RESEARCH ON ENGINEERING APPLICATIONS IN MULTIDISCIPLINARY SECTORS

PART 1

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Research on Engineering Applications in Multidisciplinary Sectors

(Part 1)

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CONTENTS

PREFACE

In the fiercely competitive global environment, scientific analysis of systems under study is fundamental to achieving market leadership. Competitive advantage through superior processes, products, and services is attainable by developing robust knowledge bases and providing easy access to structured databases built on quantitative studies of systems, processes, and technologies. Further, as fashion, taste, and technology continuously evolve, forecasting outcomes and future trends becomes increasingly critical. Part 1 of this book focuses on establishing this foundation by examining emerging trends in computation intelligence and disruptive technologies, equipping researchers and practitioners with the insights necessary to navigate and lead in this dynamic landscape.

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CHAPTER 1

Resource-efficient Key Management in Lightweight Cryptosystems

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Abstract: Effective key management is crucial in lightweight cryptosystems to enable secure communication and safeguard sensitive data in resource-constrained settings. This work thoroughly analyzes lightweight cryptosystem-specific key management strategies that are resource-efficient. We investigate novel key generation, distribution, updating, and revocation methods that balance cryptographic security with efficient resource use. By examining their performance, we illustrate the effectiveness of several essential management techniques in lowering computational overhead, memory, and communication costs. Our research offers essential tips for developing secure, practical, lightweight cryptosystems that can protect data while using few resources, making them suitable for use in Internet of Things (IoT) devices, wireless sensor networks, and other scenarios where resources are scarce.

Keywords: Cryptography, Key management, Lightweight cryptosystems, Resource efficiency, Security.

INTRODUCTION TO LIGHTWEIGHT CRYPTOSYSTEMS

In many applications, cryptosystems are essential to ensure data confidentiality, integrity, and validity, especially in an era driven by digital connectivity and sensitive information exchange. Traditional cryptosystems, while robust, often demand significant computational power and memory, rendering them unsuitable for resource-constrained devices such as embedded systems and Internet of Things (IoT) sensors. Lightweight cryptosystems are specifically designed to address these limitations by reducing memory and computational overhead while maintaining a high level of security. These systems employ streamlined algorithms and compact key sizes to achieve an optimal balance between

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

performance and protection. For instance, cryptosystems like PRESENT, Simon, and Speck demonstrate minimal energy consumption and memory usage, making them ideal for constrained environments [1, 2]. By efficiently safeguarding data without overburdening device resources, lightweight cryptosystems enable secure communications in critical domains such as healthcare, smart cities, and autonomous vehicles [3, 4].

In recent years, several lightweight cryptosystems have been proposed. Examples that stand out include:

1. **PRESENT**: A compact block cipher made for low-resource settings. It uses a small amount of electricity and has a small memory footprint [1].
2. **Simon and Speck**: They are two compact block ciphers created by the US National Security Agency (NSA). They are made to be very effective on limited devices and offer a variety of security settings [2].
3. **LED**: A compact encryption technique appropriate for devices with limited resources. LED offers a nice mix of security and efficiency and has a low memory demand [3].
4. **Grain-128** is a compact stream cipher that works with low-power gadgets. It is made to generate many keystream bits efficiently [4].

These lightweight cryptosystems have undergone extensive analysis and have shown promising results regarding security and efficiency. They provide a viable solution for securing data in resource-constrained environments. Finally, lightweight cryptosystems provide an alternative to regular cryptosystems for devices with limited resources. They concentrate on lowering computing and memory demands while keeping a sufficient level of security. To maintain secure communication and data security in embedded systems, IoT devices, and other resource-constrained applications, it is essential to build lightweight cryptosystems.

IMPORTANCE OF RESOURCE-EFFICIENCY IN KEY MANAGEMENT

Key management that is resource-effective is a crucial component of lightweight cryptosystems. The requirement for resource-constrained environments for secure and effective communication is driving up the demand for lightweight cryptosystems. These compact cryptosystems strive to offer secure communication while consuming little power, memory, and computing resources. In order to achieve this, effective key management strategies are necessary.

Key generation, distribution, and storage are key management aspects in lightweight cryptosystems. While minimizing computational and storage overheads, the main goal is to secure these keys' secrecy, integrity, and

availability. Traditional key management strategies may not be appropriate due to their resource-intensive nature because lightweight cryptosystems operate in limited contexts like IoT devices, wireless sensor networks, and embedded systems.

Lightweight cryptosystems put a particular emphasis on tackling the problems brought on by resource constraints. These difficulties include memory capacity limitations, inadequate computing power, and energy restrictions. Cryptosystems and secure operation of lightweight cryptosystems depend on optimizing key generation, distribution, storage, and update operations.

The optimization of crucial generation algorithms is one of the most essential components of resource-effective key management. Due to their high computational complexity, traditional fundamental generation techniques like those based on Rivest-Shamir-Adleman (RSA) or Elliptic Curve Cryptography (ECC) may not be appropriate for lightweight cryptosystems. Different lightweight key generation methods like NTRU, McElwee, or SFLASH have been proposed to reduce computational costs while retaining security.

Another significant element of resource-efficient key management is efficient key distribution methods. Due to their scalability and performance restrictions, conventional methods like centralized key management structures might not be appropriate for lightweight cryptosystems. Distributed key management solutions, including pairwise key establishment protocols and group key agreements, have been developed to overcome these restrictions. These methods seek to distribute keys efficiently and securely among the involved parties while reducing communication and computational overhead.

Adequate key storage and updating procedures are essential factors in resource-efficient key management. Because lightweight cryptosystems frequently contain little amounts of memory, it is crucial to optimize key storage. The memory footprint of key storage and update activities is minimized by using methods like key hierarchy, key derivation functions, or practical key update algorithms.

Numerous studies have been conducted to create resource-effective key management methods for use in lightweight cryptosystems. For example, Shang *et al*. [5] suggest a simple key management system for wireless sensor networks based on group key agreement. They provide a Key Cluster Tree-based method for efficiently distributing keys across the network with the least processing and communication overhead [5]. In a different paper, Du, Chen, and Zeng [6] offer a key storage and update mechanism based on key hierarchy and symmetric cryptography that is effective for restricted devices.

CHAPTER 2

Short-term Forecasting of Power Generation of a PV Plant through Relevant Atmospheric Parameters Using ML/DL Methods

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Abstract: For power engineers and researchers across the world, forecasting solar power is a nightmare, as the output is entirely dependent on unpredictable climatic changes. Forecasting of power from PV plants is crucial for load scheduling and electrical grid stabilisation. Forecasting using ML/DL solutions is a powerful and popular method throughout the world. Though various studies have been carried out internationally using various AI solutions for 1 hour ahead forecasting of power generation by large PV plants, in the Indian context, there is very research in this domain. This paper proposes a Deep Learning Approach for forecasting the short-term (1 hour ahead) PV output of a 10 MW solar power plant in the West Bengal state of India. The paper forecasts the power output of a 10 MW plant with LSTM. As the atmospheric variables affecting the PV output power are innumerable, relevant physical parameters are selected through correlation analysis/auto and partial correlation. Conventional machine learning techniques and Deep Learning techniques for multi-variate time series analysis have been used to find the forecasting solution. The performance of the various methods is thoroughly analyzed and it was found that LSTM has an edge over other methods.

Keywords: ARIMA, Cloud vector movement, Correlation metrics, Deep learning, LSTM, Machine learning, NASA, Performance metrics, RNN, VAR.

INTRODUCTION

The world has seen the growth of solar power in the last decade as an alternative to conventional fossil fuel power plants. Harnessing solar energy is growing at a faster pace across the globe and India is forging ahead in inducting new major solar PV plants. The future of mankind verily depends on reducing the carbon

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

footprint so as to limit the average global rise in temperature to 1.5 Degrees Celsius from that of pre-industrialized times. PV Power is an important part of sustainable development throughout the world [1, 2]. Solar power is replacing other means of generation in a very fast manner due to its low carbon emission [3]. A brief look into the growth of solar generation can be seen from the chart Fig. (**1**).

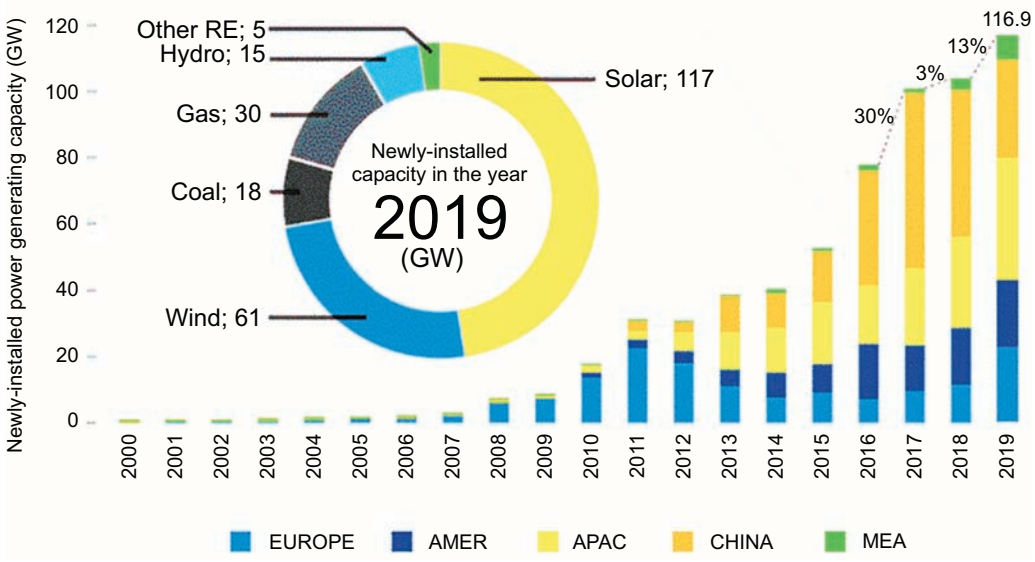

Fig. (1). Growth of solar generation (in GW) year-wise.

A study points out that solar power is a good alternative when compared to coal-based power as the non-renewable energy cost and carbon emission per unit of electricity delivered are estimated as 55% and 64% of that by the reference of a coal-based generation source in China, respectively [4]. Research studies indicate that in the Indian context,(according to a study carried out in West Bengal), the emission of CO_2 was 35 g CO_2 /kWh (units of electricity generation) and it is phenomenally less than the emission of CO_2 when other modes of conventional fossil fuel-based generation are concerned [5].

Unfortunately, the addition of solar plants adds a lot of uncertainty in the grid, as unlike conventional electrical power generating plants, forecasting of solar plants is near to impossible, and throws a great challenge to power system engineers. The chaotic nature of the cloud movements which mars the solar radiance on the ground makes it difficult to forecast the surface radiation [6]. Any forecasting model that does not consider the stochastic characteristic of cloud motion and irradiation on the surface would be inadequate in predicting the PV output power.

Recent studies show that a 25% improvement in PV power output forecast accuracy will result in savings of of 1.56% in the net generation cost [7]. Forecasting can be done at various spatial aggregation levels like control area-level aggregated forecasts are useful for net load forecasting, reserve dimensioning, ramp management, uncertainty handling, *etc* [8 - 10]. Solar power produced by a PV module is numerically equal to the product of cell area, light intensity, cell efficiency, and the number of sunshine hours. Therefore, the prediction of the PV power can be derived from the radiation indeed. It is very challenging to confirm the parameters that affect the light intensity and the extent of its influence on it. According to the horizons of power forecasting, there are different categories of predictions. It varies from minute ahead to days ahead. Short-term forecasting, which is between 0-6 hour time horizon (ahead) is of prime importance for load scheduling for both TSO and DSO [11].

EXISTING TECHNIQUES FOR FORECASTING OF SOLAR PV OUTPUT

Forecasting of PV power can be categorized broadly as physical and statistical. Physical approaches use NWP and Total Sky images. Statistical methods make use of the historical data to train the models. NWP makes use of the dynamic movements of the cloud cover and thus does not require extensive monitoring instruments. NWP models are scalable and effective in large-scale modelling of the atmosphere [12, 13].

Through NWP, effective predictions can be made with vide spatial-temporal resolution, it is not effective for the partially cloudy days with sudden cloud movements. Also, the computation time required is more for the NWP approach for short-term forecasting, 2 hours is required for 2 minutes ahead forecasting. Though the method works fine for very small temporal resolution and a very long time ahead forecasting, its effectiveness for short-term forecasting is not proven.

Nowadays, ANN and DL methods are widely used for combining both physical and historical values and train the statistical models to yield better performance.

Statistical methods are also effective for solar irradiation and PV predictions. Machine Learning/ANN techniques are widely used for enhancing the statistical model performances. These techniques are used for nonlinear mapping between historical data and future values. These methods can be used for forecasting different time horizons also. Like regressive methods, ANNs show better performance in both data-rich/poor conditions [13]. In this study, ANN/ML modelling, *i.e* LSTM, is used as the main technique and compared with other models such as Vector Auto Regression and Random Forest models. The models are analyzed for their performance based on various performance metrics as

CHAPTER 3

Lymphoma Prediction using Random Forests with Robust Mahalanobis Distance and Model Ensemble for Outlier Handling and Overfitting Mitigation

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Abstract: Lymphoma is a cancer of the lymphatic system. It is a heterogeneous disease, with many different subtypes. To improve patient outcomes, early diagnosis and treatment are crucial. This study proposes a new approach for predicting lymphoma using Random Forests with robust Mahalanobis distance and model ensemble for outlier handling and overfitting mitigation. The proposed approach was evaluated on a real-world dataset of lymphoma patients. The model achieved an accuracy of 92.5% on the test set, which is a significant improvement over the accuracy of other approaches. The suggested method has a number of benefits over alternative methods. First, the use of robust Mahalanobis distance for outlier handling can improve the accuracy of the model by reducing the impact of outliers. Second, the use of a model ensemble can improve the robustness of the model by reducing the risk of overfitting. Third, the use of clinical data can improve the accuracy of the model by providing additional information about the patients. The results of this study suggest that the proposed approach can be used to improve the accuracy and robustness of lymphoma prediction. This could lead to earlier diagnosis and treatment of lymphoma, which could improve patient outcomes.

Keywords: Lymphoma prediction, Outliers, Overfitting, Random forest.

INTRODUCTION

Lymphoma is a cancer of the lymphatic system, which is part of the body's immune system. It is a heterogeneous disease, with many different subtypes. Early diagnosis and treatment are essential for improving patient outcomes [1].

Traditionally, lymphoma is diagnosed based on clinical and pathological features. However, these methods are not always accurate and are time-consuming. In recent years, there has been increasing interest in the use of machine-learning

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

methods for lymphoma prediction [2]. Machine learning methods can be used to analyze large datasets of clinical and biological features to identify patterns that are associated with lymphoma [3 - 6]. This improves the accuracy of diagnosis and to identify patients who are at high risk of developing lymphoma [7].

Machine learning is a subset of artificial intelligence that focuses on the development of algorithms and statistical models that enable computers to learn from and make predictions or decisions based on data. Machine learning analyzes data by identifying patterns and relationships within large datasets. It uses algorithms to extract meaningful insights and make predictions based on historical information. Machine learning techniques can automatically adapt and improve their performance as they process more data.

There are a number of challenges in using machine learning methods for lymphoma prediction. One challenge is the presence of outliers in the data. Outliers are data points that stand out from the rest of the data in a significant way. Outliers can have a significant impact on the performance of machine learning models, and can make it difficult to identify accurate patterns in the data. Another challenge in using machine learning methods for lymphoma prediction is the risk of overfitting. Overfitting occurs when a model learns the training data too well, and it is unable to generalize to new data and can lead to inaccurate predictions.

In this study, we present a novel approach that combines Random Forests with robust Mahalanobis distance and model ensemble techniques within a framework of neural network clustering and optimal tuning. Our approach aims to enhance the accuracy of lymphoma prediction models and effectively handle outliers and overfitting. The results of this study suggest that the proposed approach can be used to improve the accuracy and robustness of lymphoma prediction.

