turn the solar panel into the corresponding direction of the sunlight. The rotation can be done by using servo motor. Figure 9 represents the sample code for the operation of solar tracker.

```
int topleft;
int topright;
int downleft;
int downright;
int waittime = 1;

void setup() {
  pinMode(9, OUTPUT);
  pinMode(10, OUTPUT);
  TCCR1A = 0;
  TCCR1A = (1 << COM1A1) | (1 << COM1B1) | (1 << WGM11);
  TCCR1B = 0;
  TCCR1B = (1 << WGM13) | (1 << WGM12) | (1 << CS11);
  ICR1 = 40000;
  OCR1A = 3000;
  OCR1B = 3600;
}

void loop() {
  topleft = analogRead(A0);
  topright = analogRead(A1);
  downleft = analogRead(A2);
  downright = analogRead(A3);

  if (topleft > topright) {
    OCR1A = OCR1A + 1;
    delay(waittime);
  }
  if (downleft > downright) {
    OCR1A = OCR1A + 1;
    delay(waittime);
  }
  if (topleft < topright) {
    OCR1A = OCR1A - 1;
    delay(waittime);
  }
  if (downleft < downright) {
    OCR1A = OCR1A - 1;
    delay(waittime);
  }
  if (OCR1A > 4000) {
    OCR1A = 4000;
  }
  if (OCR1A < 2000) {
    OCR1A = 2000;
  }
  if (topleft > downleft) {
    OCR1B = OCR1B - 1;
    delay(waittime);
  }
  if (topright > downright) {
    OCR1B = OCR1B - 1;
    delay(waittime);
  }
  if (topleft < downleft) {
    OCR1B = OCR1B + 1;
    delay(waittime);
  }
```

Figure 9: Sample code for Solar Tracker

RESULTS AND DISCUSSION:

The main idea behind this paper to accomplish sustainable development goal number seven means affordable and clean energy. Here the paper is discussed with how to convert renewable solar energy into electrical energy and the proper usage of this energy for automatic powering of street lights. By applying this automatic on or off mechanism, large amount of energy can be saved. Also the robotic car introduced in this paper is powered with the converted solar energy from the solar battery. It also helps to avoid wastage of energy.

CONCLUSION:

The paper is concluded about saving of energy and it leads to achieve sustainable development goal designed by United Nations. The paper explained about how to convert renewable solar energy into electrical energy and how it can be applied in

various situations such as automatic streetlights and IoT based robotic car. The circuit diagrams and implementation of the application is also explained.

REFERENCES:

[1] International Energy Agency. Light's labour's lost: policies for energy efficient lighting. France: IEA; 2006

[2] LIU Lianhao, "A new street lamp controller design" (J). Computing Technology and Automation, 1997, (4):61-63.

[3] ZHANG Liqun, Single-chip single board controller from time to time in the street lamp factory control (J). Application of Energy Technologies, 1998, (4):33-34.

[4] YU Xiao-xiang, HUANG Pei-wei. Intelligent Road Lamp Control System Based on Lonworks(J).Computer Technology and Development, 2007,(2):99-102.

[5] Jeremy Lagorse, Damien Paire, Abdellatif Miraoui. Sizing optimization of a stand-alone street lighting system powered by a hybrid system using fuel cell, PV and battery (J). Renewable Energy, 2009, (34): 683691.

[6] J. Pearce et al., "Optimization of open circuit voltage in amorphous silicon solar cells with mixed-phase (amorphous+nanocrystalline) ptype contacts of low nanocrystalline content," J. Appl. Phys., vol. 101, no. 11, Jun. 2007,pp. 114301–114307.

[7] Sun JH, Su JF, Zhang GS, Li Y, Zhao C. An energy-saving control method based on multi-sensor system for solar street lamp. In: Proc int conf digital manufacturing and automation (ICDMA), ChangSha; 2010. p. 192–4

[8] Wu Y, Shi C, Yang W. Study of acquisition streetlights background signal by multi-sensor array. In: proc int conf control automation and systems(ICCAS), Gyeonggi-do; 2010. p. 1000–3.

[9] Sei Ping Lau , Geoff V. Merrett, Alex S. Weddell, Neil M. White, "A traffic-aware street lighting scheme for Smart Cities using autonomous networked sensors," Computers and Electrical Engineering, Electronics and Computer Science, University of Southampton, UK ,2015.

SEASONAL DISEASE PREDICTION USING MACHINE LEARNING ALGORITHMS

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ABSTRACT

This paper employs machine learning to predict diseases through an app or website, aiming to reduce misdiagnosis risks and save time. It analyzes patient records to forecast disease likelihood using models like Support Vector Machine, K-Nearest Neighbors, and deep learning. These predictive tools promote early diagnosis and tailored treatment, revolutionizing healthcare. This study explores various machine learning algorithms to seasonal disease predict using medical records, genetics, and symptoms. Models developed, including supervised techniques, enhance accuracy and offer tools for early diagnosis and personalized care. It showcases the potential of machine learning in revolutionizing healthcare.

(*Keyword*: Machine Learning, SVM, KNN,Random Forest, Decision tree)

INTRODUCTION

Predicting seasonal diseases via machine learning involves training models on vast medical datasets, aiding early detection. This process includes data preprocessing, model training, and assessment using decision trees, random forests, Support Vector Machines, and deep learning. These models aim to assist healthcare professionals in effective diagnosis and treatment, improving public health. Leveraging diverse data sources, such as symptoms and lifestyle information, machine learning enables simultaneous seasonal disease prediction, revolutionizing healthcare. The Illness Indicator, using web data, forecasts Illnesses based on symptoms, catering to the increasing desire for accessible health knowledge. It utilizes supervised and unsupervised techniques, emphasizing featureengineering and model refinement for accurate predictions.

The goal is to enable early disease diagnosis and personalized treatments, aligning with the transformative impact of machine learning in healthcare. The project utilized various ML models and algorithms onsegregated data, offering potential for seasonal disease prediction.

This project aims to predict seasonal diseases simultaneously using diverse datasets and advanced machine learning techniques. The goal is to create user-friendly tools for early

seasonal disease prediction, fostering personalized treatments and proactive healthcare management. Additionally, it addresses the challenge of identifying seasonal diseases using innovative approaches.

LITERATURE SURVEY

Singh Et Al (2020) [1] Proposed the"Machine Learning-Based Method for Personalized and Cost-Effective Detection of Alzheimer's disease" Data mining sorts through a ton of health info to find hidden patterns and insights. It helps predict diseases, making healthcare plans more reliable. This way, we safeguard against illnesses by understanding and using this data wisely. It's like digging for essential details in a pile of complex information to make smart healthcare choices.

Vinitha S (2020) [2] "Proposed Disease Prediction using Machine Learning over Big data" Data is super important in many fields, especially in healthcare. As healthcare gets better, the info about it grows too. Gathering this info helps us make healthcare better. A computer program, a machine learning algorithm, is used to collect and predict missing info. This helps fill in the blanks and make our data complete. CNN-MDRP. It's smarter because it uses data from hospitals, all kinds of info, not just the regular stuff. And guess what? It's even better at predicting disease risks than the old system.

Sayali Ambekar (2018) [3] "Disease Prediction using Machine Learning" This idea is all about using data from hospitals to fix two problems: not having enough data and having missing info. A new method that'sfaster and more accurate at guessing disease risks. It gets data from a clinic that has all kinds of info, not just the regular stuff, and uses smart algorithms to predict diseases. It's faster than the old method and does a better job at guessing possible disease outbreaks.

Smriti Mukesh Singh (2020) [4] "Improving disease Prediction by machine learning" The author proposes using machine learning to improve disease prediction by leveraging big medical data. They employ KNN and SVM algorithms, using a genetic algorithm to manage missing data.

The CNN-MDRP technique focuses on chronic diseases, using a database with detailed patient histories. RNN-based methods handle data effectively. The system works online and offline to predict diseases accurately.

MD. Atikur Rahman (2023) [5] "Predicting disease from several symptoms using machine learning approach" In health, machine learning is gaining traction. It helps spot diseases early, making treatment easier for medical staff. By predicting and diagnosing accurately, it's

changing medicine for the better, giving experts powerful tools to treat patients more effectively.

To predict diseases based on symptoms. Users input symptoms, and the system predicts the disease. Hospital data affects accuracy in predicting disease risks, and our KNN algorithm hit 98.37% accuracy.

SYSTEM ANALYSIS

For a system analyzing Seasonal diseases using machine learning, the focus involves leveraging algorithms capable of processing diverse medical data. It's about employing a range of machine learning techniques to predict various diseases from symptoms or patient data. The system's core involves data collection, preprocessing, and employing algorithms that can handle seasonal disease predictions simultaneously. This system aims to enhance accuracy by analyzing a wide array of medical information, potentially revolutionizing seasonal disease prediction and diagnosis.

EXISTING SYSTEM

Existing investigations centre on particular regular illnesses, requiring clients to switch between models for summer and winter examinations, driving to a time-consuming handle. In the event that a client encounters numerous regular illnesses, the system's impediment to anticipate as it were one season's infection postures a chance of expanded mortality rates due to the failure to estimate other maladies in development.

Existing frameworks assemble verifiable wellbeing information, which may incorporate understanding records, natural information, and malady episode data. Information pre-processing strategies are utilized to clean, normalize, and structure the information for investigation. In Machine Learning Models Different machine learning calculations are utilized to construct prescient models. Common calculations incorporate choice trees, arbitrary timberlands, back vector machines, k-nearest neighbors', neural systems, and more.

PROPOSED SYSTEM

A proposed system for Seasonal disease prediction using machine learning would involve several key components:

1. **Data Collection and Integration:** The system would gather medical data from various sources, including patient records, diagnostic tests, and medical literature. This data would be integrated and stored in a structured format.

2. **Data Preprocessing:** Before feeding data into machine learning models, preprocessing steps would be applied, including data cleaning, feature selection, and handling missing valuesto ensure data quality.

3. **Feature Engineering**: Relevant features, such as symptoms, patient history, genetic information, and test results, would be extracted and transformed to create meaningful input for machine learning models.

4. **Machine Learning Models:** The system would implement a range of machine learning algorithms, such as decision trees, random forests, support vector machines, or deep learning neural networks, tailored to predict seasonal diseases simultaneously.

5. **Model Training and Validation:** The models would be trained on historical data and validated using different techniques like cross- validation to assess their predictive performance.

6. **Integration with Real-time Data:** The system may incorporate real-time data streams or user input for dynamic seasonal disease prediction.

7. **User Interface:** An easy-to-use interface would allow medical professionals and possibly patients to input data and receive seasonal disease predictions.

8. **Continuous Learning and Improvement:** The system would be designed to adapt and improve over time, incorporating new data and research findings to enhance prediction accuracy.

9. **Security and Privacy:** Strong security measures would be in place to protect patient data and comply with privacy regulations.

The proposed system aims to provide accurate and efficient predictions for multiple diseases, aiding healthcare professionals in early diagnosis and treatment planning. It would continuously evolve and improve as more data becomes available and machine learning techniques advance.

SYSTEM DESIGN

Design the system to scale as the dataset grows and as the need for predictions increases. Regular maintenance and updates to incorporate new findings and enhance prediction accuracy.

This design aims to create a robust and efficientsystem capable of predicting multiple diseases simultaneously while ensuring accuracy and adherence to medical standards and regulations.

Architecture of the system Design

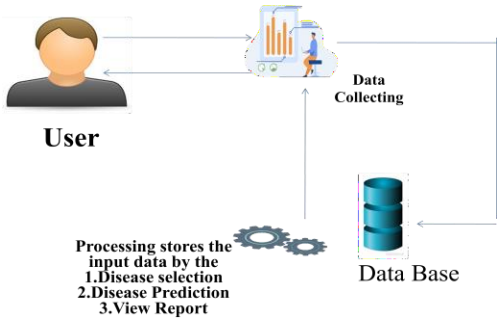

Figure 1: System Architecture

Data Collection gathers data from diverse sources including medical records, research databases, and diagnostic reports given in figure 1. Integrate and store data in a structured format. User develops an intuitive interface for medical professionals to input patient data and receive seasonal disease predictions. Possibly create visualizations or reports for easy interpretation of predictions. Data Pre- processing cleanse and preprocess the data by handling missing values, normalizing, and standardizing. Feature selection and extraction for relevant information. Security ensure strong security measures to protect sensitive patient data and compliance with healthcare regulations

BLOCK DIAGRAM

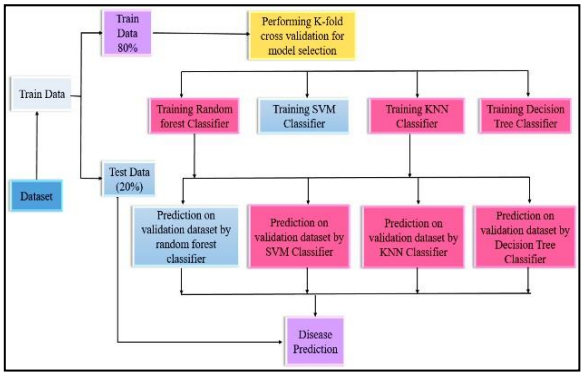

Figure 2: Block diagram

A block diagram is given in figure 2 for a machine learning system designed for multiple disease prediction can provide a visual representation of the key components and their interactions. Below is an explanation of the major blocks in such a system:

1. Data Collection and Integration:

The first step is to gather data from dataset, the important data from distinctive sources, like advanced wellbeing records, supportive databases, or other places. This data incorporates where

a individual is from, their therapeutic history, how they live, and the comes about of tests.

2. Data Pre-processing:

Raw data undergoes pre-processing to clean, normalize, and engineer features. This step involves handling missing values, encoding categorical variables, and scaling numerical features to prepare the data for machine learning algorithms.

3. Feature Selection:

Identify and select relevant features that contribute to disease prediction. Techniques like dimensionality reduction orfeature importance analysis may be applied.

4. Predictive Model:

Implement machine learning algorithms, such as Random Forest Regression Support Vector Machines, KNN, Decision tree to train the model using the pre-processed data.

5. Knowledge Base:

Based on the symptoms, age, andgender of an individual, the diagnosis system gives the output as the disease that the individual might be suffering from. The weighted KNN algorithm gave the best results as compared to the other algorithms.

6. Disease Prediction:

Create a user-friendly interface that allows healthcare professionals or users to input data and receive predictions or recommendations. Once the model is trainedand validated, deploy it in a production environment where it can be accessed for predictions by end-users or integrated into healthcare systems.

RESULT

The results of a machine learning- based Seasonal disease prediction system canbe diverse and depend on the quality of data, feature selection, model choice, and the complexity of the medical conditions involved. It's essential to interpret these results in thecontext of their real-world impact and in collaboration with medical experts to ensure the system's reliability and usability.

CONCLUSION

In the past, hospitals had trouble with testing and giving out reports. For testing used manual methods that were slow and could have mistakes. Today, using a lot of information,computers are being used to guess when peoplemight get sick with things like heart disease, breast cancer,

diabetes etc. This app makes it easier for patients. It gives them quick feedback about their health and suggests the best hospitals nearby for their condition. The goal is to make it easier for people to find healthcare. Want to give them a website that recommends

good healthcare and helps them make decisions. This plan uses new technology tohelp people with health problems. It offers many good choices in one easy-to-use place. The main aim is to use these new developments to make a system that gives personalized recommendations to patients in hospitals. This will improve the happiness and health of peoplewho are looking for healthcare. Machine learning helps doctors to analyze a lot of data and gives them lab reports faster. This makes their diagnoses more accurate.

REFERENCES

[1] Liang H, Tsui BY, Ni H, et al. Evaluation and accurate diagnoses of pediatric diseases using artificial intelligence. Nat Med. 2019;25 (3):433- 438.

[2] Deo RC. Machine learning in medicine. Circulation. 2015;132 (20):1920-1930.

[3] Rajendra Acharya U, Fujita H, Oh SL, et al. Application of deep convolutional neural network for automated detection of myocardial infarction using ECG signals. Inf Sci (Ny). 2017; 415-416:190-198.

[4] Paniagua JA, Molina-Antonio JD,LopezMartinez F, et al. Heart disease prediction using random forests. J Med Syst. 2019; 43(10):329.

[5] Poudel RP, Lamichhane S, Kumar A, et al. Predicting the risk of type 2 diabetes mellitus using data mining techniques. J Diabetes Res. 2018; 2018:1686023.

[6] Al-Mallah MH, Aljizeeri A, Ahmed AM, et al. Prediction of diabetes mellitus type-II using machine learning techniques. Int J Med Inform.2014;83(8):596-604.

[7] Tsanas A, Little MA, McSharry PE, Ramig LO. Nonlinear speech analysis algorithms mapped to a standard metric achieve clinically useful quantification of average Parkinson's disease symptom severity. J R Soc Interface. 2012;9(65):2756-2764.

[8] Arora S, Aggarwal P, Sivaswamy J. Automated diagnosis of Parkinson's disease using ensemble machine learning. IEEE Trans Inf Technol Biomed. 2017;21(1):289-299.

[9] Ahmad F, Hussain M, Khan MK, et al.Comparative analysis of data mining algorithms for heart disease prediction. J Med Syst. 2019;43(4):101.

[10] Parashar A, Gupta A, Gupta A. Machine learning techniques for diabetes prediction. IntJ Emerg Technol Adv Eng. 2014;4(3):672-675.

[11] Breiman L. Random forests. Mach Learn. 2001;45(1):5-32.

[12] Hastie T, Tibshirani R, Friedman J. The Elements of Statistical Learning: Data Mining, Inference, and Prediction. 2nd ed. Springer; 2009.

[13] Pedregosa F, Varoquaux G, Gramfort A, et al. Scikit-learn: Machine learning in Python. J Mach Learn Res. 2011; 12:2825-2830.

[14] Mc Kinney W, van der Walt S, Lamoureux C, et al. Data structures for statistical computing in Python. In: Proceedings of the 9th Python in Science Conference; 2010.

[15] Huang ML, Hung CC, Hsu CY, et al. Predicting ischemic stroke using the Framingham Stroke Risk Score and a simple decision rule in Chinese patients with type 2 diabetes. 2010;33(2):427-429.

ALGEBRAIC PROPERTIES OF GRAPH THEORY AND ITS APPLICATIONS

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Abstract:

Mathematics heavily relies on graph theory. wherein the algebraic techniques used to solve graph theory problems serve as the foundation for algebraic graph theory. An effective framework for comprehending complicated systems and their behavior is provided by the relationships between graph properties and algebraic structures. There are two basic analogies between mathematics and graph theory. These originate from the adjacency matrix and automorphism group of a graph, two algebraic objects connected with the graph. The topic of graph analysis in relation to algebra and its uses is covered in this article.

Keywords: Graph, Group, Cycle, Subgroup, Connectedness

INTRODUCTION

Graphs are mathematical structures that are used to depict pairwise interactions between objects. A graph's study is known as graph theory. A graph is composed of an array of edges, or connections, that join pairs of vertices, and a group of nodes, or vertices. Numerous characteristics of graphs, including connectedness, pathways, cycles, colorings, and much more, are investigated by graph theory. It is widely applicable in many domains, including social network analysis, operations research, computer science, and many more. Group theory, on the other hand, is the mathematical analysis of symmetry. It works with groups, which are algebraic structures made up of an operation satisfying specific conditions on a grouping of components. Group theory has applications in physics, chemistry, cryptography, and other fields. It is used to investigate the symmetries and transformations of mathematical objects. Studying the symmetries and algebraic characteristics of graphs is a common task at the interface

between group theory and graph theory. Through the use of group theory tools, this connection facilitates a deeper understanding of the structural and symmetry aspects of graphs and offers insights into a variety of graph theoretic issues.

Fundamentals of Graph Theory

A set G= G (V, E) is a graph made up of two parts:

I. the finite set of vertices, also known as points or nodes, and

II. the finite set of edges, also known as lines or arcs, that connect two pairs of vertices.

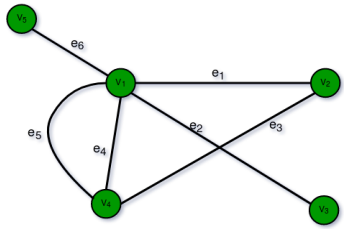

Fig 1: Graph

Directed graph: When each edge in a graph must have a direction assigned to it, the graph is referred to as a directed graph, or digraph.

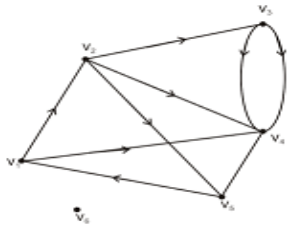

Fig 2: Directed Graph

Walk: When an edge appears just once, a walk is a series of vertices and edges that starts at v_i and moves along edges to v_j. If a walk has the potential to start and finish at the same vertices, $v_i = v_j$, it is said to be a closed walk. If not, the stroll is said to as open.

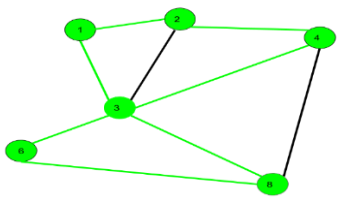

Fig 3: Walk

Path: It involves walking over a succession of vertices, v_0, v_1, v_2……, v_n, with each vertex next to the one before it, without any vertex repetition. A path's length is determined by how many edges it has.

Trail or simple path: A path without a repeating edge connecting a vertex (u) to v is called a trail or simple path.

Circuit or Cycle: It is a non-zero length closed walk with the same start and finish vertices and no duplicated edges.

Connected graph: If there is a path connecting each pair of vertices in a graph, it is referred to as connected; if not, it is considered unconnected.

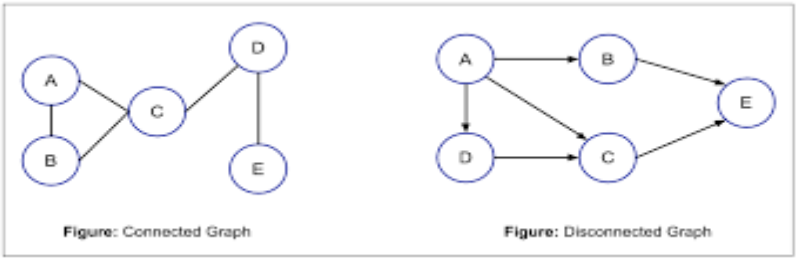

Fig 4: Disconnected Graph

Sub graphs: A subgraph of G is defined as the graph H (V', E') that results from removing a small number of vertices and edges from G (V, E), regardless of whether G is directed or undirected.

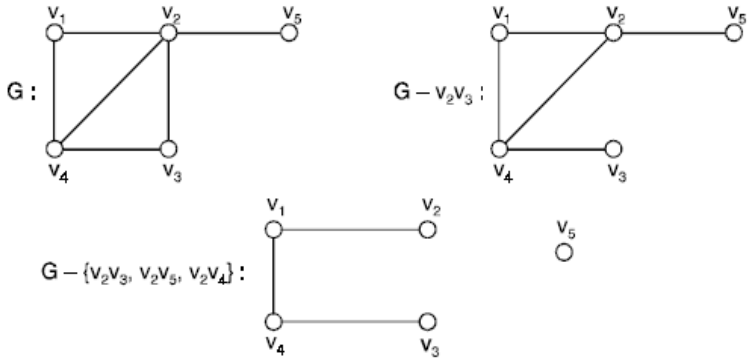

Fig 5: Subgraph Graph

Spanning sub graph: If a subgraph H (V', E') of a given directed or undirected graph G (V, E) contains every vertex in G, then H is called a spanning sub graph of G.

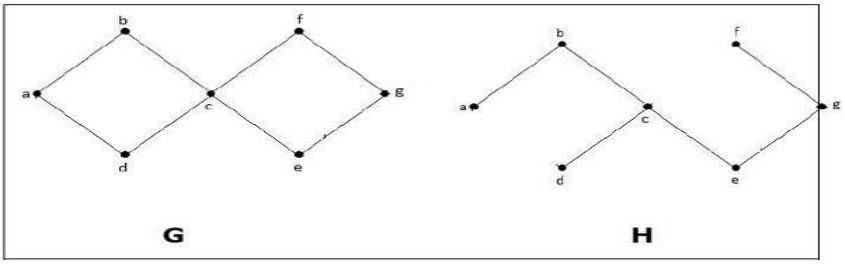

Fig 6: Spanning subgraph

Complete graph: A directed graph with two unique edges connecting each pair of distinct vertices is called a complete digraph.

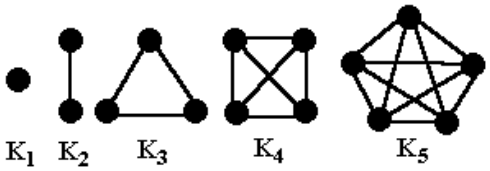

Fig 7: Complete Graph

Regular graph: If the degree of each vertex in graph G is the same, then the graph is considered regular. A graph is referred to be a "k-regular graph" if each vertex has a degree of "k

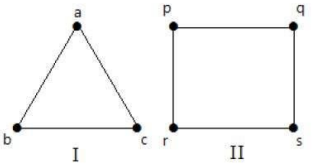

Fig 8: Regular Graph

In both the graphs, all the vertices have degree 2. They are called 2-Regular Graphs.

Bipartite graph:

A basic graph If every edge of G = (V, E) connects a vertex in V_1 to a vertex in V2, then G = (V, E) with vertex partition V = {V_1, V_2} is referred to as a bipartite graph. A bipartite graph with partition "G," where G = (V, E), V = {V_1,V_2} is said to be a ***complete bipartite*** graph if every vertex in V_1 is connected to every vertex of V_2

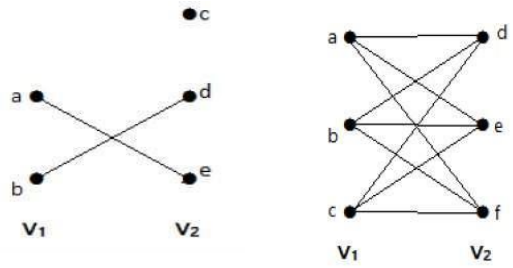

Fig 9: Bipartite Graph

Euler graph:

The Eulerian path of a graph is a path that visits each edge exactly once. An Eulerian path with the same vertex at both is referred to as an Eulerian circuit. A graph with an Euler tour within it is called an Eulerian graph

Hamiltonian graphs:

If every vertex in the connected graph is visited precisely once by a closed walk that exists there. If a graph has all of its edges repeated (apart from the starting vertex), it is referred to as a Hamiltonian graph.

Adjacency Matrix:

The adjacency matrix, also known as the connection matrix, is a matrix made up of rows and columns that is used to show a straightforward labelled graph. It determines whether or not Vi and Vj are adjacent by assigning a value of 0 or 1 to their respective positions. It is a compact representation of the finite graph of a m x m matrix M with n vertices.

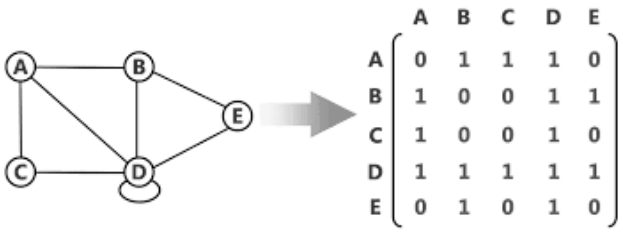

Fig 10: Adjacency Matrix

Fundamentals of Group theory

Group theory is a fundamental area of mathematics that studies the algebraic structures known as groups. A group is a set G with a binary operation ◦ that satisfies key properties: associativity, identity, and inverses.