LITERATURE REVIEW

A study [8] uses random forests, a type of ensemble learning algorithm, to predict lymphoma. The study uses two techniques to handle outliers and mitigate overfitting: robust Mahalanobis distance and model ensemble. The study provides an accuracy of 90%, and can be improved by using more sophisticated machine learning techniques.

A machine learning-based method for classifying lymphomas is shown in a study [9]. Several machine learning algorithms, such as Random Forests, Support Vector Machines, and Naive Bayes, were used by the authors. On a real-world dataset, they tested the algorithms. The results showed that Random Forests had the highest classification accuracy.

A deep learning-based strategy for lymphoma prediction is presented in a study [10]. The authors extracted features from medical photos using a convolutional neural network. They tested the algorithm on a real-world dataset and showed that it can predict lymphomas with a high degree of accuracy.

The study [11] suggests a unique method for lymphoma prediction that uses machine learning and gene expression data. Based on gene expression data, the authors built a Random Forest classifier to forecast lymphoma risk. They tested the classifier on a real-world dataset and showed that it could predict lymphomas with a high degree of accuracy.

An ensemble learning strategy for lymphoma prediction is suggested in a study [12]. To determine lymphoma risk, the authors combined Random Forests, Support Vector Machines, and Naive Bayes. On a real-world dataset, they analyzed the ensemble and showed that it can predict lymphomas with a high degree of accuracy.

Using machine learning and clinical variables, the study [13] suggests a hybrid model for predicting lymphoma. Based on gene expression data and clinical characteristics, the authors built a Random Forest classifier to forecast lymphoma risk. The study shows that it can predict lymphomas with excellent accuracy.

In another study [14], the researchers use machine learning methods to predict lymphoma in patients with B-cell Chronic Lymphocytic Leukemia (CLL). The study found that Random Forests was the most accurate method with an accuracy of 92.5%.

Another study [15] presents a novel approach for Lymphoma prediction using decision trees. The study found that the decision tree model achieved an accuracy of 90.5%.

Another study [16] shows a comparison of machine learning methods for lymphoma prediction in children. The study compared the performance of four machine-learning methods for lymphoma prediction in children: Random Forests, Support Vector Machines, K-Nearest Neighbors, and Neural Networks. The study found that Random Forests was the most accurate method, with an accuracy of 88.5%.

A study [17] proposes a recursive feature elimination approach for lymphoma prediction. The study found that the recursive feature elimination model achieved an accuracy of 91.5%, which is better than the accuracy of the original model without feature elimination.

CHAPTER 4

Modeling the Manufacturer-retailer Supply Chain Inventory under Shortages and Inflation with Weibull Degradation

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Abstract: Supply chain is more complex than working individually, but the results of working together are better than those of trying it alone. Better communication between supply chain members is highly needed to get the correct information about the material and to make the arrangement easy. Under this model, the supply chain consists of a manufacturer and a retailer. They work together to make things more stable. It is well known that stock out is unavoidable while running any business. The present study attempts to study the effect of supply chain models under shortages. Shortages are allowed and fully backlogged. Every firm experiences items degradation during storage, and most of the time these items cannot be recovered. Using deterministic demand rates, this study examined the Weibull distribution deterioration rate and inflation. The effect of inflation and the time value of money were examined under various inflation and discount rates. Mathematical expressions were derived to find the cycle time that is optimal for all cost structures. We demonstrate the model using sensitivity analysis with numerical examples.

Keywords: Inflation, Inventory, Shortages, Supply chain, Weibull deterioration.

INTRODUCTION

Retailers play a significant role in enhancing the efficiency of manufacturers by providing critical market insights, managing demand fluctuations, and ensuring product availability. The information gathered by retailers on consumer preferences and purchasing patterns helps manufacturers optimize production schedules, reduce overproduction, and minimize wastage. Retailers also act as a buffer, absorbing excess inventory during unexpected demand surges, which

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

improves supply chain responsiveness. Additionally, effective collaboration between retailers and manufacturers fosters better demand forecasting, allowing manufacturers to meet consumer demands without overstocking. This symbiotic relationship contributes to cost savings and improved service levels, benefiting the overall supply chain performance. The retailer and vendors are an integral part of the trade cycles but differ in their functions. A retailer sells the product to the end-users, while a vendor supplies the products. The integration of vendors and buyers in supply chains is one of the key aspects of doing business today. Relationships between businesses are essential both economically and for improving market structure. Gautam and Khanna [1] have presented a framework that is aimed at facilitating sustainable inventory management with the involvement of vendors and buyers. In another model, Tiwari *et al*. [2] have provided a two-level partial trade credit policy. In this model, items are considered to be deteriorating in nature, with an appropriate stockout. Another model has been developed on a two-stage supply chain by Darom *et al*. [3]. In this article, a recovery model has been presented for the case of supply disruption. For retailers and manufacturers, safety stock has been considered while carbon emissions have been considered for transportation. Another study conducted by Panja and Mondal [4] presented an unreliable production system. The study focuses on the effect of the green degree on the production cost. Bai *et al*. [5] have developed a model incorporating greenhouse gas emissions. In this supply chain model, the level of green technology has been used during production to predict demand. In Sainathan and Groenevelt [6], they study the coordination and management of a supply chain with vendor-managed inventory. Rani *et al*. [7] have derived the optimal replenishment policies for the deteriorating inventory model items considering the end-of-life treatment for the used products. The demand for the product has been considered to be dependent on the carbon emitted from the product. Vagueness has also been taken into account for the model. A recent literature review by Utama *et al*. [8], has shed light on the IPP modelling issues. In this review, the authors have presented a comprehensive study of 102 papers published in the last 30 years on this issue.

For products, deterioration can be defined as decay, damage or evaporation. Beverages, gasoline, flammable liquids, and foodstuffs are all items prone to deterioration. The phenomenon of degeneration cannot be ignored when developing integrated models. Deterioration has received a lot of attention over the past couple of years, making it a central concern in inventory management. Numerous authors have examined inventory degradation in the integrated models. Analysis of the economic effects of production quantity for items that have a deteriorating nature with partial back ordering. Handa *et al*. [9] created a supply chain problem where exponential demand and multivariate production/remanufacturing rates for deteriorated products are considered.

Khakzad and Gholamian [10] presented an inventory model, which includes decaying items. Similarly, another model of inventory for decaying items with nonlinear price and linear stock dependence is discussed by Halim *et al*. [11].

As inventory accounts for a significant portion of a company's financial assets, it is heavily influenced by the market's response to various situations, especially inflation. Currently, the global economy is undergoing a period of inflation. It can be defined as an anomalous situation when increasing purchasing power causes or results in an increase in prices. An extended period of prolonged inflation results in the disruption of society on all levels - economic, political, social, and moral. The time value of money and inflation has also drawn the attention of researchers. Their importance cannot be overstated. Accordingly, we have incorporated inflation into our inventory system. The effect of inflation was taken into account. While the discounted cash flow was used under the finite time horizon. In a time-varying demand environment with an inflationary environment, a study is required on deterioration rates with a shortage. The link between inflation and stock-based demand with shortages is discussed. Some other articles developed along the same line of research such as Chakraborty *et al*. [12], Saha and Sen [13] and Singh and Rana [14]. Chakraborty *et al*. [12] have investigated a deteriorating inventory model under inflation. In this paper, they have provided the optimal replenishment policies for seasonal products with trade credit. Saha and Sen [13] have designed a model considering the stockout. The shortage was assumed to be partially backlogged. Under the influence of inflation, the model was designed to obtain the minimum inventory cost along with the optimal replenishment policy. Furthermore, a deteriorating inventory model with a flexible multivariate demand rate considering the time-varying storage cost was presented by Singh and Rana [14].

Aside from that, in the event of a shortage, there are customers who would be willing to wait patiently for backorders to arrive. Others, however, may turn elsewhere for their purchases. It has reflected on the possibility of constant partial backlogging over the shortage time period in their inventory models. It is common that customers have become accustomed to the idea of a delay in shipping and are prepared to be patient for a short time. In order to ensure that they get the choice they want. This has proposed an inventory model specifically to handle decaying commodities under conditions of stock-dependent demand. This has designed an inventory model that consists of deteriorating items associated with a stock-dependent demand. Shortages of shipments are permitted with a partial backlog. A discussion of the optimal replenishment schedule used when replenishing deteriorating items based on stock-dependent demand and partial backlogs has been discussed by various authors. Kumar *et al.* [15] have developed an model with shortages under inflationary circumstances and green investment.

CHAPTER 5

Solution of the Problem of Services with Incorrect QoS Information Datasets in Knowledge Discovery and Data Mining

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Abstract: An analytical technique called knowledge discovery employs computers to sort through and analyze enormous volumes of data to derive information from the data. Knowledge discovery technologies have been highly beneficial for many enterprises, including networking, marketing, sales, healthcare organizations, and financial institutions. Earlier, we used the data miner tool for analyzing huge volumes of data to derive knowledge from data and examined the uses of data mining tools, contrasting their boundaries with one another, and figuring out the performance of the data miner tool. For instance, in a dispersed network environment, there may be many network services that handle a lot of data and knowledge and provide users with applications based on Web services and Service-Oriented Architecture technologies. As a result, one of the most pressing issues is the need for a workable web service discovery technique for the data and knowledge discovery process in the complicated network environment. Knowledge discovery has several benefits across many industries. The process of knowledge discovery, which turns information into knowledge that can be applied, has improved the decision-making standard. It also makes speedy data analysis possible. The techniques for knowledge discovery and data mining are reviewed in this study. To determine the best approach, the performance of two well-known data mining classifier algorithms, ID3, J48, and Naive Bayes classifier algorithm has been examined using various parameters.

Keywords: Data mining, ID3, J48, Knowledge discovery, Machine learning, Naive Bayes classifier algorithm, Quality of Service.

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INTRODUCTION

The procedures and assurances that ensure the knowledge discovery process satisfies particular performance and reliability standards are referred to as knowledge discovery, Quality of Service (QoS). This covers factors including system reliability, accuracy and relevance, scalability, resource use, and data processing efficiency. While controlling operational and computational limitations, QoS in knowledge discovery guarantees that the procedure is dependable, effective, and yields significant insights. It has been manually possible to extract trends and patterns from data for centuries. When performing manual extraction in the past, regression analysis was utilized. Data gathering, storage, and data manipulation capabilities have all accelerated due to advances in computer technology [1]. Because datasets are becoming larger and more complicated, automated data processing methods like support vector machines, decision trees, and neural networks have been added to the manual data processing process. Using these tools to find unnoticed trends and patterns in the data is hence known as knowledge discovery [2]. A rather unique process is knowledge discovery. The user-provided results, like those from regular database operations, are something the user was previously aware of. On the other side, data mining harvests and offers information that the user was unaware of, such as the connection between consumer behavior and factors that defy logic. And because the information is unknown beforehand, it is harder to jump to use the system's output to solve a business problem [3]. Utilizing data mining technologies, businesses can make knowledge-driven, proactive choices by forecasting future trends and behaviors. Data mining methods provide for the quick and effective resolution of business problems that were previously time-consuming [4]. These technologies analyze datasets to discover hidden patterns and predictive data that experts might overlook because it is outside of what they would normally anticipate [5].

The techniques for knowledge discovery and data mining are covered in this study to determine which strategy is the most successful, in this study, we analyze the performance of three well-recognized data mining classifier algorithms: ID3, J48, and Naive Bayes [6].

LITERATURE SURVEY

The difficulties brought on by inaccurate QoS data include the possibility of faulty analyses and the identification of dubious patterns or trends, as well as processing data of low quality might take more time and processing resources, which lowers system efficiency overall and Decision-making processes that rely on the acquired insights may be hampered by inaccurate QoS indicators. Machine

learning algorithms build a model considering test data, known as planning data, to seek after decision production without being customized [7 - 12]. Machine learning is used in a wide number of applications, for instance, in medicine, email filtration, speech recognition, and computer vision, where it is troublesome or non-serviceable to utilize customary techniques to complete the expected task.

We focus on defining a cutting-edge method that companies can use to anticipate QoS for their active workflow instances by using data mining techniques for previous data. The technique is broken down into three distinct phases Fig. (**1**), which are covered in the following subsections. The methodology presented in this study marks a significant shift from the method.

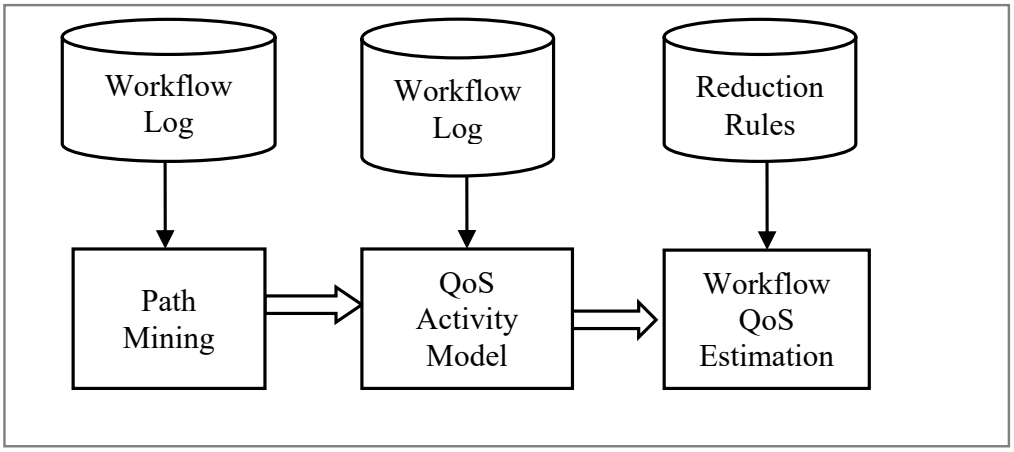

Fig. (1). Workflow with QoS Parameter.

METHODOLOGY

Incorrect Quality of Service (QoS) data can have a significant impact on e-commerce companies, as they rely on it for smooth operations, optimized website performance, and a positive customer experience. Key QoS metrics, such as response times, transaction latencies, and server uptimes, inform decision-making processes for resource allocation, marketing strategies, and user personalization. The company began noticing a decline in customer satisfaction and revenue. Investigations revealed that incorrect QoS data caused by outdated monitoring tools and inconsistent reporting was the root of the problems: analytics, overprovisioning, and poor personalization.

In this study, the Naive Bayes classifier technique is used for workload clustering. Table **1** lists the various workload types and the QoS requirements that were taken into account.

CHAPTER 6

Pioneering Progress: A Critical Review of Smart City Mission in India- Vision, Initiatives, and Challenges

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Abstract: India's development journey towards becoming a self-sustained, technology-driven, and smart city nation meets with the urgent need to address the challenges of urban development, including infrastructure, quality of life, and sustainability. The transition is akin to piecing together a complex puzzle, with each component representing a facet of technological progress and necessitates the incorporation of state-of-the-art technologies such as Artificial Intelligence (AI), Internet of Things (IoT) devices, data analytics, and advanced communication systems to digitalize and revamp city infrastructure. To materialize this vision, it is equally important to have smart governance to enforce these changes and active participation of the citizens. This paper assesses India's current smart city landscape, spanning major cities, towns, and villages, identifies existing gaps, and proposes a meticulously crafted roadmap to shape India's future.

Keywords: Artificial Intelligence (AI), Citizen engagement, Smart Cities Mission (SCM), Sustainability, Urban Development.

INTRODUCTION

The concept of a 'Smart City' is ambiguous and is generally outlined in the context of its associated resources, technology, and administrative exercises in practice focusing on the sustainable development and welfare of its residents [1]. Researchers [2] have stated that there is not a single universally accepted definition for a smart city, even within India. So, in an attempt to define it the phrase 'Smart city' is strongly correlated with terms like 'Urban Intelligence'

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

[3, 4], 'Intelligent city', 'The Intelligence associated with Urban Life', *etc*., and is subject to vary with location, its residents, government policies, and resources.