- for all g, h, k ∈ G, (g ◦ h) ◦ k = g ◦ (h ◦ k) (associative law);
- there exists an element 1 ∈ G (the identity) such that 1 ◦ g = g ◦ 1 = g for all g ∈ G;
- for each g ∈ G, there is an element g−1 ∈ G (the inverse of g) such that g ◦ g−1 = g−1 ◦ g = 1.

Abelian group:

If a group ⟨G,·⟩ satisfies the following extra property, it is called abelian, or commutative:

• Commutativity: a · b = b · a for each a, b ∈ G.

Subgroup:

Subgroups are subsets of a group that come together to form a group when subjected to the same action. They are essential to the study of groups, and a greater knowledge of group theory requires a grasp of their properties. Any subset H of G such that H is also a group with regard to the same operation is called a subgroup H of a group ⟨G,·⟩.

Group Homomorphism

A map Φ: G → G′ between two groups (G, 0) and (G′, *) is called a group homomorphism if the group operation is preserved in the following sense:

$\Phi(a \circ b) = \Phi(a) * \Phi(b) \; \forall \; a, b \in G$

Group Isomorphism

An isomorphism is a map Φ: (G, 0) → (G′, *) between two groups if and only if the following criteria are met:

• The homomorphism Φ is a group; that is, Φ(ab)=Φ(a)Φ(b) ∀ a, b ∈ G.

• Φ is upon and one-to-one.

An isomorphism is a bijective group homomorphism between groups.

Automorphism:

For a group (G, +), a mapping *f*: G → G is called auto morphism if

- f is one-one.
- f is homomorphic i.e. f (a +b) = f(a) + f(b) ∀ a, b ∈ G.

Cyclic Group

If there is an element a^n in G such that a generates G, then a group (G, ∘) is said to be cyclic. Put differently, G = {an : n ∈ Z}.The generator of G is the element a. It is expressed mathematically as follows: G is equal to <a>. We have G = {na: n ∈ Z} if G is an additive cyclic group formed by a.

Permutation Group

Given a set A, a permutation of A is a function f: A → A which is 1-1 and onto. A permutation that come together to form a group under function composition is known as a permutation group of A.

Study of Algebraic Graph:

The two main areas of overlap between graph theory and algebra are as follows. These originate from two algebraic objects connected to a graph: its automorphism group and adjacency matrix. Any set of permutation matrices that commute with the adjacency matrix is known as the automorphism group. Nonetheless, group theory and linear algebra are two distinct algebraic methods used in the two links. Mathematically speaking, linear algebra focuses on linear functions and equations, and how matrices and vector spaces are used to represent them. The foundation of linear algebra in

contemporary geometry presentations. Mathematicians who study group theory might learn about algebraic structures known as groups. Many aspects of algebra have been influenced by the group theory approach. Both lie groups and linear algebraic groups are subfields of group theory that Two areas of group theory that have made progress are linear algebraic groups and lie groups. Graph theory is the study of graphs, which are mathematical structures that show pairwise interactions between objects. In this sense, a network consists of vertices, nodes, or points connected by arcs, lines, or edges. Graphs are among the most important things.

Applications of Algebraic Graph theory

An essential tool for studying electrical networks, from tiny integrated circuits to massive power systems on a continental scale, is algebraic graph theory. Conversely, early electrical circuit analysts established many of the essential findings of algebraic graph theory. The applications span various fields including computer science- network analysis, coding theory, Physics- quantum mechanics, Electrical networks and social sciences- sociology, communication networks.

- **Network Analysis:**

Network analysis and algebraic graph theory are closely linked subjects. Network analysis focuses on comprehending the structure and behavior of networks, while algebraic graph theory use algebraic techniques to explore the features of graphs. The representation of graph and network analysis using matrix algebra is a key link between the two. For instance, a graph's adjacency matrix's applications are possible to examine its characteristics, and matrix operations can provide details about a network's connectedness and organization. Furthermore, the characteristics and connectedness of graphs are studied by spectral graph theory, a subfield of algebraic graph theory, through the use of the mathematical eigenvalues and eigenvectors associated with graphs. Understanding connectivity, robustness and information flow in various networks like social networks, the internet or transportation systems.

- **Coding Theory**

Algebraic graph theory and coding share multiple connections. The application of algebraic structures in coding theory is one significant point of linkage. For instance, the features of graphs representing error-correcting codes, which are employed in

communication systems to securely transmit data over noisy channels, is amenable to analyse an algebraic graph theory. Furthermore, the features of graphs utilized in coding theory can be examined using methods from algebraic graph theory, such as spectral graph theory. This can aid in the design of effective error-correcting codes additionally the comprehension of their functionality. All things considered, algebraic graph theory offers a mathematical framework for comprehending the connections between graphs and codes and can be an effective tool for coding scheme analysis and design. Designing error correcting codes crucial in data transmission and storage, where graphs represents code structures.

- **Quantum Mechanics**

Quantum graph theory is a subfield of mathematics that connects algebraic graph theory and quantum mechanics. In this discipline, the behaviour of quantum systems that is able to be shown as graphs is studied via algebraic approaches. In this application, graphs are mathematical structures that symbolize networks of connections between different points; in quantum mechanics, they can be utilized to model physical systems. Through the use of algebraic methods, scientists may examine the characteristics of these quantum systems and learn more about how particles behave, what energy states exist, and other significant aspects of quantum mechanics. All things considered, algebraic graph theory and quantum mechanics are related because they both employ mathematical techniques to characterize and comprehend intricate systems at the quantum level. Investigating quantum states through graph- based representations of interactions and entanglements.

- **Electrical networks**

The study of electrical networks, the theory of graphs, and the accompanying matrices have a long and rich history of mutual evolution and synergy. Analyzing and modeling electrical circuits have inspired the creation and development of a wide variety of graph-theoretical notions and specific classes of matrices, beginning with the foundational Gustav Kirchhoff's classical composition. Conversely, key developments in the theory of electrical networks have been made possible by algebraic graph theory notions and structures.

Conclusion

This work analyzes the literature for the study of algebraic theory in graph theory, utilizing the ideas and applications of the first three branches of algebraic theory. A few research works based on algebraic theory were also looked at in order to perform more research on the topic within algebraic graph theory. With applications in computer science, quantum mechanics, electrical networks, network analysis, sociology, and coding theory, algebraic graph theory is a flexible and potent tool. The profound relationships that exist between graph attributes and algebraic structures provide important new perspectives on the dynamic and structural features of complex systems. As multidisciplinary research and technology progress, algebraic graph theory continues to be an essential foundation for comprehending and improving a wide range of real-world systems.

REFERENCES:

[1]. Bondy J.A. and U.S.R. Murty, graph theory with applications MacMillan London.

[2].Application of graph theory of computer science an overview by S. G. Shrinivas, S. Vetrivel and Dr. N.M. Elango. (International journal of engineering science and technology vol. 2 (9) 2010.4610-4621.

[4]. Graph theory with application to engineering and computer science Narshing Deo.

[5]. A text book of graph theory by R.Balakrishnan & K Ranganathan ,Second edition ,Springer Newyork Heidelberg Dordrecht London.

[6]. Biggs.N, (1993) "Algebraic Graph Theory (2nd ed.)", Cambridge: Cambridge University Press.

[7]. Paul M.Nguyen and Liem Doan, (2017) "Linear Algebra Applied to Graph Theory".

[8]. Dylan Johnson, (May 3, 2017) "Graph Theory and Linear Algebra", May 3, 2017.

[9]. Cheng Ye, Cesar H.Comin, Thomas K.DM.Peron, Filipi N. Silva, Francisco A. Rodrigues, Luciano da F.Costa, Andrea Torsello, Edwin R.Hancock, (2015)

"Thermodynamic Characterization of Networks using graph Polynomials", Physical Review 92, 032810.

[10]. Angela Mestre, 2013, "An Algebraic Representation of Graphs and Applications to Graph Enumeration", Hindawi Publishing Corporation, International Journal of Combinatorics, Volume 2013, Article ID 347613.

[11]. Chris Godsil, Gordon Royle, (2001) "Algebraic graph theory", Springer International Edition.

[12]. Ivanov.A.A, Shpectorov.S.V, (1994) "Applications of group amalgams to algebraic graph theory", Springer, Dordrecht, Vol 84.

[13]. Edward A. Bertram, (10 March, 1982) "Some Application of graph theory to finite groups", North Holland Publishing company.

Exploring the Effectiveness of Information Gain Method for Feature Selection in Designing Intrusion Detection Systems for IoT Security: A Comprehensive Literature Review

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Abstract

The growing number of IoT devices demands stronger security, with IDS as a key tool for protecting them. As more and more IoT devices connect, we need better security measures. IDS are crucial for keeping them safe. This research examines how effective Information Gain is at selecting features for IDS in IoT security, and reviews existing research on using Information Gain for feature selection in IoT-specific IDS. The review begins by contextualizing the significance of IoT security challenges and the role of IDS in mitigating emerging threats. A particular emphasis is placed on the importance of feature selection in optimizing IDS performance. The Information Gain Method is introduced as a key approach in this context, with an exploration of its principles and applications. Through an extensive examination of existing literature, including empirical studies and comparative analyses, this paper synthesizes key findings regarding the efficacy of the Information Gain Method. The review discusses insights gained from studies employing IGM in the design of IDS for IoT security and identifies trends, challenges, and areas for future research. By offering a comprehensive overview of the current state of research on this topic, this paper contributes to the understanding of how Information Gain can enhance feature selection strategies, thereby fortifying the development of effective IDS for IoT security.

Keywords: Internet of Things (IoT), Security, Intrusion Detection Systems (IDS), Feature Selection, Information Gain.

1. Introduction

With the integration of diverse devices into networked systems, the Internet of Things (IoT) has experienced exponential expansion. IoT device proliferation has, however, also raised the possibility of security breaches and threats. By identifying and stopping hostile activity, intrusion detection systems (IDS) are essential for protecting Internet of Things environments. A crucial first step in improving the effectiveness and precision of IDS is feature selection [1]. Finding the most pertinent and instructive aspects from the large amount of accessible data is known as feature selection, and it is an essential stage in the creation of an efficient intrusion detection system. The Information Gain method has become well-known among feature selection strategies because it can quantify how important a given feature is to improving intrusion detection model accuracy [2]. The purpose of this thorough literature analysis is to investigate the usefulness of the Information Gain approach while choosing features for Intrusion Detection Systems that are especially made for Internet of Things security. We seek to offer a comprehensive overview of the most recent methods, difficulties, and developments in utilizing Information Gain to improve the effectiveness of IDS in IoT contexts by exploring the literature.

IDS enables the early detection of possible security risks within IoT networks by offering real-time monitoring and detection capabilities. Early detection lessens the impact of assaults by enabling quick action and mitigation strategies [3]. IDS uses anomaly detection methods to find anomalies in IoT network traffic that deviate from typical patterns of activity. Finding abnormalities aids in identifying possible security lapses, such as malevolent acts, illegal access, or data theft [4]. IDS uses anomaly detection methods to find anomalies in IoT network traffic that deviate from typical patterns of activity. Finding abnormalities aids in identifying possible security lapses, such as malevolent acts, illegal access, or data theft. Intrusion detection systems are designed to continually monitor network traffic and analyze behavioral patterns for abnormalities in real-time, enabling them to quickly identify and respond to security breaches [5]. Because they can detect and prevent tampering, unauthorized changes, and other actions that could compromise the general reliability and performance of networked devices, intrusion detection systems are essential to maintaining the integrity of Internet of Things systems[6].

Information gain approach combines as a viable feature selection solution for improving Intrusion Detection Systems (IDS) for Internet of Things (IoT) security. This machine learning-based method is especially applicable in the dynamic and heterogeneous Internet of Things context since it measures the decrease in uncertainty within a dataset when taking particular features into account. Information gain helps discover critical metrics necessary for detecting security risks in Internet of Things networks by ranking attributes that greatly reduce uncertainty [7]. This study investigates the efficacy of information gain in great detail with the goal of shedding light on its benefits and drawbacks via comparisons with other approaches, literature reviews, and experimental assessments. By means of this inquiry, the research aims to provide significant insights into the current discussion around enhancing the security of networked devices in the Internet of Things.

Objectives:

This study aims to comprehensively evaluate the information gain method's performance in the area of feature selection for intrusion detection systems (IDS) in Internet of Things (IoT) environments. The study is to investigate how information gain helps improve the performance of IDS by methodically assessing how good it is at choosing pertinent features, with a particular focus on IoT security. The goals of the study include a thorough analysis of how information gain affects the precision and effectiveness of IDS models used in Internet of Things networks. Additionally, the study aims to determine and examine any obstacles or restrictions related to the use of information gain in the context of IoT IDS feature selection.

The creation of reliable and scalable intrusion detection systems (IDS) that are suited to the security problems of Internet of Things (IoT) environments is greatly advanced by this research. The diversity and heterogeneity of linked devices present never-before-seen security threats as IoT grows [8]. This work covers a crucial component of improving security measures by concentrating on the evaluation of the information gain method for feature selection in IoT IDS particular. It is hoped that the results would provide insightful information about how information gain might strengthen IoT networks against new threats. The design and implementation of IDS can be greatly impacted by an understanding of how this strategy helps identify and prioritize pertinent characteristics in real-time monitoring.

2. Related Work

A lot of study has been done on the effectiveness of feature selection techniques in the design of intrusion detection systems (IDS) for Internet of Things security. This section offers a brief overview of the body of research that has already been done in the topic, emphasizing important studies and their significant contributions.

Alazzam et al. [9] in their paper proposes a novel approach to binarize continuous optimization, which is compared to conventional methods for binarizing continuous swarm intelligent algorithms. It also introduces a wrapper feature selection algorithm for Intrusion Detection Systems (IDS), utilizing the Pigeon Inspired Optimizer.

In another study, conducted by Balakrishnan et al. [10], contributes to the existing literature by introducing and implementing an Intrusion Detection System (IDS) designed for effective attack detection, thereby expanding the scholarly knowledge in this field. The primary novelty is the use of a brand-new feature selection technique to choose the ideal number of features from the KDD Cup dataset. This algorithm is called the Optimal Feature Selection algorithm based on Information Gain Ratio.

In their article, Nimbalkar et al. [11] presents a feature selection technique for Intrusion Detection Systems (IDSs) that ranks and finds the top 50% of characteristics for identifying DoS and DDoS attacks. Information Gain (IG) and Gain Ratio (GR) are used in this process. The suggested method uses union and insertion operations on subsets that are obtained from the highest-ranked IG and GR features. Using a JRip classifier, the approach is evaluated and validated on the IoT-BoT and KDD Cup 1999 datasets.

Jaw et al. [12] in their work presents an ensemble classifier combined with a hybrid feature selection (HFS) strategy to improve intrusion detection system attack classification. In order to effectively pick subsets of features with high correlation, the suggested method makes use of the advantages of CfsSubsetEval, genetic search, and a rule-based engine. This lowers model complexity and enhances generalization. KODE (K-means, One-Class SVM, DBSCAN, and Expectation-Maximization) is an ensemble classifier that consistently distinguishes between malicious and normal cases based on their asymmetric probability distributions.

Overview of Feature Selection in IDS:

In their research Alazzam et al. [13] uses the Pigeon-Inspired Optimizer (PIO) as the core optimization tool, the study suggests a wrapper feature selection technique for intrusion detection systems (IDS). One important contribution is the development of a new way to binarize the continuous PIO, which provides a different approach from the traditional methods in swarm intelligence algorithms. The effectiveness of this binarization methodology is assessed in the study by contrasting it with conventional techniques. The main goal is to improve the feature selection procedure for intrusion detection systems (IDS), and the study sheds light on the possible benefits of the suggested algorithm and binarization technique over current methods.

By putting forth an enhanced Naive Bayes classifier, Kumar et al. [14] seeks to increase intrusion detection accuracy in IDS. Improving classification accuracy and cutting processing time in comparison to current classifiers are the main objectives. The study uses three common feature selection techniques to improve the suggested classifier's performance and accuracy in evaluating network traffic in order to meet these goals. The emphasis on increasing accuracy as well as processing economy highlights how useful the research is for intrusion detection systems in real-world settings.

The main goal of the study by Yiqun He et al. [15] is to identify and comprehend the major obstacles that Internet of Things (IoT)-based applications in high-risk Environmental, Health, and Safety (EHS) businesses must overcome in the context of Industry 4.0. To systematically identify these problems, the research combines a thorough literature analysis with a survey method. A total of 28 significant difficulties have been identified by the study, some of which include communication (c2) and energy efficiency (c1). This methodology enables a comprehensive analysis of the constraints encountered by IoT applications in EHS sectors, offering insightful solutions for resolving these issues within the framework of Industry 4.0.

Sarhan et al. [16] performs a thorough analysis of well-known problems and obstacles in the field of the Internet of Things (IoT), including topics such dependable collaboration, standards, protocols, operational issues, data management, and software difficulties. The study sheds light on the challenges faced by IoT implementations and covers a wide range

of directions relevant to these concerns. The paper also emphasizes the contributions and ongoing work being done by several research communities to address these issues.

Introduction to Information Gain:

To measure a feature's efficacy in terms of its capacity to distinguish and categorize data, machine learning and feature selection practitioners frequently employ the idea of information gain. When considering decision trees and other classification techniques, it is especially pertinent. Measuring the decrease in entropy or uncertainty brought about by including a certain feature into the decision-making process is the basic concept that drives information gain. The degree of disorder or unpredictability in a dataset is represented by entropy. By choosing features that maximize Information Gain, one seeks to improve the model's predictive power. Higher Information Gain features are considered more informative because they greatly lower uncertainty and enhance the model's overall predictive performance [17].

Information Gain serves as a crucial metric in the process of feature selection, evaluating and ranking features based on their ability to predict the performance of a model. Features with high Information Gain are preferred as they provide more valuable insights into the underlying patterns within the data. One can make more effective and efficient models by choosing features with the largest Information Gain, which reduces the dataset's dimensionality while preserving the most pertinent data for precise classification or prediction tasks. By concentrating on the most informative features, this increases interpretability in addition to improving model performance [18].

The following table presents a concise overview of past studies employing Information Gain (IG) across diverse domains such as natural language processing, healthcare, finance, and cybersecurity. A comparative understanding of the many uses and results of Information Gain in various study contexts is made easier by the formatted presentation.

Reference	Domain	Application	Key Findings
Bhandari et al. [19]	Healthcare	Disease Diagnosis and Prognosis	Used Information Gain to rank genetic markers for cancer.
Htet Htun et al. [20]	Finance	Stock Market Prediction	Applied Information Gain for feature selection in models.

Khraisat et al. [21]	Cybersecurity	Intrusion Detection Systems	Enhanced system performance through feature optimization.
Ramasamy et al.[22]	Natural Language	Sentiment Analysis	Identified salient linguistic features using Information Gain.

Information Gain in IoT Security:

Using Information Gain (IG) in the design of Intrusion Detection Systems (IDS) for Internet of Things (IoT) security is essential to improving threat identification and anomaly detection performance. IG is a useful feature selection metric in the context of IoT, where a multiplicity of linked devices continuously generate enormous volumes of data. IDS designers can optimize the system's performance by using IG to help them sort through the vast amount of data provided and choose the most relevant and instructive aspects [23].

Using IG in IDS design for IoT security entails evaluating how each feature affects the capacity to distinguish between benign and malevolent activity. High IG features are thought to be more informative and are therefore essential for efficiently identifying anomalies or intrusions. This methodology not only enhances the precision of the IDS but also aids in alleviating the difficulties brought about by the resource limitations frequently linked to IoT devices. By ensuring that the IDS concentrates on the most pertinent elements of the data stream, the implementation of IG enhances detection capabilities and improves overall safety in Internet of Things environments [24].

Alwahedi et al. [23] conducted a survey that offers a thorough analysis of how machine learning (ML) approaches might improve Internet of Things (IoT) security. The survey, which is divided into five categories, covers important facets of machine learning's role in IoT security. The writers provide a perceptive synopsis of current machine learning trends that are especially relevant to cyber threat identification in Internet of Things settings. The report also explores current cyber detection techniques, with thorough explanations of their definitions, methodologies, attack surface considerations, and assessments. One notable aspect of the survey is its thorough exploration of the ML

techniques employed in IoT security, with a focus on defining and comparing their advantages and drawbacks within relevant use cases.

Comparison with Other Methods:

Several feature selection techniques are used in data analysis and machine learning. These methods cater to different scenarios and considerations, and the choice often depends on the characteristics of the dataset, the specific learning algorithm used, and the desired outcomes of the analysis. Here's an overview of several popular methods:

Feature Selection Method	**Overview**	**Advantages**	**Disadvantages**
Filter Methods	Assess relevance based on statistics	Computationally efficient	Ignores feature dependencies
Wrapper Methods	Evaluate subsets through model training	Considers feature dependencies	Computationally expensive
Embedded Methods	Feature selection integrated in models	Efficient resource utilization	Limited to specific algorithms
Recursive Feature Elimination	Recursive removal of least important	Works well with various models	Computationally expensive, prone to overfit
Principal Component Analysis	Transform features into uncorrelated	Reduces dimensionality effectively	Loss of interpretability, assumes linearity
Information Gain	Measures feature relevance	Effective with non-linear relationships	Sensitive to noise in data
Genetic Algorithms	Evolutionary search for optimal subset	Handles complex interactions	Computationally intensive

3. Methodology

Datasets used for evaluating machine-learning models in the context of IoT environments need to address specific characteristics unique to IoT. By considering these characteristics, datasets used for evaluating machine-learning models in IoT environments provide a more realistic and challenging testing ground, enabling

researchers and practitioners to assess the models' effectiveness in addressing the complexities of IoT security.

In their survey, De Keersmaeker et al. [25] presents a thorough and contemporary comparison of 44 IoT datasets, providing valuable insights for researchers seeking to evaluate machine learning techniques or design IoT security systems. The datasets were sourced from various platforms, including search engines and digital libraries like Google, IEEE Xplore, IEEE Dataport, and ResearchGate. The survey meticulously identifies general attributes of these datasets, emphasizing their diverse origins.

While specific datasets for IoT security can vary based on the focus of the research, here are a few examples that are commonly used or suitable for evaluating machine learning models in IoT security scenarios:

CICIDS2017:

Characteristics: A comprehensive dataset for intrusion detection in IoT environments.

Details: It includes normal and attack traffic generated in a simulated IoT network, covering various attack scenarios and providing labeled data for supervised learning.

IoT-23:

Characteristics: Focuses on diverse IoT devices and communication protocols.

Details: It comprises network traffic data from 23 different IoT devices, allowing for the evaluation of models across a variety of IoT ecosystems.

Stratosphere IoT Dataset:

Characteristics: Emphasizes real-world IoT network traffic.

Details: Captures network traffic from a smart home environment, offering insights into the challenges of securing IoT devices in domestic settings.

Aarhus Smart Home Dataset:

Characteristics: Captures IoT data from a residential smart home.

Details: Includes sensor data from various devices, such as motion detectors and door/window sensors, providing a realistic representation of smart home IoT scenarios.

Bot-IoT Dataset:

Characteristics: Focused on IoT botnet detection.

Details: Contains network traffic data related to IoT devices infected with the Mirai malware, aiding in the development of models for botnet detection in IoT environments.

4. Recommendations for Future Research:

Future Directions:

1. **Machine Learning Advancements:**

Advanced machine-learning techniques, such as deep learning, to improve the accuracy and robustness of IDS for detecting sophisticated and evolving threats.

2. **Context-Aware Intrusion Detection:**

Context-aware IDS that consider the specific characteristics and context of IoT environments, adapting detection mechanisms based on the nature of connected devices and their interactions.

3. **Behavioral Analysis:**

Behavioral analysis techniques to identify anomalies in the behavior of IoT devices, enabling the detection of novel and subtle attacks.

4. **Collaborative Intrusion Detection:**

Collaborative approaches where multiple IDS instances share information and collaborate in real-time to enhance the overall security posture of IoT ecosystems.

5. **Explainable AI in IDS:**

The integration of explainable artificial intelligence (XAI) techniques to provide transparent and interpretable insights into the decision-making process of IDS.

Recommendations:

1. **Standardization of IoT Security Measures:**

Standardized security measures and protocols for IoT devices, facilitating the development of more robust and interoperable IDS solutions.

2. **User Education and Awareness:**

Emphasize the importance of user education and awareness programs to promote secure IoT device usage and discourage practices that may expose networks to vulnerabilities.

3. **Cross-Domain Collaboration:**

Encourage collaboration between researchers, industry stakeholders, and policymakers to address security challenges comprehensively, considering both technical and regulatory aspects.

4. **Continuous Monitoring and Updates:**

Establish a framework for continuous monitoring of IoT security threats and regular updates to IDS systems to address emerging risks and vulnerabilities.

5. Conclusion

As we conclude this literature review, it becomes evident that the exploration of Information Gain in the realm of feature selection for IoT security is both timely and transformative. The reviewed studies collectively reinforce the importance of selecting features judiciously to fortify intrusion detection capabilities in the ever-expanding landscape of IoT.Moving forward, it is imperative for researchers and practitioners to build upon these foundations, addressing the nuances of IoT security with a nuanced understanding of feature relevance. The synthesis of knowledge presented herein positions Information Gain as a cornerstone in the design and optimization of IDS, offering a pathway towards more resilient and adaptive security frameworks for the IoT.

6. References

1. Kumar, S., Tiwari, P., & Zymbler, M. (2019). Internet of Things is a revolutionary approach for future technology enhancement: a review. Journal of Big data, 6(1), 1-21.

2. Sayegh, H. R., Dong, W., & Al-madani, A. M. (2024). Enhanced Intrusion Detection with LSTM-Based Model, Feature Selection, and SMOTE for Imbalanced Data. Applied Sciences, 14(2), 479.

3. Williams, P., Dutta, I. K., Daoud, H., & Bayoumi, M. (2022). A survey on security in internet of things with a focus on the impact of emerging technologies. Internet of Things, 19, 100564.

4. Khraisat, A., Gondal, I., Vamplew, P., & Kamruzzaman, J. (2019). Survey of intrusion detection systems: techniques, datasets and challenges. Cybersecurity, 2(1), 1-22.

5. Hnamte, V., & Hussain, J. (2023). Dependable intrusion detection system using deep convolutional neural network: A novel framework and performance evaluation approach. Telematics and Informatics Reports, 11, 100077.

6. Liang, C., Shanmugam, B., Azam, S., Karim, A., Islam, A., Zamani, M., ... & Idris, N. B. (2020). Intrusion detection system for the internet of things based on blockchain and multi-agent systems. Electronics, 9(7), 1120.

7. Nimbalkar, P., & Kshirsagar, D. (2021). Feature selection for intrusion detection system in Internet-of-Things (IoT). ICT Express, 7(2), 177-181.

8. Gerodimos, A., Maglaras, L., Ferrag, M. A., Ayres, N., & Kantzavelou, I. (2023). IoT: Communication protocols and security threats. Internet of Things and Cyber-Physical Systems.