Kumar *et al*. proposed the definition of a 'Smart City' using the 3-C concept (Competence, Convenience, and Cleverness): A city becomes a smart city if it can secure a quality life with the consolidation of cutting-edge technologies while working on the environmental, social, and economic perspective of urban life in a competent, convenient, and cleverer practice [5]. The urban development of the cities can be achieved with the implementation of ICT (Information and Communication Technologies) or its sectors like IoT (Internet of Things), AI (Artificial Intelligence), *etc* [6 - 8]. That is the reason why smart cities are generally recognized as the output of top-down urban planning driven by pitchers of state-of-the-art technology through corporate storytelling while following the international policy flows. Such a description of smart cities has presented them with different naming options like digital, tech, wired, intelligent, information city, or sustainable city [9].

Smart cities act as a deviation from the effects of the growing population and their migration towards cities. For maintaining the sustainability of society, economy, and environment under such circumstances, smart cities prove to be the far-out way [10].

With the primary objective to mutate Indian cities into "smart cities" that are sustainable, technologically advanced, and facilitate a high quality of life for its residents, the Government of India (GoI) has taken several initiatives, plans, and actions. One such mission is the Smart Cities Mission (SCM), an ambitious plan of urban renewal launched in June 2015 focussed on 100 major competitively selected cities in India [11]. While the SCM limits its focus to certain cities and implementations, the Ministry of Housing and Urban Affairs (MoHUA) intends to take the successful projects and practices from SCM to 4,000 cities, each with a reasonable population, by transforming its mission into a widespread movement. And also to maximize benefits, simultaneously contemplating the integration of national programs from Union ministries into these smart cities.

In the following sections, we will review the literature on Smart City in Section 2, followed by some other initiatives and implementations that are underway such as India Urban Data Exchange (IUDX), Artificial Intelligence Strategy for Urban India (AISUI), Special Purpose Vehicles (SPVs), and Smart City Standards (SCSs) in Section 3. Thenceforth we will discuss the challenges faced along with the conclusive remarks on the current vision and the futuristic view of it in Sections 4 and 5, respectively.

LITERATURE REVIEW

A study by Praharaj *et al*., 2019 connected the universal concept of a smart city with the provincial notion of a smart city in India to assert the description of a smart city at the Indian level. This survey provided the impression that urban development in India highlights the discrepancies between top-down smart city characterization and local inclination as per the practical situations. This research was conducted using a questionnaire having two parts: ranking the possible definitions of smart city as per the urban concern in India and rating against the concepts or names associated with the smart city on the Likert Scale [9, 12].

An analysis by Kumar *et al*., 2018 concluded that the following parameters are important for their consideration: features, eligibility and selection criteria, and mission, policies, and schemes. The smart city features kept under consideration for development in India are shown in Fig. (**1**) while Fig. (**2**) shows the three-step selection process followed for a smart city [5]. The Smart City Mission of India focused on urban reformation with the help of a few policies or schemes as shown in Fig. (**3**) [13].

Fig. (1). Smart City features considered under SCM in India.

Research by Vijai and Sivakumar, 2016 explores the application of Machine Learning (ML) techniques in the field of smart city management mainly focusing on smart water management. Various aspects included in smart water management include water demand forecasting, water quality monitoring, anomaly detection, *etc*. This study presented a way to utilize the data generated by IoT for the welfare of the city's population as well as the government [14].

CHAPTER 7

Blockchain Based Hybrid Encryption Scheme For Security Enhancement in Cloud Computing

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Abstract: Cloud computing applications are becoming more popular as a result of several benefits, such as reliability, storage management, and data accessibility. Data saved in the cloud environment can be accessed at any time and from any location *via* network access. The enormous volume of user data sharing raises the likelihood of assaults, and unauthorized users have easy data access. Because of its distributed and cohesive nature, blockchain technology improves cloud security. The cryptographic methodologies employed in blockchain for hash generation across blocks boost data security. The blockchain-based security technologies enable strong data security in the cloud environment. As a result, the hybrid elliptic curve, Elgamal technique with blockchain, is provided for application.

Keywords: Blockchain technology, Cloud computing, Cryptographic hashing, Lightweight data encryption, Optimization.

INTRODUCTION

Over the last few decades, cloud computing has emerged as the best computing paradigm, incorporating many computing ideas such as parallel, grid, distributed, and so on [1, 2]. The cloud services allow individuals and businesses to use software and hardware that is managed by third parties in many remote locations [3]. Furthermore, cloud services offer an efficient type of demand-based data outsourcing. This reduces the complexity of controlling data storage, but it is badly harmed by security concerns [4, 5]. Security is an essential concern in cloud computing, and the issue must be addressed due to the increasing popularity of cloud computing [6, 7]. In the available literature, various techniques for data security are presented [8 - 11].

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Blockchain is the newest technology in the digital era that promises improved data security. Blockchain is a distributed ledger that uses a separate computer to store data and perform secure data transfers [12]. Blockchain employs a cryptographic mechanism to organize data into specific structures known as blocks. The blocks are interconnected and create the structure's chain. The use of blockchain for data security in information exchange has gained substantial appeal [13]. This reduces the security risk of data transactions and provides data transparency to various users in a scalable manner. The cryptography technology is used to secure the data records. Blockchain protects data transactions from hackers and offers greater security than data kept in a traditional database [14]. The blockchain concept is frequently used to enhance data security by reducing processing and transmission overheads. Blockchain is a difficult subject in cryptography, to building methods to prevent unwanted individuals from accessing data. Prior to storing the data in the cloud, it secures data confidentiality by providing the defined data security [15].

RELATED WORK

By combining a cryptosystem with a GA (genetic algorithm), Muhammad Tahir *et al*. [16] established a novel cloud data security approach. Here, data security and secrecy were provided using the GA optimization approach. The public and private keys are generated by GA and used in conjunction with the encryption algorithms to encrypt and decrypt data. A hybrid cryptographic solution to data protection in cloud computing was presented by Chinnasamy *et al*. [17]. To provide data security, a hybrid approach has been created that combines blowfish optimization and ECC. The problems with symmetric and asymmetric data are resolved by the hybrid methodology.

An innovative hybrid cryptographic method for data privacy in cloud computing was created by Ali Kadhim Bermani *et al*. [18]. Here, the data can be secured using a hybrid data encryption technique made up of the message digest algorithm (MD-5) and Blowfish, AES, *etc*. To attain the best security, this hybrid technique combines hashing and symmetric encryption. An RE technique (randomized encoding) was presented by Parmod Kalia *et al*. [19] for enhanced data security in cloud environments. The proposed RE technique was used to change the data by adding random noise from the pre-existing scattered data. A data security framework in the cloud was created by Indira *et al*. [20] utilizing a random round encryption procedure. Here, a round, random key was taken into consideration for better cloud data security.

The examination of existing methodologies identifies the numerous difficulties that exist in existing works. The authentication method is more complicated in the

present schemes. Unauthorized users are gaining access as a result of a lack of data privacy. In the event of providing data security by a cryptographic approach, and losing the original data, the performance of the present ways needs to be improved further by employing the improved approaches. As a result, the difficulties prevalent in existing schemes are addressed by suggesting a hybrid method utilizing blockchain technology.

PROPOSED METHODOLOGY

This study describes a hybrid data encryption system with blockchain-based security enhancements for cloud computing. Users first register their data in the cloud for secure data storage. The ECC technique is used to generate appropriate keys for data encryption. Following that, users submit their data for authentication, and the FSA technique is used to determine the best key. The hybrid technique is then utilized for the encrypted data using the chosen keys. The encrypted data is then transferred to a cloud server for storage. The cloud server generates blocks for secure data storage using blockchain technology and the SHA-256 hashing technique at this point. Finally, the PoA scheme is employed to validate data security. After this step, the generated ciphertext is transferred to the cloud server for storage purposes. At this stage, the cloud controller creates blocks for storage of data, where one block is created for each data separately. Fig. (**1**) depicts a schematic diagram of the proposed methodology.

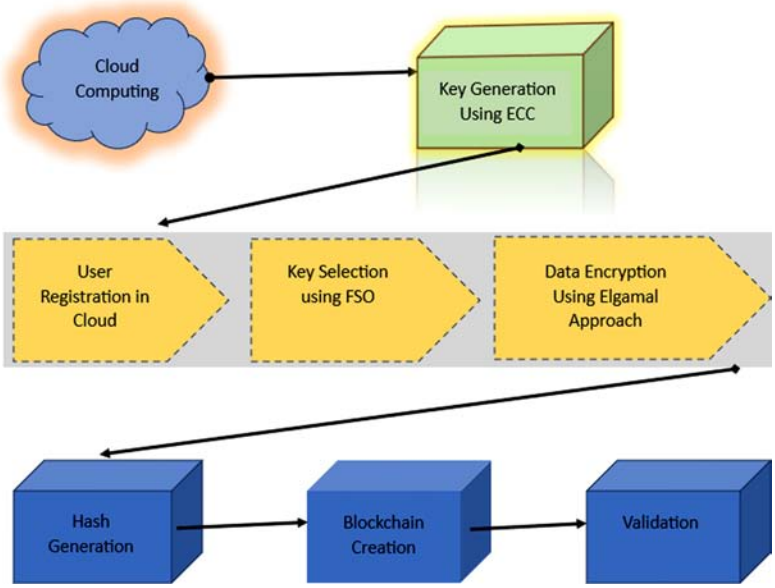

Fig. (1). Schematic diagram of the proposed methodology.

CHAPTER 8

Advancements in Brain Tumor Detection: A Comprehensive Survey of Machine Learning Techniques for Human Diagnosis

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Abstract: Early and accurate detection of brain tumors is important for good diagnosis and treatment strategies. Leveraging advances in machine learning, researchers are using these techniques to accurately and effectively diagnose brain tumors. This study provides an investigation of the current state of machine learning for the detection of brain tumors in human subjects. We classify available data according to different machine learning algorithms, data sources, extraction methods, and measurement models. We also provide an in-depth look at the challenges faced in the field and suggest potential avenues for future research and development. This article presents a way to understand the combination of machine learning and brain tumor detection, revealing the evolving landscape of diagnostics.

Keywords: Brain tumor, CNN, Image processing, MRI, Segmentation.

INTRODUCTION

The brain, an intricate and intricate organ within the human body, orchestrates an intricate network of cells collaborating harmoniously. However, the development of brain tumors disrupts this delicate harmony, stemming from irregular cell division that generates aberrant patterns. This unchecked proliferation of cells exerts a profound influence on the brain's physical and behavioral functions, instigating cellular damage and dysfunction [1].

In the realm of medical diagnostics, the manipulation of digital images assumes paramount importance, particularly in the context of processing magnetic resonance (MR) images. Within the medical domain, X-ray images find frequent application in the prediction and identification of tumors residing within the body. Strikingly, brain tumors afflict both children and adults alike, occupying a

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

significant portion of the brain's spatial landscape. Their growth transcends anatomical boundaries, spanning across the cranium and often engaging in a dynamic interplay with the brain's functional activities. Alas, these tumors can precipitate the onset of cancer, which accounts for approximately 15% of global mortality. This worrisome statistic is indicative of the escalating incidence of cancer cases, evoking concern on a global scale.

Fig. (**1**) serves as a visual depiction substantiating the presence of brain tumors. Unearthing the existence of these tumors poses a formidable challenge in contemporary medical practice. More importantly, interferential abnormalities during magnetic resonance imaging (MRI), computed tomography (CT) scans, and X-ray procedures aid the teaching process. Brain tumors are characterized by specific symptoms such as

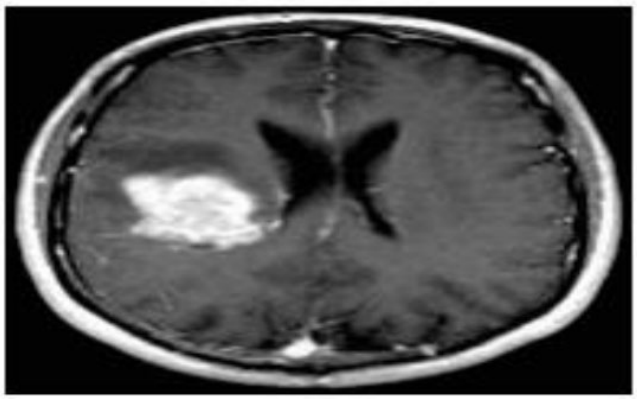

Fig. (1). Presence of brain tumor.

seizures, impaired motor functions, vertigo, heightened anxiety, sensory numbness, speech impairments, and hormonal fluctuations. Furthermore, alterations in both movement patterns and behavioral traits manifest as additional manifestations of nervous system involvement [2, 3].

Human expertise plays a pivotal role in achieving the utmost precision in diagnosis, as it hinges upon a nuanced comprehension of MRI scan interpretations. Mitigating the potential for misdiagnosis and erroneous tumor identification remains paramount. However, the realm of digital imaging offers a potent avenue, rendering the observation and recognition of tumors an endeavor marked by enhanced simplicity and reliability.

Central to the focus of this study is the concept of image segmentation within the context of therapeutic intervention. This domain confronts the formidable challenge of accurately delineating images of brain pathologies. Radiologists,

equipped with an array of diagnostic tools such as CT scans and MRIs, assume a crucial role in patient assessment. Their scrutiny encompasses the intricate landscape of brain structure, sizing up tumors, and harnessing the informative potential of MRI images [4] to pinpoint the tumor's precise location.

In sum, this study's core thrust revolves around the intricate task of image segmentation in the context of therapeutic applications. This undertaking is underpinned by the invaluable insights of seasoned medical professionals who leverage the capabilities of digital imaging to unravel the intricacies of brain disorders. The intersection of human expertise and technological advancements underscores the collective effort aimed at attaining unparalleled accuracy in diagnosing and characterizing brain tumors.

Illustrated in Fig. (**2**) is the depiction of brain cells within a brain tumor, facilitated by employing a robust magnet coupled with weak radio waves to generate three-dimensional images of glandular structures through Magnetic Resonance Imaging (MRI). A noteworthy advantage of MRI technology lies in its absence of ionizing radiation, making it a safer diagnostic tool. Furthermore, the potential of MRI scans is further amplified by leveraging image processing techniques to enhance diagnostic precision. Brain imaging has an important place in the field of medical imaging, revealing the hidden inner workings of the body's imperceptible diseases. The resulting medical images reduce the burden on patients and doctors and also enable accurate diagnosis. This technique is the basis of mathematics that provides a clear image representation [5].

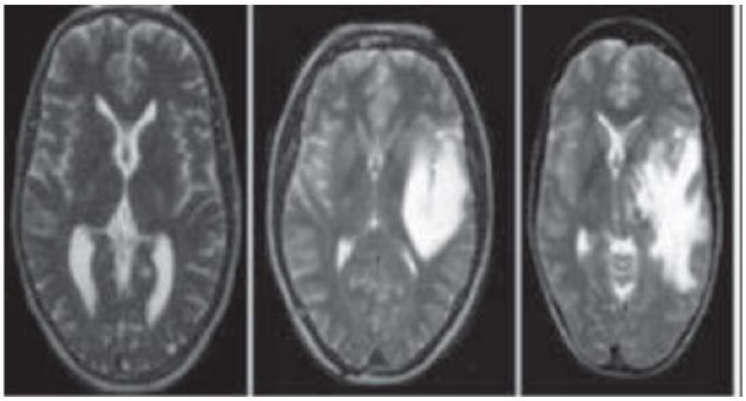

Fig. (2). (**a**) Normal brain (**b**)Benign tumor (**c**) Malignant tumor.

Imaging to identify brain tumors has been used for decades. Research endeavors have yielded an array of semi-automatic and automated image processing techniques for brain tumor detection. However, it is noteworthy that many of

CHAPTER 9

Comparative Analysis of Weld Quality of Gas Metal Arc Welding with Pulse Current of High-Strength Low-Alloy Steel and Stainless Steel

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Abstract: Gas Metal Arc Welding (GMAW) with pulse current has gained prominence as a versatile technique for joining various materials, including high-strength low-alloy steel (HSLA) as well as stainless steel. This study aims to perform a comparative analysis of GMAW with pulse current applied to these two distinct materials in terms of weld quality and microstructural characteristics. The research methodology involved laying out of weld bead on both HSLA and stainless steel plates separately, with GMAW performed under identical welding conditions but varying pulse current parameters. Weld bead geometry and microstructural analysis were carried out to evaluate the welds' quality and performance.

Results indicate that pulse current GMAW exhibited notable differences in weld bead profiles and others, including the penetration characteristics between HSLA and stainless steel. Microstructural examination revealed distinct grain structures and phase compositions in the fusion zones of the two materials. Mechanical tests demonstrated variations in hardness properties, highlighting the influence of pulse current on the final weld properties. In conclusion, this comparative analysis sheds light on the nuanced effects of pulse current GMAW on high-strength low-alloy steel as well as stainless steel welding. The findings provide valuable insights into optimizing welding parameters for these materials, enhancing weld integrity, and tailoring mechanical properties to meet specific application requirements.

Keywords: Gas metal arc welding (GMAW), High strength low alloy steel (HSLA), Pulse current, Stainless steel, Weld quality.

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

INTRODUCTION

GMAW, also frequently called Metal Inert Gas (MIG) welding, has been a staple in modern manufacturing and construction industries for joining a wide range of metallic materials. This versatile welding process involves the fusion of metals through the controlled application of heat, with a consumable electrode and an inert shielding gas [1 - 4]. Over the years, GMAW has evolved, giving rise to innovative variations such as GMAW with pulse current, which offers enhanced control and potential improvements in weld quality and mechanical properties [5 - 7].

In industrial applications, the choice of welding technique and parameters significantly influences the quality and integrity of welded joints. Two materials of immense importance in engineering and manufacturing are High Strength Low Alloy (HSLA) steel, as well as stainless steel [8 - 10]. HSLA steel is lauded for its excellent combination of strength, toughness, and weldability, making it a prime candidate for structural components [11 - 13]. On the other hand, stainless steel is renowned for its resistance to corrosion and staining, rendering it invaluable in environments where durability and hygiene are paramount [14, 15]. As industries continue to demand higher performance and reliability from welded structures, it becomes crucial to optimize welding parameters for these materials. The research at hand aims to conduct an extensive comparative analysis of GMAW with pulse current applied to HSLA steel and stainless steel [16 - 18]. The primary objectives of this study are threefold.

Weld Bead Geometry and Penetration Characteristics Governing Quality of Weld

This research seeks to investigate the impact of different pulse current parameters on the weld bead geometry and penetration characteristics for both HSLA steel and stainless steel. By understanding how pulse current influences the fusion of these materials, we can glean insights into optimizing weld strength and integrity.

Microstructural Evolution: The evolution of microstructure within the fusion zones of weld joints is a critical determinant of their mechanical properties. This study will meticulously analyze the microstructural changes in both HSLA steel and stainless steel welds under differing pulse current conditions, shedding light on how pulse current influences grain structure.

Mechanical Properties: The third objective of this research is to assess the mechanical properties of welded joints, including hardness. By systematically varying pulse current parameters, we can ascertain the relationship between

welding conditions and resultant mechanical attributes, aiding in the optimization of welded components for specific applications.

The significance of this research is underscored by the importance of HSLA steel and stainless steel in various industries. From automotive manufacturing to aerospace engineering, and from construction to medical equipment fabrication, these materials underpin a myriad of applications [19 - 24]. Through a comprehensive investigation of GMAW with pulse current on HSLA steel and stainless steel, this study aims to provide practical insights that can guide the welding process, enhancing the quality and performance of welded structures. By elucidating the intricate interplay between welding parameters and resulting weld quality and mechanical properties, we aspire to empower engineers and manufacturers with the tools necessary to produce welded components that meet the rigorous demands of modern industries.

EXPERIMENTATION

Two distinct materials were chosen for this study: HSLA steel and stainless steel. The chemical compositions of the materials are presented in Table **1**. Both materials were selected due to their widespread use in various industries and their differing properties. The thermal properties of HSLA steel are melting temperature 1420-1460 ^{0}C, specific heat capacity 470 J/kg-K, thermal conductivity 51 W/m-K, and latent heat of fusion 250 KJ/Kg. The thermal properties of stainless steel (304) are melting temperature, 1400 - 1450°C, specific heat capacity, 530 J/kg-K, thermal conductivity, 16.2 W/m-K, and latent heat of fusion, 260-285 KJ/Kg.

Table 1. Chemical compositions of HSLA and stainless steel.

Materials	Chemical composition (Wt. %)												
	C	**Si**	**Mn**	**Ni**	**Mo**	**Cr**	**Cu**	**Nb**	**Ti**	**V**	**Al**	**P**	**S**
HSLA Steel	0.13	0.3	1.34	--	--	0.003	0.037	0.05	0.020	0.042	0.08	0.019	0.015
Stainless Steel (304)	0.087	0.54	1.42	7.5	0.35	21.1	0.20	--	--	--	--	0.012	0.015

The welding experiments were conducted using a welding machine, ESAB Aristo 2000 – LUD 450 UW, equipped with a pulse current capability. The setup consisted of a welding torch, a workpiece clamping mechanism, and a shielding gas supply. A constant voltage (CV) mode was employed, and the pulse current parameters were systematically varied. The shielding gas used was commercial argon, keeping the flow rate at 18 l/min. Beads were deposited on both plates, keeping pulse and other parameters the same using standard welding procedures. The plates were cleaned, aligned, and clamped securely in the welding fixture

CHAPTER 10

The Influence of Laterite Soil on the Strength Characteristics of Lightweight Concrete

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Abstract: Cellular lightweight concrete is a resourceful material that is made up of cement, fly ash, and protein-based foam. Its strength is lower than conventional concrete, so it is useful for a non-load-bearing structural element. Cellular Lightweight Concrete (CLC) is a type of concrete that contains a high volume of tiny air bubbles or cells, which give it a lower density and lighter weight compared to traditional concrete. CLC is known for its insulating properties and is used in various construction applications where lightweight and insulating materials are required. As the research shows that the LWC has a lower modulus of elasticity, lower coefficient of thermal expansion, higher inelastic strains, more voids between particles, and a more continuous contact zone between the aggregates and paste, and so on. These properties act as factors of attraction for the using LWC over traditional concrete. Lightweight concrete holds its voids between the different admixtures and stops the development of laitance layers or cement film when placed on the walls. In this experimental study, the compressive strength of lightweight concrete (LWC), as well as the compressive strength of lightweight concrete with partial replacement of laterite soil, has been investigated. After partial replacement of fine aggregates with laterite soil, the structural strength after 7-14 days was less compared to conventional LWC. But at 28 days, LWC with laterite soil had obtained its complete strength. The average reduction in its weight was around 17% as compared to conventional lightweight concrete.

Keywords: Cellulose resin, Compressive strength test, Conventional concrete, Laterite soil, Lightweight concrete.

INTRODUCTION

The current scenario shows that as construction work increases, the use of concrete also gets higher. To minimize energy consumption, environmental pollution, and construction costs, Laterite soil can be used over sand. CLC often

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requires less cement compared to traditional concrete, which reduces its carbon footprint. This eco-friendly aspect has contributed to its popularity in an era of increasing environmental awareness. The entrapped air bubbles in CLC also contribute to sound insulation. This makes it an effective choice in projects where noise reduction is a priority, such as in soundproofing walls. Cellular lightweight concrete (CLC) generally focuses on green technology and is interpreted as being a possible sustainable material. While CLC may have a slightly higher initial material cost, it often leads to cost savings in other areas. Its lightweight nature reduces the structural requirements, leading to cost savings in foundations and structural elements. Additionally, its insulating properties can lower energy bills in the long run. Strong oxidizing and leaching conditions prevent a wide range of rocks from weathering, allowing laterite soil to be rich in iron oxide. CLC, also known as foamed concrete, is widely used for construction purposes as it has various advantages and prevailing usage over traditional concrete. The weight of CLC is found to be comparatively less, around 17%, as compared to conventional lightweight concrete. As the CLC is a non-load-bearing element, it is mainly used for aesthetic purposes, partition walls, and so on.

In that regard, it is vital to continue researching the properties of lightweight concrete as well as its compressive strength when partial laterite soil replacement is used. Laterite soil is a naturally available material as it doesn't need any mining or other processes, which makes it cheap.

LITERATURE REVIEW

The study by **Vani Kulkarni** [1] examined the effects of partially substituting fly ash for cement and coconut shell aggregate for coarse aggregate. The study substituted 5%, 10%, 15%, and 20% of coconut shell aggregates for the coarse aggregate while maintaining 10% of fly ash as a consistent substitute for cement. The purpose of the study was to ascertain how the coconut shell aggregate affected the concrete's strength and durability, as well as the ideal replacement percentage that could be applied to building projects.

The study by **Santha Kumar G *et al.*** [2] sought to determine whether Granite Fine Powder (GFP) might be used as a substitute raw material in the production of foam-based Cellular Lightweight Concrete (CLWC). Three distinct foam-binder ratios of 0.025, 0.05, and 0.1 were utilized, along with weight ratios of GFP and binder of 0.8:1, 1:1, and 1.2:1. Overall, the study showed that the foam-binder ratio is an important consideration when optimizing the properties of CLWC and that GFP can be used as an alternative raw material for manufacturing CLWC. The results of this study may be useful in the development of more sustainable lightweight concrete materials for construction applications.

Inparticular, the study by **Devansh Jain *et al.*** [3] looks into the compressive strength, water absorption capacity, and dry density of CLWC. In this work, cubes are cast at three goal densities: 800 to 1000 kg/m^3, 1000 to 1200 kg/m^3, and 1200 to 1400 kg/m^3. This is achieved by reducing the cement percentage from 50% to 20% and altering the fly ash content from 50% to 80% at intervals of 5%. All mixtures have the same amount of water—40% of the total weight of cement and fly ash. One component foaming ingredient diluted with thirty-five parts water makes up the foam. Since the amount of foam influences the dry density of concrete, different goal densities can be achieved by varying the foam content, which ranges from 1% to 1.5%. Silica fume is added to further lower the cement content once the fly ash content has reached its ideal level. Silica fume is added to the mixture at intervals of 5% by weight of cement, ranging from 0% to 15%, and its mechanical and physical qualities are evaluated.

The study by **Sandesh Dhavale *et al.*** [4] was discovered that the trial mix with 2% glass fiber (R95G2) had a compressive strength of 21.16 MPa, which is almost equal to the standard mix's strength of 22 MPa. Thus, it can be said that traditional concrete bricks can be replaced with cellular lightweight concrete reinforced with glass fiber.

In the research by **Sidhardhan S *et al.*** [5] foam concrete was combined with recycled plastic and glass trash. In the experiment, recycled glass waste was used in amounts of 5%, 10%, and 15%, and recycled plastic waste was added as filler in amounts of 1%, 3%, and 5%. According to the study, adding waste plastic and recycled glass to regular foam concrete can be beneficial for load-bearing wall applications. Other mathematical models have also been introduced by the authors, which can be utilised for analysis [6 - 8].

MATERIALS USED

a. Cement

The history of cementing material is indeed very old and can be traced back to the beginnings of engineering construction. Portland cement is said to have been invented in 1824 by Joseph Aspdin. He accomplished this by heating a mixture of finely divided clay and limestone to a very high temperature in a furnace.

Cement is a fundamental construction material used for making concrete, mortar, and other building elements. It possesses several important properties that influence its suitability for various construction applications. In general, cement is a cohesive and sticky substance that has the ability to consolidate particles into a compact, long-lasting mass [9]. In order to create a solid and robust concrete

CHAPTER 11

Natural Language Processing for Sentiment Analysis in Social Media

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Abstract: In today's ever-changing communication landscape, social media platforms have emerged as powerful channels for individuals to express their thoughts and feelings. The vast and continuously expanding reservoir of social media information presents a priceless opportunity for gaining insights into public sentiment, making sentiment analysis an essential undertaking. This research paper explores the effective application of Natural Language Processing (NLP) methods to address the intricate task of sentiment analysis within the domain of social media. Crucial aspects encompass the rapid proliferation of social media data, real-time accessibility for event monitoring, the diversity of data types necessitating advanced NLP techniques, handling of sarcasm and irony, adaptability to evolving sentiment, support for multiple languages, ethical considerations, and the broader implications of sentiment analysis in various fields, such as politics, healthcare, and social sciences. Emotion detection is highlighted as a means to achieve a more nuanced understanding of these applications.

Keywords: Data sources, Emotion assessment, Natural Language Processing (NLP), Social media information, Social media, Techniques.

INTRODUCTION

Sentiment analysis involves the assessment of attitudes, opinions, or judgments rooted in emotions and is often referred to as opinion mining. It primarily focuses on the examination of individuals' feelings toward specific entities [1 - 8]. The internet serves as a valuable repository of sentiment-related data, allowing users to express their viewpoints across an array of social media channels, such as discussion forums, micro-blogging platforms, and online social networks.

Simultaneously, researchers and developers have harnessed the Application Programming Interfaces (APIs) of social media platforms for the collection and analysis of data. Twitter offers three separate API iterations [9]: the REST API

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

allows for fetching status data and user details, the Search API simplifies focused searches for Twitter content, and the Streaming API enables the immediate gathering of real-time Twitter content. Developers can also combine these APIs to create customized applications, establishing a robust foundation for sentiment analysis with access to extensive online data.

However, online data of this nature exhibit several limitations that can potentially hinder the sentiment analysis process. The primary drawback lies in the fact that individuals can freely post content, resulting in varying levels of opinion quality. For example, online spammers often flood forums with irrelevant or nonsensical content, including fabricated opinions [10 - 12]. Another constraint arises from the absence of definitive reference points for online data. Ground truth acts as a categorization for a given opinion, indicating whether it leans towards being positive, negative, or neutral. One publicly available dataset that provides ground truth is the Stanford Sentiment 140 Tweet Corpus [13], which encompasses 1.6 million Twitter messages, each tagged by automated processes using emoticons (☺ for positive and ☺ for negative).

In this paper, the dataset utilized comprises product reviews sourced from Amazon [14], collected during the period from February to April 2014. To mitigate the limitations mentioned above, several measures were put in place. Firstly, every product review underwent a pre-screening process before publication to ensure content quality. Secondly, each review includes a rating, which serves as the ground truth for the purpose of conducting sentiment analysis.

LITERATURE REVIEW

The available literature presents various techniques utilized by Machine Learning [15 - 20]. One of the central challenges in the field of sentiment analysis revolves around the categorization of sentiment polarity [6, 21 - 29]. This challenge entails the task of assigning a specific sentiment polarity—whether it is positive, negative, or neutral—to a given piece of written text. Depending on the level of analysis, sentiment polarity classification occurs at three distinct levels: document level, sentence level, and entity and aspect level [29].

At the document level, the aim is to determine whether an entire document predominantly conveys a positive or negative sentiment. Conversely, when conducting sentence-level analysis, the focus is on categorizing the sentiment expressed within individual sentences. Lastly, scrutiny at the entity and aspect level involves identifying the specific aspects or entities that individuals express liking or disliking in their opinions.

Despite the wealth of existing research on sentiment analysis [29], this section will examine relevant previous studies upon which our work is built. Authors in [29] compiled lists of positive and negative words, drawing from customer reviews. The positive word list encompasses 2006 words, while the negative word list consists of 4783 words. Both lists include commonly misspelled words that are frequently encountered in social media content.

The process of sentiment categorization inherently involves a classification task, where features containing opinion or sentiment-related information must be identified before classification can be carried out. Regarding feature selection, Pang and Lee [5] recommended the elimination of objective sentences by extracting subjective ones. They introduced a text categorization technique capable of identifying subjective content using the concept of the minimum cut.