9. Alazzam, H., Sharieh, A., & Sabri, K. E. (2020). A feature selection algorithm for intrusion detection system based on pigeon inspired optimizer. Expert systems with applications, 148, 113249.

10. Balakrishnan, S., Venkatalakshmi, K., & Kannan, A. (2014). Intrusion detection system using feature selection and classification technique. International journal of computer science and application, 3(4), 145-151.

11. Nimbalkar, P., & Kshirsagar, D. (2021). Feature selection for intrusion detection system in Internet-of-Things (IoT). ICT Express, 7(2), 177-181.

12. Jaw, E., & Wang, X. (2021). Feature selection and ensemble-based intrusion detection system: an efficient and comprehensive approach. Symmetry, 13(10), 1764.

13. Alazzam, H., Sharieh, A., & Sabri, K. E. (2020). A feature selection algorithm for intrusion detection system based on Pigeon Inspired Optimizer. Expert Systems with Applications, 148, 113249.

14. Kumar, K., & Singh, J. (2016). Network Intrusion Detection with Feature Selection Techniques using Machine-Learning Algorithms. International Journal of Computer Applications, 150(12), 1–13.

15. He, Y., He, J., & Wen, N. (2023). The challenges of IoT-based applications in high-risk environments, health and safety industries in the Industry 4.0 era using decision-making approach. Journal of Innovation & Knowledge, 8(2).

16. Sarhan, Q. I. (2018). Internet of things: a survey of challenges and issues. International Journal of Internet of Things and Cyber-Assurance, 1(1), 40.

17. Prasetiyowati, M. I., Maulidevi, N. U., & Surendro, K. (2021). Determining threshold value on information gain feature selection to increase speed and prediction accuracy of random forest. Journal of Big Data, 8(1).

18. Lei, S. (2012, March 1). A Feature Selection Method Based on Information Gain and Genetic Algorithm. IEEE Xplore.

19. Bhandari, A., Tripathy, B. K., Jawad, K., Bhatia, S., Rahmani, M. K. I., & Mashat, A. (2022). Cancer Detection and Prediction Using Genetic Algorithms. Computational Intelligence and Neuroscience, 2022, e1871841.

20. Htun, H. H., Biehl, M., & Petkov, N. (2023). Survey of feature selection and extraction techniques for stock market prediction. Financial Innovation, 9(1).

21. Khraisat, A., Gondal, I., Vamplew, P., & Kamruzzaman, J. (2019). Survey of intrusion detection systems: techniques, datasets and challenges. Cybersecurity, 2(1), 1–22.

22. Ramasamy, M., & Meena Kowshalya, A. (2022). Information gain based feature selection for improved textual sentiment analysis. Wireless Personal Communications, 125(2), 1203-1219.

23. Alwahedi, F., Alyazia Aldhaheri, Mohamed Amine Ferrag, Ammar Battah, & Tihanyi, N. (2024). Machine learning techniques for IoT security: Current research and future vision with generative AI and large language models. Internet of Things and Cyber-Physical Systems.

24. Chauhan, S., Gangopadhyay, S., & Gangopadhyay, A. K. (2022). Intrusion Detection System for IoT Using Logical Analysis of Data and Information Gain Ratio. Cryptography, 6(4), 62.

25. De Keersmaeker, F., Cao, Y., Ndonda, G. K., & Sadre, R. (2023). A Survey of Public IoT Datasets for Network Security Research. IEEE Communications Surveys & Tutorials.

26. Alex, C., Creado, G., Almobaideen, W., Alghanam, O. A., & Saadeh, M. (2023). A Comprehensive Survey for IoT Security Datasets Taxonomy, Classification and Machine Learning Mechanisms. Computers & Security, 103283.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING EARLY DETECTION AND DIAGNOSIS OF MELANOMA

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Abstract

The applications of Artificial Intelligence (AI) in dermatology have emerged as a viable tool for enhancing the early detection and diagnosis of melanoma. Melanoma a deadly form of skin cancer, poses a significant global health challenge with its rising incidence rates. Early detection is crucial so that they are provided with the right treatment which will improve patient outcomes. This paper explores the evolving landscape of melanoma diagnosis, focusing on the transformative role that artificial intelligence (AI) plays in enhancing early detection and diagnosis and also reviews the current state of AI applications in dermatology, emphasizing the advancements in image recognition, feature extraction, and classification algorithms that contribute to more accurate and timely melanoma diagnoses.

Keywords: Artificial Intelligence (AI), Machine Learning, Dermatology, Computer-aided diagnosis (CAD), Convolutional Neural Networks (CNN).

1.Introduction

Melanoma is a type of skin cancer that originates in the pigment-producing cells of the skin known as melanocytes. These cells are responsible for producing melanin, the pigment that gives colour to the skin, hair, and eyes. Melanoma is considered the most dangerous form of skin cancer due to its potential to spread to other parts of the body. Melanoma is a highly aggressive form of skin cancer that develops in the melanocytes, the cells responsible for producing melanin. Melanin gives color to the skin, hair, and eyes, and melanocytes play a crucial role in protecting the skin from the harmful effects of ultraviolet (UV) radiation. However, when these cells undergo malignant transformation, they can give rise to melanoma. This type of skin cancer is particularly dangerous because of its ability to metastasize, spreading to other organs and tissues in the body.

Traditional methods for diagnosing and treating melanoma involve a combination of visual examination, biopsy, and surgical intervention. Dermatologists typically perform regular skin checks, looking for changes in moles, asymmetry, irregular borders, variations in color, and changes in size. Suspicious lesions are often subjected to a biopsy, where a sample of tissue is examined under a microscope to determine if cancer cells are present. If diagnosed early, surgical removal of the affected tissue may be sufficient to treat localized melanoma. However, in more advanced cases, additional treatments such as chemotherapy, immunotherapy, or targeted therapy may be necessary. Regular skin screenings, public awareness, and sun protection remain crucial in preventing and detecting melanoma at its early stages, improving the chances of successful treatment.

The risk factors of melanoma are:

- UV Exposure: Prolonged exposure to ultraviolet (UV) radiation from the sun or tanning beds increases the risk.
- Fair Skin: People with fair skin, light hair, and light-coloured eyes are at a higher risk.
- Family History: Individuals with a family history of melanoma have an increased risk.
- Moles: Having many moles or unusual moles may increase risk.
- Weakened Immune System: Individuals with weakened immune systems may be more susceptible

In 2023, an estimated 97,610 adults (58,120 men and 39,490 women) in the United States will be diagnosed with invasive melanoma of the skin. Worldwide, an estimated 324,635 people were diagnosed with melanoma in 2020. In the United States, melanoma is the fifth most common cancer among men. Norway is considered as the country which has reported the most case of melanoma which increased significantly in 2022, with 2,911 diagnoses, 468 more than the previous year. The most significant growth was observed among the elderly. Norway leads globally in both melanoma cases and related deaths, largely linked to sun exposure and sunbed usage. A worldwide total of 325 000 new melanoma cases (174 000 males, 151 000 females) and 57 000 deaths (32 000 males, 25 000 females) was estimated for 2020. The prevalence of melanoma, like other types of

cancer, can vary by region, demographic factors, and environmental influences. Melanoma is more common in fair-skinned individuals, and its occurrence is often linked to exposure to ultraviolet (UV) radiation from the sun or artificial sources like tanning beds. Here are some general points about the prevalence of melanoma:

Global Incidence: Melanoma is one of the most common cancers worldwide, and its incidence has been increasing over the past few decades. It is more prevalent in countries with predominantly fair-skinned populations.

Geographic Variation: The incidence of melanoma is higher in regions with greater exposure to UV radiation, such as sunny climates. Countries like Australia and New Zealand, with high UV levels, have some of the highest rates of melanoma.

Age and Gender: Melanoma can occur at any age but is more commonly diagnosed in adults. It is slightly more common in males than females.

Risk Groups: Individuals with a family history of melanoma, those with numerous atypical moles, and people with a history of severe sunburns are at higher risk.

Trends: Melanoma incidence has been rising in many parts of the world, possibly due to increased awareness, better detection methods, and changing sun exposure patterns.

Survival Rates: Early detection and treatment significantly improve survival rates. Melanoma, when detected at an early stage and surgically removed, often has a high cure rate.

2. Role of AI in melanoma detection

The role of Artificial Intelligence (AI) in melanoma detection is transformative, revolutionizing the field of dermatology by providing advanced tools and techniques for accurate and early diagnosis. Various AI methods leverage machine learning and deep learning algorithms to analyze dermatoscopic images, clinical data, and patient histories. Various AI approaches are employed to analyze dermatoscopic images, clinical data, and other relevant information for effective melanoma detection.There are several different techniques used in melanoma diagnosis are Deep neural networks(DNN), Dermoscopic image analysis, skin lesion analysis, Deep learning, sparse coding, SVM.

2.1. Deep neural network (DNN)

A deep neural network (DNN) technique known as a convolutional neural network (CNN). CNNs have proven to be highly effective in image classification tasks due to their ability to automatically learn hierarchical features from input data. In this study, the CNN was trained on a diverse dataset of skin images, encompassing various skin lesions and diseases. The architecture of the CNN allowed it to capture intricate patterns and features within high-resolution skin images, enabling accurate classification of skin cancer. The use of deep learning, particularly CNNs, marked a significant advancement in achieving dermatologist-level accuracy in skin cancer classification, showcasing the potential of artificial intelligence in revolutionizing dermatological diagnostics.

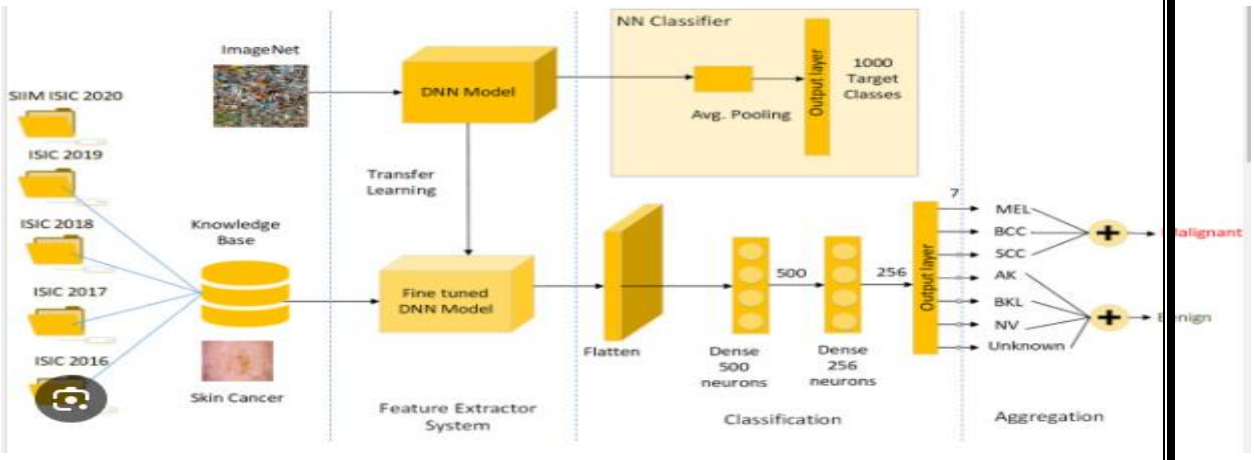

Fig 1: Melanoma diagnosis using Deep neural network

2.2 Dermatoscopic Image

The primary technique employed is dermatoscopic image analysis. Dermatoscopy, also known as dermoscopy, involves the examination of skin lesions using a dermatoscope, which is a handheld device equipped with magnification and lighting. Dermoscopic image analysis specifically refers to the process of analyzing digital images captured using dermatoscopy for the purpose of diagnosing pigmented skin lesions. here creating and introducing the HAM10000 dataset, which is a large collection of multi-source dermatoscopic images featuring common pigmented skin lesions. The dataset was designed to facilitate research in the field of dermatology, particularly for the development and evaluation of algorithms and techniques related to dermatoscopic image analysis.

The technique involves the visual examination and analysis of dermatoscopic features within skin lesions, aiming to improve the accuracy and reliability of melanoma diagnosis. Dermoscopic image analysis often includes the identification of specific patterns, colors, and structures within skin lesions, which can be indicative of various skin conditions, including melanoma. The use of such datasets and analysis techniques contributes to advancements in automated diagnostic tools and aids in training artificial intelligence models for improved melanoma detection.

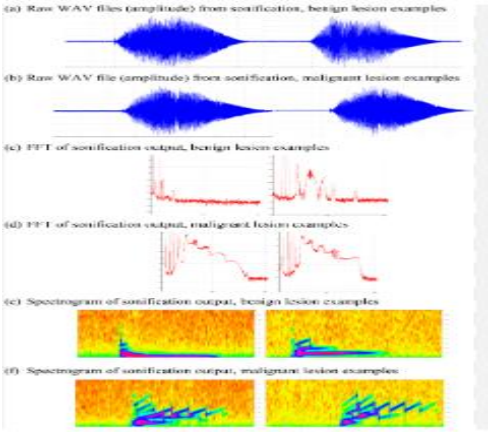

Fig 2: Melanoma diagnosis using Dermatoscopic images

2.3. Skin lesion analysis

Skin lesion analysis in AI involves the application of artificial intelligence techniques to the examination and interpretation of dermatological images for the detection and diagnosis of skin lesions. AI plays a crucial role in automating and enhancing the accuracy of skin lesion analysis, particularly in the context of melanoma detection. Advanced machine learning algorithms, such as convolutional neural networks (CNNs) and deep learning models, are trained on diverse datasets of skin images to learn complex patterns and features indicative of various skin conditions. These AI models can effectively differentiate between benign and malignant lesions, aiding dermatologists in early diagnosis and decision-making. The integration of AI in skin lesion analysis not only offers rapid and objective assessments but also contributes to the development of computer-aided diagnostic tools, paving the way for more efficient and reliable dermatological care. The continuous advancements in AI technologies underscore their potential to revolutionize skin lesion analysis, providing valuable support to healthcare professionals in the field of dermatology.