Furthermore, Abd *et al*. [29] conducted the selection of 6,799 tokens from Twitter data, assigning each token a sentiment score referred to as the Total Sentiment Index (TSI). The TSI for a particular token is computed using the following formula:

Text Complexity Index (TCI)

- This denotes the significance or importance of the term “i” within the given text.
- represents the frequency of term *i* in the text.

Semantic Similarity Score (SSS)

- represents the total number of documents in the corpus.
- represents the number of documents containing the term.
- and represent the total number of documents containing two different terms.
- and expresses the count of documents that include both of the mentioned terms.

Document Sentiment Impact (DSI)

- represents the sentiment score of the sentence .
- represents the temporal weight of the sentence .
- is a damping factor for the sentiment impact.

Named Entity Recognition Confidence (NERC)

- is the total number of named entities in the text.
- represents the confidence score of the named entity .
- represents the importance of the weight of the named entity .

CHAPTER 12

The Impact of an Aggressive Environment on the Durability of Geo-polymer Concrete: A Review

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Abstract: Numerous studies looking at the mechanical qualities of geo-polymer concretes have been based on the generally held belief that it has a lower potential for global warming in comparison to OPC (Ordinary Portland Cement) concrete. As per the study, geo-polymer concrete produces 80% less CO_2 emissions than OPC. This concrete has emerged as a potential alternative to conventional Portland cement-based concrete because of its sustainable attributes and enhanced performance characteristics. The environmental benefit of geo-polymer concrete is a significant focus of the review, underscoring its reduced carbon footprint and lower energy consumption during production compared to conventional cement-based concrete. The utilization of industrial by-products, like fly ash and slag, as precursor material further contributes to its sustainability. This study compares geo-polymer concrete with ordinary concrete and examines its performance under various conditions, including carbonation, sulfate solution, acid corrosion, and chloride penetration. It has been found that in several cases, geo-polymer concrete durability is better than conventional concrete.

Keywords: Aggressive environment, Carbonation, Durability, Geopolymer concrete, Mechanical properties, Sulfate attack.

INTRODUCTION

After China, India is the world's 2nd-largest manufacturer of cement. OPC, which has been historically employed as the main binder in concrete, is responsible for between 5 and 7 percent of worldwide carbon dioxide (CO_2) emissions [1]. Global warming and other negative effects are the result of massive environmental pollution produced by CO_2 emissions and non-absorption due to deforestation and other factors. OPC manufacturing is thought to be responsible for 7% of GHG emissions into the environment each year. As per the statistical projections, by the

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

middle of this century, the world's OPC production will have reached 6 billion tons [2]. China produced over 0.73 and 23.5 billion tons of OPC in the years 2002 and 2019, respectively, showing a sharp annual rise in these years. Consequently, lowering the production and consumption of cement is required to lower the CO_2 amount that has been released into the atmosphere. Researchers have been exploring the use of various admixtures and fibers to enhance the GPC (Geopolymer Concrete) properties. It is interesting to note that hemp can also be added to GPC to improve its properties. This shows the potential of utilizing sustainable materials in construction, which is a step towards creating a more environmentally friendly industry. Wet preservation of hemp improves mechanical strength properties and dosages used to provide high-quality concretes, and wet-preserved hemp minimizes water usage in geopolymer hempcrete [3]. The additives, particularly micro-silica, raised the compressive strength as well as the increased temp resistance of GPCs by providing crack-stopping and clamping effects. The study suggests that micro-silica significantly enhanced the increased temp performance of GPCs [4]. Improved engineering qualities were demonstrated using steel fiber-reinforced GPC. Increased toughness, energy absorption, and ductile behavior resulted from the inclusion of steel fibers. Better earthquake resilience was demonstrated by GGBS-dolomite GPC beam-column joints when contrasted with OPC beam-column joints having ductile detailing [5]. The cube compressive strength of Laterized GPC (LGC) may be enhanced by 63 percent by adjusting the NaOH molarity from 8-16. Additionally, waste and marginal materials can be used as aggregates to make GPC. LGC increases as NaOH molarity increases [6]. In the building business, geopolymer technology has demonstrated encouraging results as a Portland cement substitute binder. Its exceptional qualities include higher compressive strength, minimal creep, superior acid resistance, lower shrinkage, and fire resistance. Efforts were being made to decrease the utilization of Portland cement in concrete manufacture by utilizing supplementary cementing materials and finding alternative binders. The proportion of GGBS to fly ash at 60:40 gives the maximum strength in comparison to other ratios [7]. The GPC has shown excellent performance in terms of chemical and fire resistance, desirable mechanical and structural properties for the construction industry, and potential for heat-resistant pavement applications [8]. Compared to regular Portland cement concrete, fly ash-based GPC exhibits superior resistance to the attack of chloride and a longer durability against corrosion cracking. When it comes to extreme maritime situations, GPC performs better in terms of durability than regular Portland cement concrete [9]. The concrete's split tensile strength dramatically improved with polypropylene fibers, transforming the failure pattern from brittle to ductile, which is advantageous for structural engineering applications. However, the concrete's compressive strength remained relatively unchanged. The

use of polypropylene fibers resulted in a significant reduction in capillary porosity, indicating improved durability of the GPC structure. Additionally, the polypropylene fiber-reinforced GPC showed more resistance to acidic environments compared to OPC and GPC without fibers [10]. Aggressive environments for concrete are conditions that accelerate deterioration, reducing its durability and lifespan. These environments can be chemical, physical, or mechanical in nature. Sulphate attacks, chloride attacks, alkali-silica reactions, and carbonation are factors of a chemically aggressive environment. Physically aggressive environment has freeing and thawing, high temperature, abrasion, and erosion as its factors.

EFFECT OF CHLORIDE

Chloride ions can penetrate the concrete and reach the steel reinforcement bars embedded within the structure. In the presence of moisture and oxygen, chlorides can trigger the corrosion of steel, leading to rust formation. This corrosion process can weaken the steel, causing cracking and spalling of the concrete. GPC is renowned for its exceptional compressive strength, particularly at optimal elevated temperatures. Furthermore, it exhibits low to medium chloride ion penetrability, rendering it a highly desirable material for civil engineering applications. GPC is also characterized by its superior resistance to acid attack and abrasion, which enhances its durability and longevity [11]. GPCs exhibit a significantly higher resistance to corrosion caused by chlorides, as opposed to specimens of Portland cement. This resistance could be attributed to the notable GPCs' low chloride permeability, rendering them a superior choice for preventing damage resulting from corrosion [12].

EFFECT OF SULFATE

Sulfates present in the environment can lead to a chemical reaction with certain components of GPC. This reaction can cause the breakdown of the concrete structure, leading to expansion, cracking, and ultimately reduced durability. Higher concentrations of sulfates in the environment can intensify the sulfate attack on GPC. Prolonged exposure to sulfate-rich environments, especially in conditions where the concrete is continuously wet, can accelerate the deterioration process. Although geopolymer exhibits a decline in strength after exposure to sulfate attacks, incorporating metakaolin as the partial replacement for fly ash yields a major rise in strength, particularly when the replacement level exceeds 15%. This finding is particularly encouraging, as it suggests that the use of metakaolin can assist in mitigating the loss of strength experienced by geopolymer after exposure to sulfate attacks. The incorporation of metakaolin in geopolymer has been found to enhance its strength and increase its resistance to

CHAPTER 13

Innovative Structural Solutions for Tall Buildings: A Way Forward

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Abstract: Diagrid structures are commonly used these days for tall buildings due to their structural efficiency and architectural aesthetic potential, and new grids can be studied and tested as a result. A diagrid refers specifically to the structural system of a building, involving diagonal members forming a grid for support, while an irregular grid refers to the irregular layout of buildings in an urban or architectural context. The two concepts are related to different aspects of building design and construction. The irregular grid is one of the grids chosen here. Because irregular geometry for tall buildings was used in this study, it is critical to identify relevant structural systems for improved overall performance. An irregular grid was chosen as the outer grid for this tall building. The main cases considered here are regular shape and irregular shape (L shape and C shape) buildings with irregular grids, including peripheral columns, and conventional grids with peripheral columns for the same shape. Irregular geometry was modelled in Rhino 3D with Grasshopper as a plugin, which was imported into SAP2000. Steel had been chosen as the building material in this case. According to codal provisions, analysis had been performed for both Lateral Loads, namely Earthquake and Wind Load. This study can serve as a benchmark for future infrastructure development by demonstrating how effectively irregular geometry can be used to overcome all of the flaws of conventional methods.

Keywords: Rhino 3D, SAP2000, Tall building, Unconventional grid.

INTRODUCTION

Tall buildings are a worldwide architectural phenomenon today due to the economic benefits they provide in dense urban land use. Tall buildings, on the other hand, are constructed with a plethora of resources, including structural materials, due to their enormous scale. According to the research, more efficient structural system selection and design optimisation can significantly contribute to the construction of sustainably built environments by conserving our limited

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

resources [1 - 3]. The global trend towards sustainable structural design and construction, particularly for tall structures, has influenced the development of cost-effective and energy-efficient structural systems. Diagrid is short for diagonal grid. It's a structural system where the external load-bearing elements of a building, such as columns and beams, are replaced with diagonal members forming a grid. These diagonals are often in a diagonal crisscross pattern, providing stability and support to the building. Diagrid structures are commonly made of steel and are often visible on the exterior of the building, creating an aesthetically pleasing and iconic architectural feature. Early tall building designs from the late 1800s recognised the importance of diagonal bracing members in mitigating lateral stresses. Most early tall structures had steel frames with diagonal bracing in a variety of shapes, including X, K, and eccentric. Although the structural importance of diagonals was well understood, their artistic potential was not explicitly addressed. As a result, diagonals were frequently incorporated into building cores, which were typically found within the structure. The difference between conventional exterior-braced frame structures and current diagrid structures is that almost all conventional vertical columns are removed in diagrid structures [4].

This is possible because the diagonal members in diagrid structural systems can carry gravity loads, as well as lateral forces owing to their triangulated configuration, whereas the diagonals in conventional braced frame structures carry only lateral loads based on the study of Moon *et al*. [5]. Understanding these concepts, it can be concluded that using diagonal members as a grid in tall buildings can help resist lateral loads more effectively. Still extension of the diagrid study has been done using hexagrid for tall buildings.

According to the investigation by Han-Ul Lee [6] hexagrid system is less efficient than the diagrid in terms of lateral resistance. An investigation can be carried out to see the efficiency of an irregular grid over the conventional grid.

As per the IS 16700 Criteria for Structural Safety of Tall Concrete Buildings, typical structural systems of tall concrete buildings include:
a) Structural wall systems,
b) Moment frame systems,
c) Moment frame – Structural wall systems,
d) Structural wall – Flat slab floor systems with perimeter moment frame,
e) Structural wall – Framed tube systems,
f) Framed-tube systems,
g) Tube-in-tube systems,
h) Multiple tube systems,
j) Hybrid systems, and

k) Any of the above with additional framing systems, for example, outrigger trusses, belt trusses and braced frames can be used.

An adaption of these structural systems has been discussed in this research paper for a better understanding of tall buildings.

MODULE & BUILDING CONFIGURATION

Irregular Grid

Considering Irregular grid, the model was created using Irregular mesh in Rhino 3D with grasshopper as a plugin based. The process was based on a study by Angelucci, *et al*. [4]. As shown in Figs. (**1** and **2**). Using this frame of grasshopper plugin, model in Rhino 3D can be seen as shown in Fig. (**3**).

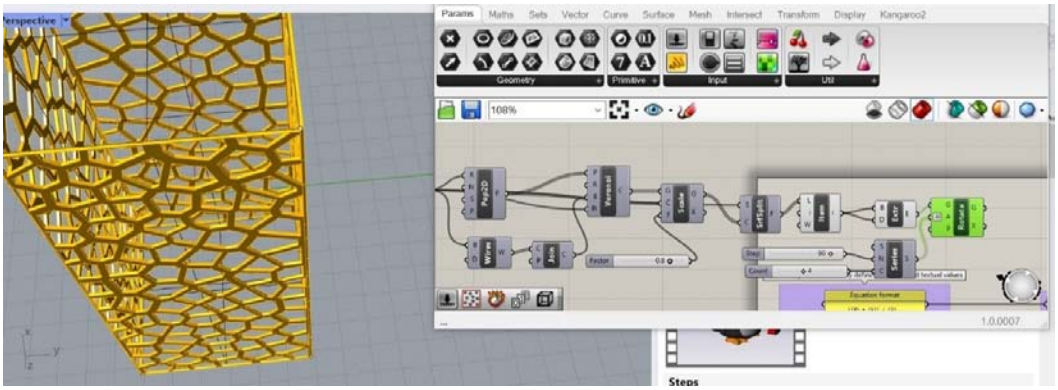

Fig. (1). Grasshopper frame for irregular model for building.

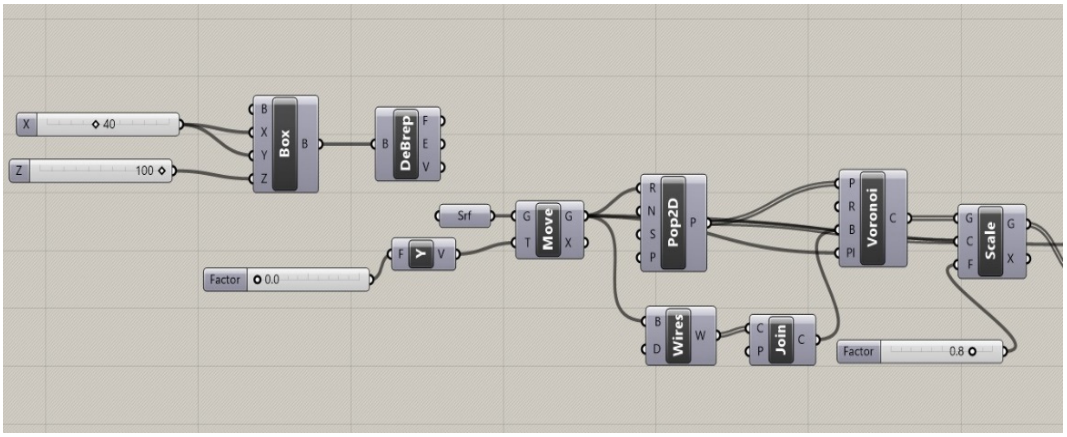

Fig. (2). Irregular grid model was exported to AUTOCAD. dxf file.

CHAPTER 14

Concerns Surrounding Artificial Intelligence in Light of Privacy and Beyond: A Legal and Ethical Analysis

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Abstract: Without a speck of doubt, Artificial Intelligence (AI) influences practically every sector of human endeavour, and has already been the primary force behind emerging technologies. However, with its growing buzz, it has been observed that there are now concerns about the potential negative repercussions of the implementation of different AI systems, particularly with regard to the standards enshrined in the Indian Constitution. Its use cannot go beyond the rights that citizens are guaranteed, such as Freedom of Speech and Expression, Liberty, Justice, Security, and the Right to Privacy, to name a few. The Supreme Court of India defined the Right to Privacy as broadly embracing autonomy, choice, and control in the context of informational privacy in the case of Justice *K.S. Puttaswamy v. Union of India* ([2017] 10 SCC 1). Though not officially addressed in the Indian Constitution, Article 21—which effectively discusses the Right to existence and Personal Liberty—inherently includes the Right to Privacy as a component of a dignified existence. As it is said that every coin has two faces, Artificial Intelligence has the potential to benefit society in many ways. However, by accelerating the speed and capacity of personal information analysis, Artificial Intelligence also increases the potential for using personal information without the consent of the concerned stakeholder in ways that could violate privacy concerns. Thus, it becomes imperative to ensure that all technological applications adhere to the letter and spirit of the law. Therefore, this paper is an analysis of the concerns surrounding AI in light of the Right to Privacy, prospects, and legal and ethical challenges with special reference to Constitutional Imperatives.

Keywords: Artificial Intelligence, Constitution, Data Ethics, Legal, Personal Information, Privacy.

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

INTRODUCTION

In the last several decades, technology has undergone amazing progress, which has changed our lives and assisted in human growth as well. Technology has, more than anything else, contributed to enabling humanity to enjoy a life of comfort and luxury, from providing roads, railroads, and aircraft for smooth travel to facilitating communication from anywhere in the world. The fact that technology has advanced in almost every sector of human endeavour speaks volumes about how crucial it is to our daily lives.

Particularly in a contemporary growing culture like our own, we have long since begun to rely on data storage in mobile phones, computers, *etc*. The data streams from mobile smartphones and other internet gadgets increase the expanse of information about every part of our lives, and privacy is thrust to the fore as a major global public policy problem. The present hype is for the development of Artificial Intelligence, referred to as AI, which is thought to exacerbate privacy problems [1]. Thus, one such aspect of technology that has become the talk of the town is Artificial Intelligence and its implications with regard to privacy.

Generally speaking, Artificial Intelligence is a technique for teaching a computer, a robot operated by a computer, or software to think critically and creatively like a human mind [2]. AI is achieved through examining the cognitive process and researching the patterns of the human brain. These research projects provide systems and software that are intelligent. In other words, it is a simulation of Human Intelligence by computers and other automated machines.

In essence and in terms of its domain, Artificial Intelligence can be roughly subclassified into two different subcategories: strong and weak Artificial Intelligence. Systems with weak AI are designed for a limited number of tasks. They are able to recognise things that are similar to what they already understand and classify them accordingly. Despite the fact that it appears to be a human experience, this is merely a simulation. Even if the AI is unable to understand orders, it will nonetheless run an algorithm to respond to them. A great example of such kind of AI is Apple's Siri, which relies on the Internet as a reliable database. On the other hand, Strong Artificial Intelligence refers to a computer that can trick a person into thinking it is also a person. It is used to describe robots that are capable of conscious thought. People think they have human cognitive abilities [3].

The current paper attempts to analyse the sustainability of the Right to Privacy and other Constitutional Imperatives in the era of Artificial Intelligence by referring to relevant laws along with future challenges and prospects. It is said that every coin has two sides, so does the potential for using personal information

without the consent of the relevant stakeholders, as Artificial Intelligence relies on ways that could violate privacy concerns. This is because it increases the speed and capacity of personal information analysis. Thus, it becomes imperative to ensure that all technological applications adhere to the letter and spirit of the law. Additionally, it is odd to note that the development of Artificial Intelligence (AI) may negatively impact not just the inherent right to privacy but also other fundamental rights, including the Right to Equality [4], Freedom of Speech and Expression [5], the Right to Life and Personal Liberty [5].

ARTIFICIAL INTELLIGENCE AND RIGHT TO PRIVACY

Many researchers have reported on the applications of AI over the past decades [6 - 11]. AI systems' utilisation of data has implications for privacy but raises data protection concerns. There are two key areas to be considered when it comes to privacy concerns with regard to data utilisation by AI systems. AI systems must, first and foremost, adhere to the strict regulations governing data protection. However, it's not obvious if India's present data protection laws can handle the privacy and data protection concerns that arise from the use of AI systems.

Moreover, given that AI systems can be used to re-identify anonymised data, the basic anonymization of data for the training of AI systems might not offer sufficient levels of security for an individual's privacy. Datasets containing personal information about individuals are commonly anonymized before sharing for training AI systems. This is done using de-identification and sampling. AI systems may be able to undo this anonymization process and re-identify individuals. However, this has serious privacy implications for the individual's personal data.

In addition to this, the use and deployment of AI systems raise questions regarding bias and discrimination. Pre-existing datasets used to train AI systems frequently exhibit historical bias, unequal distribution, and prejudice [12]. The use of biased training datasets and inaccurate sampling are possibly two ways that AI systems might become biased. Given that AI systems base their decisions on current information, one must be cautious of the possibility of previous bias and discrimination being incorporated into them.

However, when it comes to constitutional imperatives, in *Maneka Gandhi* [13], the Supreme Court of India opened up a new dimension and gave the phrase “personal liberty” the largest conceivable interpretation. The Court continued by declaring that Article 21 of the Indian Constitution guarantees the fundamental right to live in dignity. In light of “due process of law,” which stipulates that a legal system must be just, fair, and reasonable, the right to life and personal

CHAPTER 15

A Green Inventory Model for Decaying Products Under the Impact of Carbon Emissions with Two Different Demands

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Abstract: A green supply chain approach is required for industries to remain sustainable and is critical for our planet's well-being. By improving cost effectiveness, lowering waste, and satisfying customer demand for green products, it contributes to a reduction in the carbon footprint of manufacturing operations by generating less waste and reducing expenses. This study takes into account a two-level model that considers carbon release from production, carrying products, shipping, item deterioration, and waste disposal and also helps to minimize the overall cost. The presented model was analytically evaluated and optimizes the production time and supplier's replenishment time. The current study has been demonstrated by both a sensitivity analysis and a numerical analysis. A graphical representation is also given to determine the convexity of the proposed model.

Keywords: Carbon emission, Deterioration, Green supply chain, Producer, Supplier.

INTRODUCTION

A green supply chain incorporates social and eco-conscious principles into a productive and growing system. The storing, processing, and transportation of raw materials needed to develop new products generate carbon emissions, which contribute significantly to product deterioration. Lighting, heating, and freezing in warehouses and other storage facilities utilize energy, which raises carbon

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

emissions. Furthermore, new product development, packing, and distribution all increase carbon emissions. Carbon emissions from the manufacture and development of new items are also produced, mostly as a result of transportation and energy use. Product usage can also result in carbon emissions, especially if the product uses energy or produces trash. Additional carbon emissions are produced when things are burned or dumped in the garbage when their useful lifespans are extinguished. These programs need to cover everything from sourcing raw materials, manufacturing, and final-stage shipping to customer returns and disposal procedures. All these efforts are considered for the environmental and human impact of the products' pathway through all the steps. Lee *et al*. [1] studied a decaying inventory system with consumption based on stock. Kumar *et al*. [2] presented a dual-level credit for trade concept that considers the effect of conservation techniques. A supply management framework for deteriorating commodities with fluctuating demand and deficits was published by Tyagi *et al*. [3]. In order to address the ambiguous need for market centres, the impact of inflation on charges and the promotion of green investment are taken into account by Mishra *et al*. [4]. Tyagi *et al*. [5] created a comprehensive timeline model. Mashud *et al*. [6] suggested a model that includes investments in green technology to minimise the total deterioration and carbon emissions from greenhouse operations. As part of a cap-and-trade system, Giri and Ray [7] examined a supply chain that was eco-friendly, taking into account a producer and a supplier with demand that was sensitive to emissions. Manufacturing and disposal reactions produced carbon output, which is further exacerbated by deterioration, and Mishra [8] proposed a manufacturing inventory model for that issue. Singh *et al*. [9] created a model to calculate the ideal number of deliveries, demand level, and carbon emission volume while reducing the total cost of the supply chain. An approach that believes deteriorating items have an optimal lifespan has been investigated by Singh *et al*. [10]. In order to account for the impact of the learning-forgetting issues on the installation price, Yadav *et al*. [11] constructed a logistics theory. In contexts with time-varying consumer demand, under both a crisp and a fuzzy ecosystem, Parida *et al*. [12] developed durable degraded supply systems. Apart from the aforementioned authors, many others have also presented other mathematical models [13 - 15]. Handa *et al*. [16] developed a system in which the demand is considered to be linearly time-sensitive, with the end user receiving buyback items. Based on the hypotheses that learning-forgetting has an instantaneous impact on purchase expenditures and that decaying things have an optimal lifespan, Bhardwaj *et al*. [17] (2023) proposed a three-tier ecological distribution system for inventory that takes into consideration pollution levels, stock-based demand, and retailer-permitted item shortfalls.

NOTATIONS

In order to develop the model, the following notations must be considered as well (Table **1**):

Table 1. Notation for model development.

A	The cycle time during which production stops	B	The duration of the supplier replenishment cycle
x	Productivity rate	a, b	Demand components
X_P	Producer's startup cost	X_P	Producer's manufacturing cost
H_P	Producer's carrying cost	D_P	Producer's decaying cost
$q_{P^{(t)}}$	Producer's goods status at time	w_P	Predetermined waste discard cost
t_P	Predetermined shipment cost	w_{Pe}	Variable waste discard cost
t_{Pe}	Variable shipment cost	σ	The amount of energy used to keep inventory by producer
H_{Pe}	Carbon emission cost during holding items	B_{Pe}	Carbon emission cost during manufacturing
D_{Pe}	Carbon emission cost during the decay of items	P	Carbon emissions generated by using electricity
δ	Carbon emissions amount generated from decaying items during manufacturing	g	Carbon emission cost during shipping
$q_{s^{(t)}}$	Supplier's goods status at time	α, β	Demand parameter
H_S	Supplier's carrying cost	A_S	Supplier's ordering cost
p	Supplier's purchasing cost	D_S	Supplier's decaying cost
H_{Se}	Carbon generated cost during stockroom activities for supplier	TC	Total cost
η	Carbon emissions amount generated by stockroom activity	D_{Se}	Variable decaying cost for supplier
φ	Decaying 0 φ 1 rate	*T*	Total length of cycle
n	Number of shipments	ε	Use of energy during production
D	Distance covered during shipment	X	Revenue on carbon emissions
σ	The amount of energy used to keep inventory by producer	τ	Carbon output during disposal of solid waste
ω	Average amount of generated solid waste	μ	Fuel usage output during transportation
c	Fuel usage per ton	λ	Carbon emissions generated by the degradation process for supplier

ASSUMPTIONS

- A single producer and supplier with a single item are considered in this model.
- There is a time-dependent linear demand rate for the producer of the form

CHAPTER 16

Secure Quantum Proxy Signature Scheme Based on Quantum OWF and Bell Basis

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Abstract: A person is permitted to assign theirsigning rights to another individual through a proxy signature scheme. These systems have been suggested for use in various applications, particularly in distributed computing.. In the current study, a novel quantum proxy signature mechanism is proposed, by using quantum one-way function (OWF) and EPR quantum entanglement. Quantum OWF can be determined in polynomial time, but it is difficult to invert them in polynomial time. This system's unconditional protection is ensured by the quantum key distribution, OWF and one-time-pad encryption algorithm.

Keywords: Entanglement, OWF, Proxy signature, QKD, Unitary transformation.

INTRODUCTION

It is well known that OWFs are assumed to be basic and necessary tools in designing secure cryptographic schemes. Some examples of OWFs are hash function, discrete logarithm function, the RSA function, *etc*. Although these functions are non-invertible in classical mechanics, they can be inverted using quantum computers. Therefore, it becomes very important to study the likelihood of the quantum analogue of these OWFs. Thus, quantum OWFs are easy to compute through classical protocols, but it will be very difficult, or impossible, to invert them even using quantum algorithms.

Digital signature is a mathematical technique to certify the authenticity of digital information or messages. The technique of digital signature was developed by Diffie and Hellman in the 70s of the last century. However, they realized that digital signature is possible only for trapdoor OWF, but later Rivest *et al*. [1] developed the RSA protocol, which was able to produce primitive digital signatures too. A quantum digital signature scheme is a quantum analogue of a classical digital signature scheme or a handmade signature on a document. Similar

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

to handmade signatures, digital signatures can be utilized to secure important digital documents, such as a digital testament, digital policy documents, digital mark sheets, digital contracts, *etc*.

In cryptography, digital signature schemes are crucial building blocks that are commonly used for providing secure communications to humans in the world of electronic devices. Digital signature schemes provide three major cryptographic features, namely non-repudiation, authentication, and transferability. These characteristics help us to protect our important tasks like online legal contracts, software updates, online financial transactions, and many more online digital tasks. Digital signature protocols based on asymmetric encryption, which are currently in practice, show their protection from unproven computational theories, and most of them (notably those based on RSA algorithms or elliptic curves) can be broken by quantum computers [2 - 12].

If quantum communication is developed, it is possible to create digital signature schemes using fundamental quantum mechanics theory. Gottesman and Chuang [3], who introduced the basic concept of taking digital signature schemes into the field of quantum cryptography, proposed the first quantum signature protocol. However, from a theoretical point of view, their protocol was highly impractical because it required the preparation of difficult quantum states to execute quantum operations on these states and store them in a quantum memory.

A proxy signature scheme requires the original signer (known as the designator) to assign, on behalf of the designator, a proxy signer to sign documents. A proxy signer (delegate) has the right to compute the proxy signature in this system, which can be further certified by any involved person who has the ability to access the designator's attested public key. Blaze *et al*. [4] first used the term 'proxy signature 'in proxy cryptography to describe a distinct primitive with unique objectives.

We have suggested a protected quantum proxy signature scheme using quantum OWF and an EPR (Einstein-Podolsky-Rosen) quantum entanglement in the current paper. It is possible to calculate Quantum OWFs in polynomial time, but it is very difficult, almost impossible, to reverse it in polynomial time. Together with Quantum Key Distribution (QKD) and OWF, the use of the one-time-pad encryption protocol guarantees the proposed system's unconditional protection. The remainder of the paper was organized in the following manner. Some fundamental concepts are introduced in Section 2 that are important for understanding the proposed scheme. The suggested scheme consists of section 3. The correctness of our scheme is defined in section 4, followed by the security analysis explained in section 5. The current research work ends in the last section.

Other mathematical models have also been discussed by many researchers [13 - 19].

SOME BASIC TOOLS

Within this part, we will discuss some basic definitions and concepts which will help to understand the proposed scheme.

Scheme of Digital Signature

A scheme of digital signature basically consists of the following:

i. **Key Generation Algorithm**: This algorithm involves the selection of a private key, which is randomly and uniformly picked from a set of available private keys, and it outputs the public key and a corresponding private key.
ii. **Signing Algorithm:** For a given document (which is to be signed) a private key generates a signature.
iii. **Signature Authentication Algorithm:** For a given combination of public key, signature, and message, the authenticity argument of the message is either denied or accepted.

A digital signature scheme is formally a triplet of algorithms for probabilistic polynomial time, where:

i. *G* (known as key-generator) produces a private key s_k and a corresponding public key p_k on input 1^n (refers to a unary number) with the security parameter *n*.
ii. *S* (called signing algorithm) generates a tag *t* on the input s_k with a string (*X*).
iii. *V* (known as signature verifying algorithm) produces accepted or rejected output on the inputs p_k, *t* and (X).

Proxy Signature Algorithm

A proxy signature algorithm is a tuple $PSA = (DSA, (D,P), P_S, P_V, I_D$ where each ingredient algorithm runs in polynomial time, and the other constituents are described as follows:

i. $DSA = (G, S, V)$ is a digital signature scheme as defined in 2.1.
ii. is a two-party (one is called a designator, and the other is called a proxy signer) -protocol that consists of two interactive randomized algorithms *D* and *P*. Each algorithm requires two public keys pk_i, and pk_j for the designator *i*, proxy signer *j*. Besides pk_i, and pk_j, *D* needs sk_i (designator secret key), *j* (proxy signer identity) and ω (a message document for which the designator wants to delegate its signing rights to the proxy signer) as its inputs. Except pk_i, and

CHAPTER 17

Speech Emotion Recognition (SER) with Deep Belief Network and Shallow Neural Network

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Abstract: Speech emotion recognition (SER) is a growing branch of study that analyzes human emotion duringoral conversation. The target human can be a child, woman, or man. Using some datasets and algorithms, we recognized the human speechemotion. Some speech-emotional databases were also used. They also play a vital role in cross-cultural activities. SVM, HMM, or deep learning models like CNN) or RNN are frequently employed in speech recognition of emotional systems to achieve accurate emotion recognition. As speech emotion recognition technologies advance, it is essential to address privacy and ethical concerns. The algorithm's performance depends on the quality and quantity of the data, feature extraction techniques, hyperparameter tuning, and some other factors.

Keywords: Dataset, Gaussian Naive Bayes, Markov models, SER, SVM.