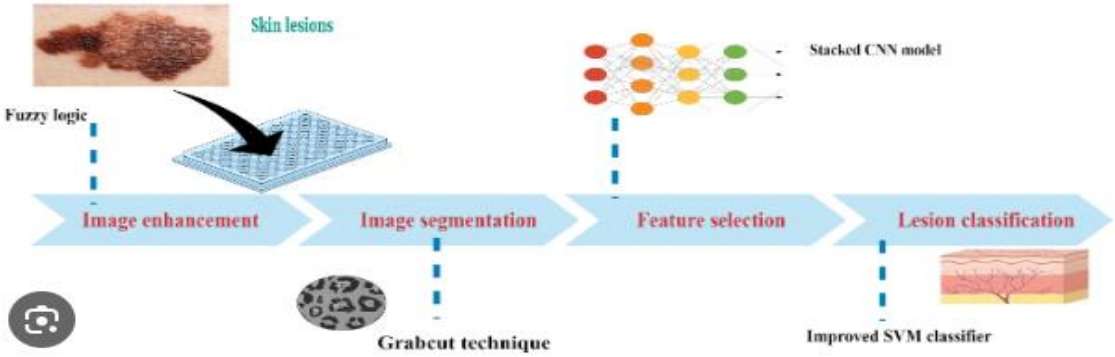

Fig 3: Melanoma diagnosis using skin lesion analysis

2.4. Deep Learning

The primary focus was on utilizing advanced neural network architectures, commonly associated with deep learning, to automatically extract complex features and patterns indicative of melanoma. This likely involves the use of convolutional neural networks (CNNs) or similar architectures trained on a dataset of dermoscopy images. Additionally, the paper explores the integration of sparse coding, a technique for representing data in terms of a sparse set of basis vectors, and Support Vector Machines (SVM) for improved melanoma recognition. This multi-faceted approach demonstrates a combination of sophisticated techniques to enhance the accuracy and reliability of melanoma detection in dermoscopy images, showcasing the versatility of deep learning in dermatological image analysis.

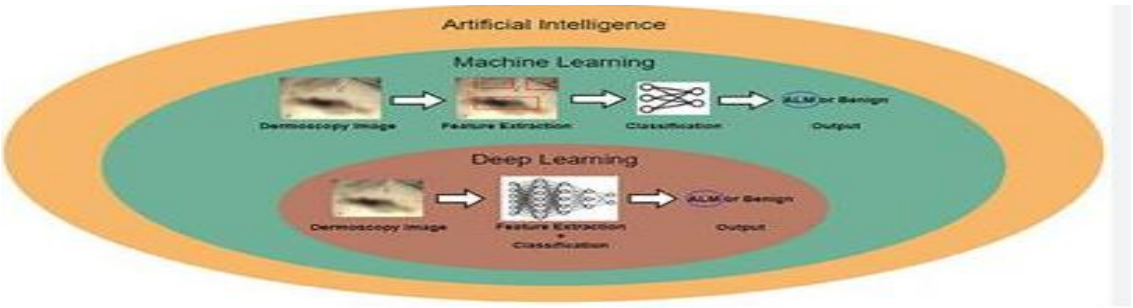

Fig 4: Melanoma diagnosis using deep learning

2.5. Support Vector Machine(SVM)

Support Vector Machines (SVM) is one of the techniques used for melanoma recognition in dermoscopy images. SVM is a supervised machine learning algorithm commonly employed for classification tasks SVM likely serves as a component in the overall

methodology for melanoma detection, working in conjunction with other techniques such as deep learning and sparse coding. SVM is known for its ability to efficiently handle high-dimensional data and can be particularly effective when combined with feature extraction methods like deep learning and sparse coding. The utilization of SVM in this study underscores its role in providing a discriminative model for distinguishing between benign and malignant skin lesions in dermoscopy images, contributing to the overall accuracy and robustness of the melanoma recognition system.

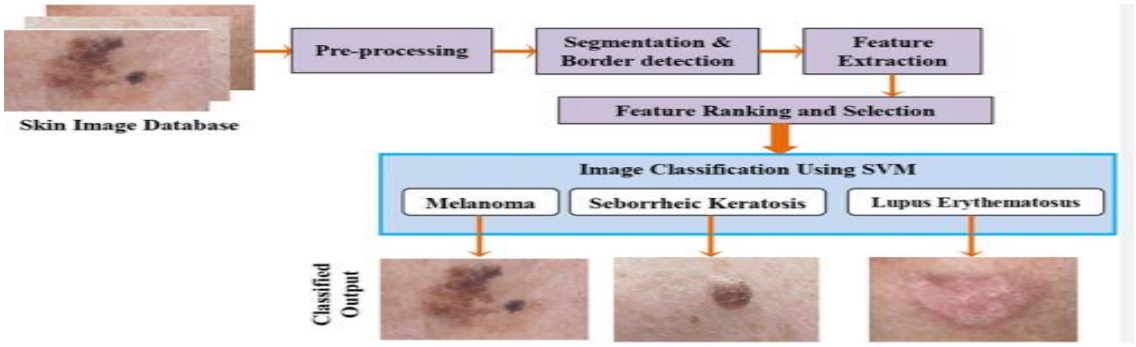

Fig 5: Melanoma diagnosis using SVM

3. Comparative Study on Melanoma Diagnosis

Paper Title & Authors	Techniques Used	Dataset	Measurements	Remarks
Esteva et al. (2017)	Deep Neural Networks	Skin lesion images (Nature dataset)	Sensitivity, Specificity	Achieved dermatologist-level accuracy in skin cancer classification
Tschandl et al. (2011)	Dermoscopic Image Analysis	HAM10000 dataset	Area under the ROC curve (AUC)	Established a large dataset of dermatoscopic images for research
Gutman et al. (2016)	Skin Lesion Analysis	ISBI challenge dataset	Accuracy, F1 Score	Highlighted challenges and advancements in melanoma detection
Brinker et al. (2019)	Deep Neural Networks	Dermoscopic images	Sensitivity, Specificity	Demonstrated superior performance compared to dermatologists
Codella et al. (2018)	Deep Learning, Sparse Coding, SVM	Dermoscopy images	Area under the Precision-Recall Curve	Explored various AI techniques for accurate melanoma recognition

Table 1: Comparative study on melanoma diagnosis

4. Conclusion

This paper, focus on different techniques for melanoma diagnosis. Mainly the study concentrated on Deep neural networks(DNN), Dermoscopic image analysis, skin lesion analysis, Deep learning, sparse coding, SVM. The most effective method for diagnosing melanoma is likely to be a combination of different approaches, considering the strengths and weaknesses of each. Deep learning techniques, especially deep neural networks, have shown promising results in image-based tasks, including dermatology. However, the integration of clinical expertise, dermoscopic image analysis, and traditional machine learning methods like SVM, along with advancements in AI, can lead to more accurate and robust melanoma diagnosis systems. The collaboration between medical professionals and technologists is crucial for developing reliable and accessible diagnostic tools for melanoma detection.

5.References

[1] Esteva, A., Kuprel, B., Novoa, R. A., Ko, J., Swetter, S. M., Blau, H. M., & Thrun, S. (2017). Dermatologist-level classification of skin cancer with deep neural networks. Nature, 542(7639), 115-118

[2] Tschandl, P., Rosendahl, C., & Kittler, H. (2011). The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions. Scientific Data, 5, 180161

[3] Gutman, D., Codella, N. C., Celebi, E., Helba, B., Marchetti, M. A., Mishra, N., ... & Halpern, A. (2016). Skin lesion analysis toward melanoma detection: A challenge at the 2017 International Symposium on Biomedical Imaging (ISBI), hosted by the International Skin Imaging Collaboration (ISIC). arXiv preprint arXiv:1612.07972

[4] Brinker, T. J., Hekler, A., Enk, A. H., Klode, J., Hauschild, A., Berking, C., ... & Schadendorf, D. (2019). Deep neural networks are superior to dermatologists in melanoma image classification. European Journal of Cancer, 119, 11-17

[5] Codella, N., Cai, J., Abedini, M., Garnavi, R., Halpern, A., Smith, J. R., & Celebi, M. E. (2018). Deep learning, sparse coding, and SVM for melanoma recognition in dermoscopy images. In 2018 25th IEEE International Conference on Image Processing (ICIP) (pp. 849-853). IEEE

[6]Liu, F., Luo, Y., Li, Y., Yang, X., Cheng, Y., Zhou, T., ... & Tian, J. (2018). A deep convolutional neural network-based automatic delineation strategy for multiple brain metastases stereotactic radiosurgery. PloS One, 13(10), e0205128.

[7]Haenssle, H. A., Fink, C., Schneiderbauer, R., Toberer, F., Buhl, T., Blum, A., ... & Tschandl, P. (2018). Man against machine: diagnostic performance of a deep learning convolutional neural network for dermoscopic melanoma recognition in comparison to 58 dermatologists. Annals of Oncology, 29(8), 1836-1842.

[8]Ferris, L. K., Harris, R. J., Giuliano, A. R., Hollis, M., Kong, C. Y., Lowe, J., ... & Wilke, L. G. (2020). A comparison of teledermatology and face-to-face visits for newly referred dermatology consultations. JAMA Dermatology, 156(3), 326-333.

[9]Mandal, M., Chen, R., Suh, J. W., & Antani, S. (2019). Skin lesion analysis toward melanoma detection using deep learning: A review. IEEE Access, 7, 115203-115239.

[10]Pathan, K., & Chen, Y. W. (2018). Skin lesion analysis: A survey. Medical & biological engineering & computing, 56(9), 1487-1516.

ADVANCING OSTEOSARCOMA DETECTION IN HISTOPATHOLOGY IMAGES THROUGH WEIGHTED BILATERAL FILTERING, PARABOLIC BALANCE CONTRAST ENHANCEMENT, AND MORPHOLOGICAL OPERATIONS

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ABSTRACT:

Osteosarcoma, kind of cancer that begins in the cells that form bones, poses a significant health challenge requiring early and accurate detection for effective treatment. This research investigates the synergistic application of advanced preprocessing techniques—weighted bilateral filtering, Parabolic Balance Contrast Enhancement (PCBE), and morphological operations—to enhance osteosarcoma detection in histopathology images. Histopathology images, crucial for diagnosing osteosarcoma, often suffer from inherent challenges such as noise and low contrast. To address these issues, we explore novel preprocessing approaches. Weighted bilateral filtering is employed to preserve image structures while reducing noise, PCBE enhances contrast through a parabolic balance approach, and morphological operations such as dilation and erosion refine image structures. This research demonstrates that the integration of weighted bilateral filtering, PCBE, and morphological operations significantly advances osteosarcoma detection in histopathology images. These findings underscore the potential for improved clinical outcomes through the implementation of advanced preprocessing techniques in osteosarcoma diagnosis. The proposed study used a PYTHON tool for implementation, and the dataset is publicly accessible online histopathological images. The proposed scheme is evaluated using accuracy, specificity, sensitivity.

Keywords: Weighted bilateral filtering, Parabolic Balance Contrast Enhancement, Dilation, Erosion, Filtering, Histopathology images

INTRODUCTION:

Osteosarcoma, a malignancy that arises from the bones, presents a pressing challenge in the field of oncology, demanding not only clinical expertise but also innovative solutions for early detection. The importance of accurate and timely diagnosis cannot be overstated, and in the era of digital pathology, histopathology images stand as crucial diagnostic aids. This research endeavors to pioneer a groundbreaking approach to enhance osteosarcoma detection in histopathological images through the fusion of advanced image processing techniques.

Traditional diagnostic methods often face limitations in capturing the complex structures and abnormalities inherent in osteosarcoma tissues. In response to this challenge, our study introduces a novel methodology designed to unravel the complexity of osteosarcoma detection.

The initial step in our methodology employs weighted bilateral filtering to strike a delicate balance between preserving crucial edges and structures while effectively suppressing noise. This process not only ensures the fidelity of essential features but also lays a foundation for subsequent stages of analysis.

In response to the intricacies of tissue textures and subtle variations within the images, our methodology incorporates parabolic balance contrast enhancement. This technique goes beyond traditional contrast enhancement methods, refining the visibility of potential osteosarcoma lesions and harmonizing contrasts. The result is an enriched representation, enabling a more nuanced and comprehensive understanding of the histopathological landscape.

The methodology is further enriched through the integration of morphological operations. These operations play a pivotal role in fine-tuning the image, isolating suspicious regions, and enhancing structural information. By employing erosion and dilation strategically, we aim to refine the details necessary for precise osteosarcoma detection.

This research stands at the intersection of medical imaging and computational methodologies, offering a promising avenue for improving osteosarcoma diagnosis. By exploring the synergies between weighted bilateral filtering, parabolic balance contrast enhancement, and morphological operations, we anticipate not only advancing the

scientific understanding of osteosarcoma but also contributing to the growth of more precise and effective diagnostic tools.

In the subsequent sections of this paper, we will explain into the detailed methodology, experimental setup, and results, presenting a comprehensive analysis of the proposed approach with some other methods.

LITERATURE REVIEW

Sweety Deswal, Shailender Gupta and Bharat Bhushan [1] various types of bilateral filtering and types are being reviewed and analyzed on account of performance matrices.Inorder to remove mixed types of noise they adopt Switching Bilateral Filter. For the removal of impulse noise they used Modified Double Bilateral Filter and for the removal of Gaussian noise they used Joint Bilateral Filter.

C. Tomasi, R. Manduchi [4] uses a non-iterative method for edge preserving smoothening. They uses the concept of domain filtering. It combines gray levels or colors on geometric closeness and photometric similarity and bilateral filtering produces no phantom colors along edges in color images, and reduces phantom colors where they appear in the original image.