INTRODUCTION

Speech Emotion Recognition (SER) is a growing branch of study that focuses on the analysis and understanding of emotional information conveyed through speech [1 - 3]. It plays a vital role in different fields, including human-computer interaction, affective computing, mental health assessment, and social robotics. This literature review's objective is to give a summary of the key developments, techniques, challenges, and future directions in the domain of speech emotion recognition.

Methodologies and Feature Extraction: Numerous methodologies [4 - 9] have been employed in speech emotion recognition, ranging from traditional machine learning approaches to more recent deep learning techniques. In these approaches, feature extraction is essential.

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

These features capture acoustic characteristics related to emotions. However, they may not fully represent the complex dynamics of emotional speech.

Datasets and Challenges: The availability of large, diverse, and annotated speech-emotion datasets is crucial for training and evaluating SER systems. Popular datasets, such as the Berlin Emotional Speech Database (EmoDB), have been widely used in the research community. However, challenges persist in terms of dataset biases, subjectivity in emotion labeling, cross-cultural variations, and the need for more real-world data [10 - 17].

Contextual and Multimodal Approaches: Emotions are not solely conveyed through speech but also through non-verbal cues such as facial expressions, gestures, and physiological signals. Therefore, integrating contextual and multimodal information has gained recognition in the last few years. Researchers have explored fusion techniques that combine speech with visual data from facial expressions or physiological signals to improve emotion recognition accuracy. These approaches leverage the complementary nature of different modalities, enhancing the robustness and reliability of emotion recognition systems.

Cross-Cultural and Individual Differences: Emotional expression varies across different cultures and individuals. Cultural norms, language-specific nuances, and personal backgrounds influence the way emotions are perceived and conveyed. Cross-cultural studies in SER aim to address these variations and develop models that can generalize well across diverse populations. Additionally, individual differences in vocal characteristics, speaking styles, and emotional perception further complicate the recognition task. Personalized or adaptive models that can capture individual idiosyncrasies are being explored to enhance the accuracy of emotional recognition.

REVIEW OF SPEECH EMOTION RECOGNITION (SER)

SER is the process of automatically identifying or detecting emotions expressed in human speech. It entails studying the acoustic properties of voice signals, such as pitch, intensity, rhythm, and spectral content, to infer the emotional state of the speaker. SER aims to classify speech into different emotional categories, such as happiness, sadness, anger, fear, surprise, or neutral.

In the subject of AI, affective computing, and human-computer interaction, the identification of emotions in speech has drawn a lot of attention [18 - 24]. It has numerous applications, including but not limited to:

Human-Computer Interaction: SER can be used to enhance the interaction between humans and computers by enabling systems to understand and respond appropriately. For example, a virtual assistant's replies are tailored to the users' emotions.

Call Center and Customer Service: SER can be employed in call centers to analyze customer interactions and gauge their emotional states. This information can be used to improve customer service by identifying dissatisfied or frustrated customers in real time.

Psychological Research and Therapy: SER can assist psychologists and researchers in studying emotional states and psychological disorders. It can provide insights into the emotional well-being of individuals.

Market Research: SER can be used to analyze customer feedback in surveys, social media, or product reviews. By understanding the emotions expressed by customers, companies can gain valuable insights into consumer preferences and opinions.

The process of speech emotion recognition involves several steps, used in SER systems to achieve accurate emotion recognition.

Ongoing research in this field aims to improve the accuracy and robustness of SER systems to make them more applicable in real-world scenarios.

ANALYSIS BETWEEN MACHINE LEARNING AND DEEP LEARNING

Speech emotion recognition can be achieved through the application of two subfields of Artificial Intelligence (AI): machine learning and deep learning. However, they differ in terms of their approach and complexity.

Machine Learning

In the context of SER, machine learning techniques typically involve extracting relevant features from speech signals and training a model to classify those features into different emotional categories. Some commonly used machine learning algorithms for these tasks include Support Vector Machines (SVM), random forests, and Gaussian Naive Bayes.

SER system is broadly composed of three parts, *i.e*., signal acquisition, feature extraction, and emotion recognition. Fig. (**1**) shows the block diagram of SER.

Advantages of Machine Learning for Speech Emotion Recognition

Simplicity

Machine learning algorithms can be relatively easier to understand and implement compared to deep learning.

CHAPTER 18

Human Disease Prediction using Machine Learning Model

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Abstract: There is a need to develop an easy-to-use system that predicts chronic disease without the need for a personal consultation with medical professionals. The goal is to identify various diseases by analyzing the symptoms of patients through various Machine-Learning Models (MLM). Machine Learning (ML) is used to predict diseases based on symptoms provided by patients or users. The proposed system takes the symptoms delivered by the patients as input and the system produces an output indicating the possibility of a specific disease. A classifier known as "Naive Bayes," which belongs to machine learning techniques, is used to find out the possibility of a disease occurring. The increasing availability of biomedical and healthcare data has enabled more accurate analyses, facilitating early disease identification and patient care. Diabetes, malaria, jaundice, dengue, and tuberculosis are just some illnesses that can be predicted using methods like linear regression and decision trees. The study compares various Machine Learning algorithms and reveals that the Random Forest algorithm achieves a 97% accuracy rate in symptom-based predictions.

Keywords: Decision tree algorithm, Gradient boost algorithm, Machine learning, Naïve bayes algorithm, Random forest algorithm.

INTRODUCTION

When a person is suffering from an ailment, they must consult a doctor, a process that is not only time-consuming but also financially burdensome. In addition, if the individual is far from medical centres, identifying the disease is difficult. Therefore, the implementation of an automated software to perform the aforementioned procedure could offer a cost-effective and timely solution, contributing to a seamless experience for the patient. Ravi and Kantheti [1] discussed several cardiac disease prediction systems that use data mining techniques to assess a patient's level of risk. The Disease Predictor, an online tool that forecasts a user's disease based on observed symptoms, serves as an illus-

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

tration. Many developed nations, including India, are grappling with a host of chronic diseases, particularly cardiovascular diseases and diabetes, with potentially far-reaching implications for global health, security, and the economy. Hybrid Machine Learning techniques were used by Thirumalai and Srivastava *et al*. [2] to produce an efficient system for heart disease prediction. Kavitha *et al*. [3] developed heart disease prediction using a hybrid Machine Learning model.

Le *et al*. [4] discuss the application of machine-learning techniques in the field of disease gene prediction. Disease gene prediction is a critical area of genomic research where scientists aim to identify genes that play an important role in the development and progression of various diseases. Identification of these genes may provide valuable information on disease mechanisms and potential targets for therapeutic interventions. Saboor *et al*. [5] highlighted the strengths and weaknesses of decision trees, random forests, support vector machines, neural networks, and other relevant models for predicting heart disease. Ahmad *et al*. [6] focus on efficient diagnosis of human cardiac diseases using hyperparameter tuning techniques in machine learning.

Rapid urbanization and economic advancement in the contemporary world have given rise to diverse lifestyles, posing a major dilemma for the medical and healthcare sectors in ensuring high-quality services for all patients. Since only a few are privileged enough, they are the only beneficiaries. Abundant healthcare data remains untapped and lacks efficient and reliable extraction techniques to reveal hidden insights crucial for effective decision-making. The proposed framework takes advantage of data mining methods to detect chronic diseases at an early stage. Machine learning, which encompasses the process of instructing computers to improve their results based on previous data or examples, plays a key role. Machine learning involves training and testing stages within your algorithm. Predicting diseases based on patients' symptoms and medical histories has posed a long-standing challenge in the realm of Machine Learning. Consequently, Machine Learning technology emerges as a powerful tool in the medical field, effectively addressing various dilemmas in healthcare. Takke *et al*. [7] also explained various Machine Learning algorithms for medical disease prediction. Srivastava and Singh *et al*. [8] provide a study that focuses on the use of machine learning approaches to forecast heart disorders.

Vayadande *et al*. [9] investigate how machine learning and deep learning algorithms can be used to predict heart disease.

When selecting machine learning algorithms for disease prediction or diagnosis, it is critical to consider the data types, accuracy, and computing complexity. Decision Tree algorithms are preferred for their simplicity and interpretability,

particularly when working with small to medium-sized datasets containing categorical or numerical data, making them appropriate for diseases with simple decision rules, such as triage systems [10]. Random Forest, an ensemble learning method, excels at dealing with varied data sources and reducing overfitting, providing excellent accuracy in multifactorial diseases such as diabetes or cardiovascular conditions due to its capacity to aggregate judgments from multiple trees [11]. Naïve Bayes is commonly used in text-based illness classification tasks, such as examining patient records to detect symptoms of common disorders [12]. Gradient Boosting, while computationally costly, is effective at capturing complex and nonlinear correlations in huge datasets, making it especially useful for uncommon illness diagnosis and genomic data analysis [13]. Healthcare practitioners can improve predicted accuracy and efficiency by aligning these algorithmic qualities with disease modeling's unique requirements.

This paper is organized as follows: in Section II, extensive literature is reviewed; in Section III, the proposed methods and their use in the proposed model architecture are explained. In Section IV, the model evaluation and comparison are presented with the help of a figure and table. Finally, in Section V, the conclusion and future work are discussed.

LITERATURE REVIEW

Extensive research has been done on disease prediction using various machine learning algorithms and methods, which can find applications in medical establishments. This article evaluates several of those research studies, examining their techniques and results. For example, a study by Hwang *et al*. [14] proposed a disease prediction system using Machine Learning algorithms such as CNN-UDRP, CNNMDRP, Naive Bayes, K-Nearest Neighbor, and Decision Tree. Diagnosing cardiac disease, supervised by Machine Learning techniques, was investigated by Kanchan *et al*. [15]. They investigated disease prediction, using principal component analysis along with techniques such as Naive Bayes, Decision Tree, and the Support Vector Machine. The accuracy achieved was 34.89% for diabetes and 53% for heart disease. Rahman *et al*. [16] explain a comparative study focused on liver disease prediction using various supervised Machine Learning algorithms. An article by Ahmed and Husien [17] focuses on the forecast of cardiovascular diseases using a combination of automated learning techniques. Hybrid techniques combine multiple approaches to develop predictive models for cardiovascular diseases. Jaganathan *et al*. [18] present a study on the use of deep learning techniques to predict splicing events in genes only from their primary DNA sequences. Splicing is an important biological process in which introns are removed and exons are spliced together to produce functional messenger RNA (mRNA), which is then translated into proteins.

CHAPTER 19

Kelvin-Helmholtz Instability (K-H) of Overlapping Flowing Fluids through a Permeable Medium under the Influence of a Magnetic Field

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Abstract: In the present paper, we analyze K-H instability for stratified viscous fluids under the influence of a vertical magnetic field in a porous medium. Using the normal mode method on the linearized perturbation equations, we obtain a dispersion relation. Numerical solutions of the dispersion relation indicate that viscosity and porosity contribute to stability, whereas streaming motion enhances instability.

Keywords: Density, Kelvin-Helmholtz instability, Kinematic viscosities, Magnetic field, Porosity.

INTRODUCTION

The K-H instability, forming in a flat interface among two interacting fluid layers in motion, is essential in numerous geophysical and experimental scenarios. Chandrasekhar [1] offered an in-depth review of studies on these phenomena in both hydrodynamics and hydromagnetics in his monograph.

The effect of finite ion Larmor radius and viscosity on the hydrodynamic transverse instability problem has been examined by El-Sayeed [2]. El-Ansary *et al*. [3] investigated the impact of rotation on the hydrodynamic stability of three-layer systems. Meignin *et al*. [4] and Watson *et al*. [5] examined the Kelvin-Helmholtz instability in a Hele-Shaw cell and a weakly ionized medium, respectively. Khan and Bhatia [6] explored the influence of porous medium permeability on various problems related to hydrodynamic and hydromagnetic

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

stability, emphasizing the relevance of these studies in fields such as rock mechanics and heavy oil recovery.

M.H.O. Allah, [7] examined the stability of superposed Newtonian fluids in a porous medium, incorporating surface tension effects when a magnetic field is not present, while Kumar and Lal [8] analyzed the stability of two layered Rivlin-Ericksen viscoelastic fluids flowing through a porous medium. Kumar *et al*. [9] investigated the instability of a rotating, layered Walters B' viscoelastic fluid permeating through a porous medium.

Kumar *et al*. [10] examined the impact of viscosity on stratified, layered non-Newtonian fluids. In every earlier study on the flow and stability of Newtonian and non-Newtonian fluids through a porous medium, the impact of convective movements was ignored. Khan and Bhatia [11] analyzed the stability of two non-streaming, superimposed viscoelastic fluids subjected to a horizontal magnetic field. For a uniform vertical magnetic field, many researchers have studied the K-H instability in layered sticky liquids inside a permeable material. Singh and Mathur [12] investigated the Rayleigh-Taylor instability of a viscoelastic fluid submerged in a horizontal magnetic field. Chand and Kumar [13] examined the thermal instability of a rotating Maxwell viscoelastic fluid under variable gravity within a porous medium. M. Cracco, C. Davies, and T. N. Phillips [14] analyzed the linear stability of a second-order fluid flowing past a wedge. Franz-Theo Schon and Michael Bestehorn [15] analyzed the development of instabilities and pattern formation in viscoelastic fluids. It helps us analyze the stability of a smooth boundary dividing two flowing, electrically conductive, and viscous liquids under a vertical magnetic field within a porous medium. Several other researchers have also proposed various statistical models that are widely utilized today [16 - 19]. The normal mode method is employed to assess stability for the stationary state in hydrodynamic or hydromagnetic systems. This approach is highly versatile and has been widely utilized. Its strength lies in providing comprehensive insights into instability, including the growth rate of any unstable disturbance. Hydromagnetic (MHD) fluid dynamics has significant usage in geological, astronomical research, Magnetohydrodynamic generators, oil industry, and water sciences. The relationship involving a moving electrically conducting fluid and a magnetic field generates a significant impact on chemistry, physics, and engineering. Additionally, fluid motion through porous media has extensive applications in oil industries, irrigation systems, soil management techniques, also in various other fields Some extensions of the previous studies to MHD motions of second-grade fluids through porous media have been provided by Hayat *et al* [20]. A magnetic field can decrease the flow resistance of a fluid and also help a fluid reach a steady state faster. The wavelength of the Kelvin-Helmholtz instability can be utilized for approximating the scale of droplet breakup.

MATHEMATICAL CALCULATION

We examined the flow behaviour of an incompressible, viscous, and perfectly electrically conductive fluid with a constant viscosity μ, moving at a steady horizontal velocity $\mathbf{U} = (U_x, U_y, 0)$ through a porous medium while subjected to a uniform vertical magnetic field $\mathbf{H} = (0, 0, H)$.