P M Narendra [6] numerous properties of the separate filter that are produced when a one-dimensional median filter is applied repeatedly to an image's rows and columns are examined. This separable filter performs similarly to noise smoothing in images, despite having a somewhat different output from the analogous nonseparable two-dimensional median filter with a square window. Specifically, its noise-smoothing efficiency and edge-related behavior are described and contrasted with the two-dimensional median filters.

Qingxiong Yang, Kar Han Tan, Narendra Ahuja [7] Remove shadows from a single image using color information. They derive a 2-D image based on colors and then use bilateral filtering to recover a 3-D image. Reduces contrast in areas with similar surface reflectance the derived image has incorrect luminance values. To correct this, they decompose the input image and the derived image as base and detail layers. They then combine the base layer from the input image and form detail layer from the derived image to create a shadow-free image with accurate luminance values.

MOTIVATION

The motivation behind this research stems from the critical need for improved diagnostic methodologies in the realm of osteosarcoma, a malignancy that poses substantial challenges to accurate detection and characterization. Osteosarcoma's intricate histopathological nature demands an innovative approach, necessitating a departure from conventional diagnostic strategies. The amalgamation of weighted bilateral filtering, parabolic balance contrast enhancement, and morphological operations is motivated by Diagnostic Complexity of Osteosarcoma, Clinical Implications of Early Detection, Technological Advancements in Image Processing, and Translational Impact on Clinical Practice. In essence, our motivation is a fusion of scientific curiosity, a commitment to addressing clinical challenges, and a profound desire to make a positive impact on patient outcomes. Through the amalgamation of cutting-edge image processing techniques, we aspire to usher in a new era of precision in osteosarcoma detection, influencing both the scientific community and the everyday practice of healthcare professionals.

PROPOSED METHODOLOGY

This section explains methodology of pre-processing such as weighted bilateral filtering for noise removal, parabolic contrast balance enhancement for image enhancement and morphology operations such as dilation and erosion for eliminating unwanted portions of the input image. Our paper mainly focused on these pre-processing technique.

Input image Preprocessed Image

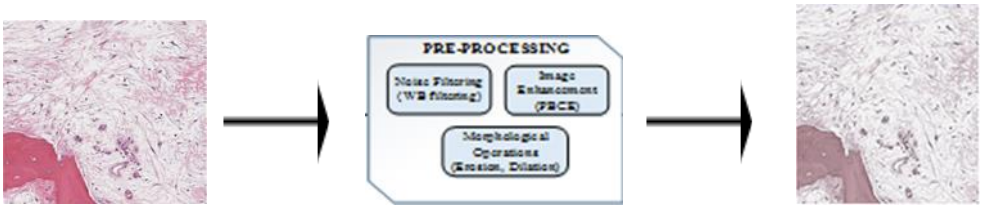

Figure 1: schematic diagram of the implemented scheme

WEIGHTED BILATERAL FILTERING

Algorithm 1: Image Processing with Weighted Bilateral Filtering

Input: image

Output: filtered image

1. Set the image path
2. Read the image
3. Convert the image to grayscale
4. Display and save the original image
5. Apply Weighted Bilateral Filtering

   Set parameters: spatial_sigma = 10, range_sigma_color = 100, range_sigma_space = 100

   Weightedbilateral_ = Weightedbilateral(image, spatial_sigma, range_sigma_color, range_sigma_space

6. Display and save the filtered image

PARABOLIC BALANCE CONTRAST ENHANCEMENT

Algorithm 2: Parabolic Balance Contrast Enhancement (PBCE)

Input: Weighted Bilateral Filtered Image (Weightedbilateral_)

Apply Parabolic Balance Contrast Enhancement:

- Create an instance of PBCE: parabalconenc = PBCE(Weightedbilateral_)

Display and save the enhanced image

Input: Grayscale Image (img)

1. Compute image statistics in the input image:

- Lmin = Minimum pixel value
- Lmax = Maximum pixel value

- Lmean = Mean pixel value

- LMssum = Mean square sum

2. Define output image range:

- Gmin = 0

- Gmax = 255

- Gmean = 110

3. Calculate parameters for the parabolic function:

- bnum = ((Lmax^2) * (Gmean - Gmin)) - (LMssum * (Gmax - Gmin)) + ((Lmin^2) * (Gmax - Gmean))

- bden = 2 * (Lmax * (Gmean - Gmin) - Lmean * (Gmax - Gmin) + Lmin * (Gmax - Gmean))

- b = bnum / bden

- a = (Gmax - Gmin) / ((Lmax - Lmin) * (Lmax + Lmin - 2 * b))

- c = Gmin - a * (Lmin - b) * (Lmin - b)

4. Apply the parabolic function to enhance contrast:

- y = a * (img - b) * (img - b) + c

5. Clip values to the valid range [0, 255]:

- y = clip(y, 0, 255)

6. Output: Enhanced Image (y)

MORPHOLOGICAL OPERATIONS

Algorithm 3: Erosion and Dilation (Morphological Process)

Input: Grayscale Image (parabalconenc)

1. Define a morphological kernel:
2. Perform Erosion
3. Display and save the eroded image
4. Perform Dilation on the eroded image

5. Display and save the dilated image

Table 1 represents a study of Weighted bilateral filtering, Parabolic Balance Contrast Enhancement and Morphological Operations

Aspect	Weighted Bilateral Filtering	Parabolic Balance Contrast Enhancement	Morphological Operations
Objective	Improve osteosarcoma detection in histopathology images	Enhance contrast using parabolic balance	Employ morphological operations
Methodology	Weighted Bilateral Filtering applied to histopathology images	Parabolic Balance Contrast Enhancement applied to pre-processed images	Morphological operations (erosion and dilation) on enhanced images
Image Enhancement	Preserves edges and reduces noise	Improves contrast using parabolic function	Morphological operations for structure enhancement
Evaluation Metrics	Sensitivity, Specificity, Accuracy	F1 Score, AUC-ROC	Sensitivity, Specificity
Results	Quantitative improvement in osteosarcoma detection	Enhanced contrast and improved visual quality	Improved structure representation
Limitations	Sensitivity to parameter selection	Sensitivity to initial image quality	Sensitivity to image variations
Advantages	Edge preservation, noise reduction	Improved contrast without losing details	Structural enhancement
Applications	Histopathology image analysis	Image enhancement in various medical imaging scenarios	Image preprocessing for further analysis
Future Directions	Optimization of parameter selection	Integration with deep learning methods	Exploration of advanced morphological techniques

PERFORMANCE MEASURES

Histopathology Images through Weighted Bilateral Filtering, Parabolic Balance Contrast Enhancement, and Morphological Operations would depend on the objectives of the study and the specific tasks involved in osteosarcoma detection. Generally, in medical image processing and analysis, several metrics are commonly used to evaluate the performance of algorithms

Sensitivity (True Positive Rate or Recall):

Sensitivity measures the proportion of actual positive cases correctly identified by the algorithm. It's calculated as TP / (TP + FN), where TP is the number of true positives, and FN is the number of false negatives.

Specificity (True Negative Rate):

Specificity measures the proportion of actual negative cases correctly identified by the algorithm. It's calculated as TN / (TN + FP), where TN is the number of true negatives, and FP is the number of false positives.

Accuracy:

An algorithm's accuracy indicates how correct it is overall.. It's calculated as (TP + TN) / (TP + TN + FP + FN).

F1 Score:

The F1 score is the harmonic mean of precision and sensitivity. It's calculated as 2 * (Precision * Sensitivity) / (Precision + Sensitivity).

Area under the ROC Curve (AUC-ROC):

AUC-ROC measures the ability of the algorithm to discriminate between positive and negative cases across different thresholds.

Table 2 Comparative study of various types of filters for noise removal

Aspect	Gaussian Filter	Median Filter	Bilateral Filter	Weighted Bilateral Filter	Wiener Filter
Objective	Smoothing, noise reduction	Noise reduction, edge preservation	Edge-preserving smoothing	Edge-preserving smoothing	Additive noise reduction
Strengths	Simplicity, effective for Gaussian noise	Robust to impulse noise, edge preservation	Edge preservation, noise reduction	Improved edge preservation, noise reduction	Adaptability, noise reduction
Weaknesses	Limited edge preservation	May blur fine details, less effective for Gaussian noise	Computationally expensive, sensitivity to parameters	Sensitivity to parameter tuning	Assumes linear noise model
Applications	General smoothing, Gaussian noise reduction	Salt-and-pepper noise reduction, edge-preserving smoothing	Image denoising with edge preservation	Edge-preserving smoothing, noise reduction	Restoration of images with additive noise
Computational Complexity	Low	Low to moderate	Moderate to high	Moderate to high	Moderate to high
Parameter Sensitivity	Low	Moderate	Moderate to high	Moderate	Moderate

Table 3 represents evaluation metrics of various types of filters for osteosarcoma detection.

Filter	Accuracy	Sensitivity	Specificity
Gaussian Filter	Moderate	Moderate	Moderate
Median Filter	Moderate	High	High
Bilateral Filter	Moderate to High	High	High
Weighted Bilateral Filter	High	High	High
Wiener Filter	High	Moderate to High	Moderate to High

CONCLUSION:

In this paper, I presented comparative study of various filtering techniques for noise removal to detect osteosarcoma in histopathology images. Each filter has properties of its own. Depending on the type of noise, the proper filter is selected and the amount of filtering necessary. Here weighted bilateral filtering is used for noise removal, Parabolic Balance Contrast Enhancement is used for image enhancement and enhance contrast and Morphological Operations such as dilation and erosion is used for removing unwanted portions and thereby structure enhancement. Thus the proposed scheme showed its dominance in all the cases. In this work, pre-processing is only done for improving the image quality for better correctness in osteosarcoma detection.

REFERENCES

[1]. Sweety Deswal, Shailender Gupta and Bharat Bhushan". A Survey of Various Bilateral Filtering Techniques" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.8, No.3 (2015).

[2] Image Filtering Techniques-A Review Ramanjeet Kaur 1, Er. Ram Singh 21 Student, Department of Computer Engineering, Punjabi University Patiala, Punjab, (India) 2 Assistant Professor, Department of Computer Engineering, Punjabi University Patiala, Punjab, (India)

[3] D. Z. P. F. L. I. Abdalla Mohamed Hambal, "Image Noise Reduction and Filtering Techniques, "International Journal of Science and Research, 2015

[4] C. Tomasi and R. Manduchi, "Bilateral filtering for gray and color images'', in the proceedings of 6th IEEE International conference on computer vision, (1998), pp. 834-846

[5] K. J. Overton and T. E. Weymouth. A noise reducing preprocessing algorithm. In Proc. IEEE Computer Science Conf. on Pattern Recognition and Image Processing, 498–507, 1979

[6] P. M. Narendra. A separable median filter for image noise smoothing. IEEE Trans., PAMI-3(1):20–29, 1981.

[7] Yang, Q.; Tan, K.-H.; Ahuja, N. Shadow removal using bilateral filtering. IEEE Trans. Image Process. 2012, 21, 4361–4368

[8] . Perreault, S.; Hebert, P. Median filtering in constant time. IEEE Trans. Image Process. 2007, 16, 2389–2394

[9] S. W. Smith, “Chapter 25: Special Imaging Techniques”

[10] “Morphological Image Analysis, Principles and Applications by Pierre Soille, 1999

[11] S.Sivasakthi “A Study On Morphological image Processing And Its Operations” Journal of Analysis and Computation ISSN 0973-2861 International Conference on Emerging Trends in IOT & Machine Learning, 2018

[12] P. Maragos and l. Pessoa “Morphological filtering for image enhancement and detection,” chapter for the image and video processing handbook, acad. Press, march 1999.

[13] G.V.Tcheslavski, “Morphological Image Processing: Grayscale morphology”, ELEN 4304/5365 DIP, Spring2010.

[14] K. Park, M. Chae, and J. H. Cho, “Image pre-processing method of machine learning for edge detection with image signal processor enhancement,” Micromachines, vol. 12, no. 1, p. 73, 2021.

[15] R. Kaur and S. Kaur, ″Comparison of contrast enhancement techniques for medical image,″ in 2016 conference on emerging devices and smart systems (ICEDSS), 2016, pp. 155-159

[16] H. Ackar, A. Abd Almisreb, and M. A. Saleh, ″A Review on Image Enhancement Techniques, ″ Southeast Europe Journal of Soft Computing, vol. 8 (1), 2019)

[17] S. B. Rana and S. Rana, ″A review of medical image enhancement techniques for image processing, ″ International Journal of Current Engineering and Technology, vol. 5 (2), pp. 1282-1286(2015)

[18] J. S. Lee. Digital image enhancement and noise filtering by use of local statistics. IEEE Trans., PAMI-2(2):165–168, 1980

[19] Hybrid Filter for Gaussian Noise Removal with Edge Preservation. IJCA Special Issue on Recent Trends in Pattern Recognition and Image Analysis RTPRIA(1):33-39, May 2013

ENHANCED TRACEABLE CP -ABE FOR EFFECTIVE DATA TRANSMISSION IN MILITARY SYSTEMS

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Abstract

When communications are to be shared amongst users via an untrusted media, security must be guaranteed. Within the military setting, users of varying grades must communicate sensitive information to one another. To safeguard the data from unwanted access, the information that must be delivered must be encrypted. Identity-based encryption, attribute-based encryption (ABE), key policy attribute-based encryption (KP-ABE), and cipher text policy attribute-based encryption (CP-ABE) are some of the techniques available for encrypting data. In CP-ABE, attributes are linked to the key and access policies are linked to the ciphertext. Decryption is only feasible if the attribute and the access policy match. Traceability, blocking characteristics, and a vast universe are added to cp-abe.

Keywords :*CP-ABE (Cipher text policy attribute encryption), IBE (Identity – Based Encryption), FIBE (Fuzzy identity based encryption), PKG (Public Key Generator)*

1. Introduction

Computer Security is a technique used to ensure that the data stored in the computer isn't compromised. There are colorful styles to ensure security like word, data encryption etc. Data encryption means cracking the data into another form which can be deciphered only by decryption key. The military communication had the topmost influence on encryption. A thorough understanding encryption helps people to develop better ways to cover precious information because the technology has come briskly and more effective. The cipher textbook and secret key in trait-based encryption are dependent on the traits.. The identity of the user is described by a set of trait. Cipher text- policy trait- grounded encryption (CP- ABE) enables fine- granulated access control to the translated data for marketable operations. Due to two components, huge macrocosm and traceability, CP-

ABE has advanced significantly in recent years, substantially improving its marketable operations. The capacity of ABE to track down the malicious user who purposefully makes a mistake with the partial or altered decryption keys in order to profit is known as traceability. However, because of the nature of CP-ABE, it is challenging to determine the original key owner from an exposed key because the decryption privilege is shared by several users with identical characteristics.

2. RELATED WORKS

2.1 Identity Based Encryption

A user's public key in an IBE system could be any string, such as their email address or another identification. This completely removes the need for certificates because the sender can just encrypt the message using the recipient's identity without first obtaining his public key (and making sure that the public key obtained is the correct one). Naturally, people are unable to create a private key for an identity on their own[1]. Because of this, the system setup is carried out by a reliable party known as the private key generator (PKG). A user would visit the PKG and provide identification in order to receive a private key for his identity. The relevant private key would then be generated by the PKG and sent on.

2.2 Fuzzy Identity-Based Encryption

An identity is seen as a collection of descriptive features in Fuzzy IBE. When two identities,! and!0, are close to one another as determined by the "set overlap" distance metric, a fuzzy IBE method permits a private key for identity! to decrypt a ciphertext encrypted with identity!0. Biometric identities can be encrypted using a fuzzy IBE scheme because of its error-tolerance feature, which makes it possible to use biometric identities despite the fact that they will always contain some noise when they are sampled. Furthermore, we demonstrate the applicability of Fuzzy-IBE for what we refer to as "attribute-based encryption" applications.

2.3 Key-policy attribute based encryption

Characteristics are appended to the cipher texts, and users' decryption keys are distributed in line with an access policy in the KPABE. The attribution set can be encrypted by ABE, and KP-ABE ensures that the identical attribution sets will correlate. Nevertheless, ABE

is unable to recognize the users who may have access to the encrypted data files. The primary characteristics of users in KP-ABE are linked to an ACT that consists of those same characteristics[6]. Relying on an external key authority prevents users from accessing and reading the data files. One crucial characteristic that must be attained in kp-abe is collusion resistance. This essentially means that separate users shouldn't be able to combine their secret keys to decrypt a ciphertext that neither of them could decode alone.

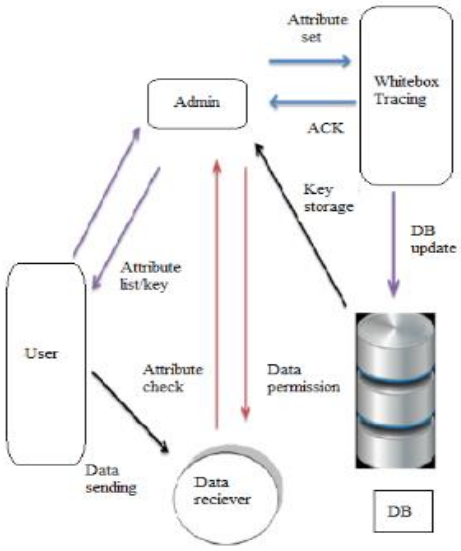
3. ENHANCED TRACEABLE LARGE UNIVERSE CP-ABE SYSTEM

We use the "individual randomness" and "layer" techniques from [9] and [13] to realize huge universe creation. To safely encrypt and decrypt data, we employ the "layer" technique. The "attribute" layer and the "secret sharing" layer are the two "layers" we use. A "binder term" is used to securely join these two layers. We use u, h words in the "attribute" layer to produce a hash function (u Ah) in the Boneh-Boyen manner [14]. Regarding the "secret sharing" layer, we utilize the w term to store the secret randomness shares 3 (r) and the secret randomness (w) throughout the KeyGen and Encrypt phases, respectively.. Lastly, we "bind" these two layers together using the v word.We employ the Boneh-Boyen-style signature [14] in the T-LU-CPABE system and other systems to achieve traceability.

An eT-LU-CP-ABE system consists of six algorithms as follows:

- **Setup**: A security parameter $\lambda \in N$ encoded in unary is fed into the method as an input. It outputs the master secret key (msk) and the public parameters (pp). We presume that the public parameters provide the description of the attribute universe U. Furthermore, it initializes an instance of INS (.t,. n), which is Shamir's (.t,.n) threshold scheme.
- **KeyGen:** The public parameters pp, the master secret key msk, and a set of attributes $S \subseteq U$ for a user with identification id are inputs to the key generation process. The inputs' security parameter guarantees that the time is polynomial in λ. The secret key skid, S, corresponding to S, is the algorithm's output.
- **Encrypt**: An access structure A over U, a plaintext message m, and the public parameters pp are the inputs of the encryption method. The ciphertext ct is output by it.

- **Decrypt**: The public parameters pp, a secret key skid, S, and a ciphertext ct are inputs to the decryption method. The plaintext m or ⊥ is output by it.
- **KeySanityCheck**: A secret key sk and the open parameters pp are inputs to the decryption handle. Sk yields 1 on the off chance that the key rational soundness check is effective. In the event that not, it produces 0. A deterministic method called the key rational soundness check is utilized to guarantee that 17 the secret key is well-formed amid the decoding handle.
- **Trace:** The fraudulent user is located using this algorithm. The aforementioned technique allows us to determine whether the key was well formed or not.



4. PROPOSED SYSTEM

In military different users that belong to different ranks needs to communicate with each other to transfer the confidential data. Table I shows some of the ranks of the officers in the army**.**

Table I Ranks in army

PRIORITY	RANK
Major	1
Lieutenant Colonel	2
Brigadier	3
Major General	4
Lieutenant General	5
General	6

When a new user wants to enter the system the corresponding request is send to his immediately top priority user as shown in Fig. 1. The top priority user can either activate or deactivate the request. If the top priority user activates the request then the requested user can enter the system. If the top priority user deactivates the request then the user cannot enter the system.

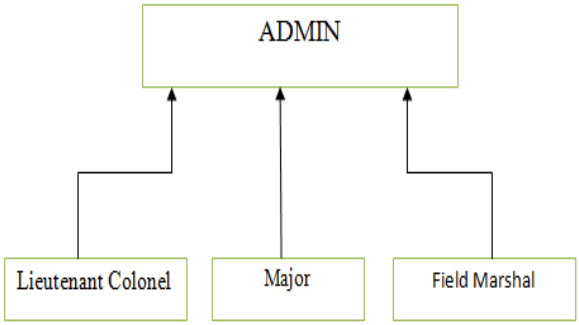


Fig. 1 Request to enter the system

First the document has to be uploaded by the sender to send the document to the receiver. After file uploading, the document will be encrypted and send to the receiver. The secret key and pin code will be generated when the encrypted data is sent to the receiver. This secret key and pin code will be sent to the receiver through email. If the receiver gives valid secret key and pin code, then they can decrypt the document. If the pin code is invalid that user will be temporarily blocked and cannot enter the system. The blocked user can send the unblocking request to the admin. The admin can unblock the user if wanted. After unblocking if the user again gives invalid pin code then that user will be blocked for permanently as shown in Fig. 2.

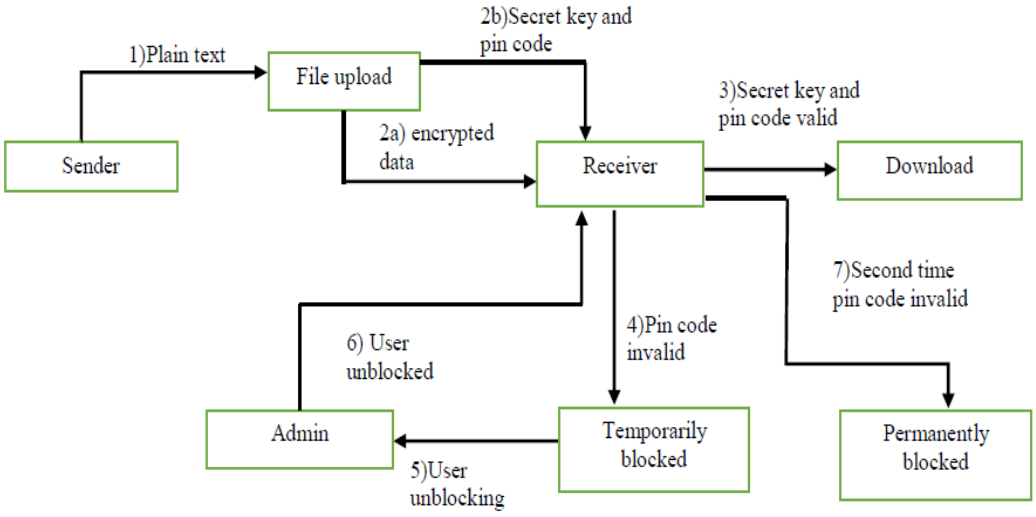


Fig. 2 Block diagram of proposed system

5. CONCLUSIONS

In the military, it is necessary for users of different ranks to transmit classified information. In order to achieve this, an enhanced large universe cipher text policy attribute-based encryption is suggested. This feature includes the ability to trace malicious users who attempt to provide invalid keys, as well as the ability to block such users from further attacks. The large universe attribute-based encryption does not require fixing during system setup. Systems known as CPABE have been created that incorporate white box traceability of permitted harmful users. We can identify the dishonest users who, in order to make money, give out partial or altered decryption keys to third parties. The public parameters size does not increase linearly with the amount of attributes, and the attribute size is unlimited. In addition, we optimize the system in tracing the malicious users to cut down the storage cost for traceability and to make the system efficient in the revocation of the users. Based on the above advantages, our new systems could be applied to many scenarios such as pay-tv systems and social networks. This system is selectively secure in the standard model, when compared with others.

REFERENCES

[1] A. Shamir, "Identity-based cryptosystems and signature schemes," in *Proc. CRYPTO*, 1984, pp. 47– 53

[2] V. Goyal, "Reducing trust in the PKG in identity based cryptosystems," in *Advances in Cryptology*. Berlin, Germany: Springer-Verlag, 2007, pp. 430–447.

[3] T. Okamoto and K. Takashima, "Fully secure functional encryption with general relation from,,. the decisional linear assumption," in *Advances in Cryptology*. Berlin, Germany: Springer-Verlag, 2010, pp. 191–208

[4] A. Lewko, T. Okamoto, A. Sahai, K. Takashima, and B. Waters, "Fully secure functional encryption: Attribute-based encryption and (hierarchical) inner product encryption".

[5] V. Goyal, A. Jain, O. Pandey, and A. Sahai, "Bounded ciphertext policy attribute based ,.encryption," in *Automata, Languages and Programming* .Berlin, Germany: Springer-Verlag, 2008, pp. 579–591.

[6] N. Attrapadung, B. Libert, and E. de Panafieu,"Expressive key-policy attribute-based encryption with constant-size ciphertexts," in *Public Key Cryptography*. Berlin, Germany: Springer-Verlag, 2011, pp. 90–108.

[7] J. Bethencourt, A. Sahai, and B. Waters, "Ciphertext-policy attribute based ., encryption," in *Proc.*and *EEE Symp. Secure. Privacy (SP)*, May 2007, pp. 321–334.

[8] L. Cheung and C. Newport, "Provably secure cipher text policy ABE,"in ,*Proc. 14th ACM Conf. Comput. Commun. Secur.*, 2007, pp. 456–465.

[9] A. Lewko and B. Waters, "Unbounded HIBE and attribute-based encryption ,,(HABE)"in *Advances in Cryptology*. Berlin, Germany: Springer-Verlag, 2011, pp. 547–567.

[10] T. ElGamal, "A public key crypto system and a signature scheme based on discrete logarithms," and in *Advances in Cryptology*. Berlin, Germany: Springer-Verlag, 1985, pp. 10–18..

[11] B. Chor, A. Fiat, and M. Naor, "Tracing traitors," in *Proc. CRYPTO*, Y. Desmedt, Ed.,1994, vol.839 257–270, ser. Lecture Notes in Computer Science, Springer.

[12] D. Boneh, A. Sahai,and B. Waters,"Fully collusion resistant traitor tracing with short Ciphertexts and Private keys," in *Proc. EUROCRYPT*,,. S. Vaudenay, Ed., 2006, vol. 4004, pp. 573– 592, ser. Lecture Notes in Computer Science, Springer.

[13] Y.Rouselakis and B Waters "Practical constructions and new proof methods for large universe attribute based encryption," in *Proc. ACM SIGSAC Conf. Comput. Commun. Secur.*, 2013, pp 463–474.

[14] D. Boneh and X. Boyen, "Short signatures without random oracles, in *Advances in Cryptology* (Lecture Notes in Computer Science),, vol.,, 3027, C. Cach in and J. L.Camenisch, Eds and also Berlin ,Germany: Springer-Verlag, 2004, pp. 56–73.

[15] Z. Liu, Z.. Cao, and D. S. Wong, "White-box traceable cipher text- policy attribute- based encryption Supporting any monotone access structures," *IEEE Trans. Inf. Forensics Security*, vol,... 8, no. 1, pp. 76–88, Jan. 201.

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