The associated linearized perturbation equations are:

$$\frac{\rho}{\varepsilon}\frac{\partial \mathbf{u}}{\partial t} + \frac{\rho}{\varepsilon}(\mathbf{U}.\nabla)\mathbf{u} = -\nabla\delta p + \mathbf{g}\,\delta\rho + (\nabla \times \mathbf{h}) \times \mathbf{H} + \frac{\mu}{\varepsilon}\nabla^2\mathbf{u} - \frac{\mu}{\lambda}\mathbf{u} \quad \textbf{(1)}$$

$$\varepsilon\frac{\partial(\delta\rho)}{\partial t} + (\mathbf{u}.\nabla)\,\rho = -(\mathbf{U}.\nabla)\delta\rho \quad \textbf{(2)}$$

$$\varepsilon\frac{\partial \mathbf{h}}{\partial t} + (\mathbf{U}.\nabla)\mathbf{h} - (\mathbf{H}.\nabla)\,\mathbf{u} = \mathbf{0} \quad \textbf{(3)}$$

$$\nabla.\mathbf{u} = 0 \quad \textbf{(4)}$$

$$\nabla.\mathbf{h} = 0 \quad \textbf{(5)}$$

Here, $\mathbf{h}(h_x, h_y, h_z)$, δρ, and δp represent the perturbations in the magnetic field **H**, density ρ, and pressure p, respectively, which arise due to the disturbance, along with Darcian velocity **u**(u,v,w) in the system. Where μ denotes the viscosity coefficient, $\mathbf{g} = (0, 0, -g)$ represents the gravitational acceleration, λ characterizes the permeability of the porous medium, and ε signifies the porosity of the medium. By examining the system through normal mode analysis, we assumed that the perturbed variables depend on spatial coordinates (x,y,z) and temporal (t) in the form (Equation 6):

$$\mathrm{f}(z)\, e^{(ik_x x + ik_y y + nt)} \quad \textbf{(6)}$$

Here, f(z) is a function that varies with z, while k_x and k_y represent the horizontal wave numbers, with the total wave number expressed as $k^2 = k^2_x + k^2_y$. Additionally, n signifies the amplification rate of the harmonic disturbance.

$$\frac{\rho}{\varepsilon}\,nu + i(U_x k_x + U_y k_y)u = [-ik_x\delta p + H_y(-ik_x h_y + ik_y h_x)] + \frac{1}{\varepsilon}[\mu(D^2 - k^2)u] - \frac{\mu}{\lambda}u \quad \textbf{(7)}$$

CHAPTER 20

A Comprehensive Analysis of AI's Influence on Human Society: A Systematic Survey

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Abstract: The main purpose of this research paper is to determine and evaluate the impact of Artificial Intelligence on human life. Artificial Intelligence is one of the most important and trending technologies in the current scenario. They are highly responsible for improving the quality of the interaction between humans and various technological systems. In today's world, Artificial Intelligence is highly advanced and is continuously growing at a rapid pace. A large number of AI applications and devices which work on the concepts of AI can be seen around us. Artificial intelligence's main goal is to build systems that can perform better than humans in various fields and to provide better solutions to problems than humans.

Keywords: AI applications, Artificial intelligence, BERT, Environment, Human intelligence.

INTRODUCTION

AI can be defined as a kind of technology used to implement human intelligence features in machines. AI is mainly used in making machines that can think and learn like human beings. It helps us to efficiently analyze a large amount of data in a very short duration of time and make predictions based on this data. Some examples are Face Detection Systems, Self-driving cars, etc. In today's world, various machines and systems related to Artificial Intelligence can perform tasks requiring human intelligence and decision-making ability [1]. Artificial intelligence can now perform many complex tasks such as translating signs and languages, performing data analysis, and making predictions. In the current scenario, people are using face filters for their posts on social media and they are using navigational apps to find the shortest route to their destination. Both of

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

these systems are applications of AI. As a result, AI is now an integral part of our life. But Artificial Intelligence and its applications have some negative effects also on our lives and society along with their positive effects.

HISTORY OF AI

The concept of AI is not very new. It was implemented for the first time by McCullouch and Pitts who made a formal design for Turing's complete Artificial Neurons in 1943. In the 1950s, Symbolic AI was used to create a symbolic representation of the world and systems, and the Connectionist approach was used to achieve intelligence through learning. In the 1960s and the 1970s, research was mainly done using the symbolic approach because it helped in creating a machine with artificial intelligence better than the connectionist approach. In the 1980s, AI research achieved a rapid pace, due to the commercial success of the devices, which were created using AI [2]. By 1985, the market for AI had reached over a billion dollars. However, due to the collapse of the Lisp Machine market in 1987, the importance of AI received a setback. AI gradually restored its reputation in the late 1990s and early 21st century by finding specific solutions to specific problems. By 2000, systems developed using Artificial Intelligence were being widely used in various fields. In 2017, a survey was done in which 20 percent of all the companies reported that they were using AI-related systems and devices in some or all processes.

RELATED WORK

To determine the capability of AI, matching Human intelligence is the most important condition. In the upcoming years, the research on AI will be more human-oriented i.e. devices will be developed, which can collect and analyze sensory information [1]. In today's scenario, AI is used in a large variety of fields such as Machine Learning, Deep Learning, Robotics, Natural Language Processing, Facial Recognition Systems, *etc* [3]. In the upcoming years, it is expected that the main goal or the motive for further progress in the field of Artificial Intelligence will be to develop systems that can connect emotionally with human beings to understand and analyze their emotions to a greater extent of accuracy than the currently available technologies. Some of the important domains where AI is extensively used are transportation, healthcare, education, and public safety and security [4]. There are a large number of issues related to AI due to its wide variety of applications. Some of the most important issues are reduced decision-making of human beings, improper handling and misuse of data, decrease in the number of jobs, etc. There must be some rules and regulations to handle these kinds of issues. In developing an AI system, there are a number of phases such as planning, data collection, model building, verification,

deployment, and monitoring. In today's scenario, companies are investing a large amount of money in using AI-related systems and devices to perform various tasks [5]. AI has some important positive impacts on human life such as it performs such tasks which can prove fatal to human beings such as developing robots for diffusing bombs. Some ethical rules or laws must be made regarding AI such as it should be secure and accurate, services provided by it should be available to all, *etc* [6]. Year-wise review of the impact of AI on society is presented in Table **1**.

REVIEW OF IMPACT OF AI ON HUMAN SOCIETY

Table 1. Year-wise review of the impact of AI on society.

YEAR	RELATED FIELD	DESCRIPTION
2012	IBM Watson [7]	It is a natural language processing system that takes questions from humans, analyses them, and then returns the answer.
2013	NEIL [8]	Never Ending Image learner, also known as NEIL, is a program that analyses images and provides information related to it. It also finds the common links between various images which we encounter in our everyday life. Hence, it is clear that NEIL has taken the concept of image recognition to a very high level than humans.
2014	Self-Driving Cars	Tesla introduced self-driving cars or cars with autopilot mode. These cars have features such as automatic control over the steering wheel, braking system, and speed limit, which is based on signs and an image recognition system. It also provides the facility of auto parking.
2015	Open AI	It is a research organization whose main objective is to increase the connectivity between humans and AI. It is mainly related to Deep Learning.
2016	Rise of AlphaGo	It is a kind of algorithm, released by Google, which defeated the World Champion, Lee Sedol in a game known as "Go". It is a game that is more complicated than chess. It has highly complex strategies and a very large no. of moves. It was believed that it can be mastered by Human Intelligence only.
	Sophia	It is a kind of social-interacting, humanoid robot. It can understand and analyze human gestures and facial expressions. It can also perform simple conversations on some selected and common topics.
2017	ONNX	Open Neural Network Exchange, also known as ONNX, is a kind of virtual format through which various deep learning models can interact with each other and can be trained in a single framework.
2018	BERT	It is a kind of language processing software that was developed by Google. It is used for language translation and other related tasks.
2019	Solving Rubik's Cube with AI	A robot hand, known as Dactyl, was invented which successfully solved a 3x3x3 Rubik's cube. This Robot hand was trained using concepts of open AI, in a real-world environment.

CHAPTER 21

An Investigative and Experimental Study the Effects of Terrazyme on the Improvement of Black Cotton Soil

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Abstract: TerraZyme is a natural, non-toxic, non-flammable, and non-corrosive liquid enzyme mixture fermented from vegetable extracts. It improves the engineering properties, workability, and stability of the soil by catalyzing clay-organic cation interactions and accelerating the cationic exchange process, allowing for the formation of a thinner adsorbed layer. TerraZyme-treated red dirt and black cotton soil were subjected to strength tests. Counselling is made easier by compressibility and index. The unconfined compressive strength, CBR, consistency limits, compressibility, and swelling of unsterilized and stabilized soil samples were measured after air drying and desiccator curing. The air-dry curing method, which mimicked field conditions, increased the UCS and CBR of TerraZyme-treated soils, both expansive and non-expanding. TerraZyme improves both expansive and non-expansive soil index qualities in addition to air-drying and desiccator curing. Air-dry curing outperforms desiccator curing in terms of compressibility and edoema. Air-dry curing is the most effective method for stabilizing expansive and non-expansive soils, according to research. Researchers investigated air drying and desiccator curing to economically stabilize TerraZyme-modified soil.

Keywords: Curing, Soil engineering properties, Soil stabilization, Terrazyme, Unconfined compressive strength.

INTRODUCTION

Black cotton soil has been present in various parts of the world for thousands of years. In India, it is believed to have formed during the Cretaceous period, around 100 million years ago. The soil is found in several states in India, including Gujarat, Maharashtra, Madhya Pradesh, and Karnataka, and is considered a significant agricultural resource in these regions. The soil has been used for various purposes throughout history, including building and construction,

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

agriculture, and even as a medium for artistic expression. However, its unique properties have also presented challenges, particularly in construction, where it can cause significant settlement and structural damage. Efforts have been made in the past years to develop strategies for managing black cotton soil in construction and agriculture, including the use of geotechnical techniques [1] to stabilize the soil and improve its load-bearing capacity, and the use of organic and inorganic amendments to improve its fertility and water retention properties.

Overall, black cotton soil's history is filled with both challenges and opportunities, and its unique properties continue to present both benefits and difficulties for those who use it.

BLACK COTTON SOIL

Black cotton soil or black soil is a type of soil that is high in clay content and organic matter, giving it a dark color. It is found in several regions of the world, particularly in India, Africa, and parts of North America.

Black cotton soil is known for its unique properties, including its ability to expand and contract significantly depending on its moisture content. When it is dry, it becomes hard and compact, but when it is wet, it swells and becomes very soft [2] and muddy. This property can make it difficult to build structures on black cotton soil, as it can lead to significant settlement and structural damage [3].

Despite its challenges, black cotton soil can also be beneficial for agricultural purposes, as it has good water retention properties and can provide nutrients to crops. However, it is important to manage its moisture content carefully to avoid issues such as waterlogging or soil erosion. Overall, black cotton soil is a unique and important soil type with both benefits and challenges depending on its intended use. Its properties make it both a valuable resource and a difficult material to work with, and understanding its characteristics is crucial for those who work with it.

Black Cotton Soil – Main Components

Main components of black cotton soil are clay minerals, particularly montmorillonite, which gives the soil its characteristic properties of high shrink-swell capacity, high plasticity, and low bearing capacity. Other components found in black cotton soil may include silt [3], sand, and organic matter. However, the proportion of these components can vary depending on the location and depth of the soil [4].

METHODOLOGY

Terrazyme

Terrazyme is a soil conditioner that contains a blend of enzymes designed to improve soil structure and fertility. The enzymes in Terrazyme are derived from a variety of sources, including bacteria, fungi, and plants.

Fig. (1). TerraZyme.

Terrazyme shown in Fig. (**1**) acts as a catalyst in the cation exchange process between clay particles and organic cations, fundamentally improving the structural and mechanical properties of black cotton soil. The enzymes in Terrazyme facilitate the breakdown of organic matter into simpler, bioavailable forms, which interact with clay particles to enhance soil stability.

At a molecular level, clay particles in black cotton soil typically exhibit a **negative charge**, which attracts water molecules and cations, forming a thick adsorbed water layer. This thick water layer is a significant factor contributing to the soil's swelling and poor compaction characteristics. Terrazyme accelerates the **cationic exchange process**, enabling clay particles to bind more strongly with organic cations. As a result:

CHAPTER 22

Social Media Monitoring for Extremism Detection using Deep Neural Network

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Abstract: Social media platforms are crucial for information and communication, but the rise of extremism and radical content has raised concerns. To ensure user safety and security, a novel approach to extremism detection is proposed using deep neural networks and a multi-language dataset. This approach considers the linguistic diversity found in social media conversations and leverages a multilingual dataset including Hindi, English, and Hindi-English code-mixed language data. Machine learning and deep learning models, including CNN, Bidirectional Long Short-Term Memory networks (Bi-LSTM), and BERT, are employed to process and analyze the multilingual data. Word embedding techniques like Word2Vec and GloVe are used to represent words and phrases in a continuous vector space. Preprocessing methods like tokenization, stemming, and top-word removal are employed to enhance the quality and consistency of the input data. The proposed approach achieves promising results in detecting extremism across different languages, surpassing traditional English-only models. The integration of diverse linguistic data and the utilization of multiple deep learning models contribute to the robustness and effectiveness of the system.

Keywords: BERT, Bi-LSTM, CNN, Deep learning, Extremism detection, Multilingual data, Social media monitoring.

INTRODUCTION

Extremist content and radicalization are risks on social media, which have changed communication. Using English-language datasets and algorithms, researchers automated social media extremism identification. Online extremism detection must be expanded to include multilingualism.

This paper provides a multi-language deep neural network-based social media monitoring and extremism diagnosis approach. The technique uses Hindi,

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

English, and Hindi-English code-mixed for social media's diverse and complicated language patterns.

CNN, Bi-LSTM, and BERT deep learning architectures find complex patterns in textual input and create sophisticated representations. FastText and GloVe word embedding captures semantic and contextual links between words, boosting the model's ability to recognize radical language trends across languages.

The proposed method is tested using a large Twitter, Facebook, and YouTube dataset. Results reveal that the offered method can detect extremism in many languages and genres.

Deep neural network-based social media monitoring and extremism detection using multi-language datasets is presented. This comprehensive social media extremist content identification method uses Hindi, English, and Hindi-English code-mixed data, deep learning models, word embeddings, and preprocessing.

CNNs, Bi-LSTMs, and BERT boost extremism detection by capturing speech and contextual clues. Word embeddings model words and phrases in a continuous vector space to discover semantic links and understand words across languages.

Tokenization, stemming, and stop-word elimination increase input data consistency. The recommended method detects extremism across languages better than English-only models.

Natural language processing and deep learning are improved by studying social media data on multilingualism. Future research might add more languages to extremism detection models, use domain adaptation to overcome the lack of labelled data in some languages, and use contextual information to improve accuracy and granularity.

RELATED WORKS

In conducting this study, an exhaustive review of relevant literature was undertaken. The subsequent section presents a comprehensive summary of some of the studies that were examined.

In their study, Nwankpa *et al*. [1] put up a methodology that utilizes a deep neural network to identify extremist content present on various social media sites. The research conducted by the authors emphasized the efficacy of a hybrid Convolutional Neural Network (CNN) and Recurrent Neural Network (RNN) model in the detection and classification of extremist content on diverse social media platforms. Although the findings demonstrate potential, the researchers

underscored the significance of ethical considerations and the need to mitigate potential biases that may arise during the implementation of these models.

The sentiment analysis-based approach proposed by Asif *et al*. [2] aimed to identify extremist content of the subject matter pertaining to social media networks, such as Twitter and Reddit. The study placed significant emphasis on the efficacy of Support Vector Machines (SVMs) and sentiment-related features in attaining a notable level of accuracy in identification. Nevertheless, the researchers acknowledged the inherent constraints present in their dataset and emphasized the need for additional study to evaluate the applicability of their approach in a broader context.

In their study, Parveen *et al*. [3] put forth a novel methodology that utilizes deep learning techniques for the identification of extremist content on various online media platforms. The authors specifically highlight the efficacy of Long Short-Term Memory (LSTM) networks in achieving this objective. The study conducted by the researchers emphasized the significance of word embeddings and semantic properties. As with previous investigations, the researchers acknowledged the presence of ethical considerations and emphasized the need for further inquiry into the issue of scalability.

In their study, Gaikwad *et al*. [4] undertook a comprehensive analysis of existing scholarly literature on the detection of online extremism. The authors identified several recurring obstacles encountered in the use of standardized datasets, potential biases inherent in classification models, and issues associated with generalizing findings. The proposed approach for tackling these difficulties involves the utilization of varied datasets, the implementation of explainable AI techniques, and the adoption of interdisciplinary approaches.

Torregrosa and Bello-Orgaz [5] conducted an extensive examination of the analysis of extremism through the application of natural language processing (NLP) techniques. The individuals engaged in a discourse pertaining to diverse forms of extremism that have been subject to investigation, as well as the utilization of Natural Language Processing (NLP) techniques. In doing so, they emphasized the necessity for annotated datasets and models that exhibit enhanced transparency. Furthermore, many researchers have presented machine learning and deep learning algorithm applications in their work [6 - 12].

DATA PREPARATION

We have collected 1.1 million Twitter messages and tested multiple word preprocessing and word embedding methods using a development dataset. This study determined the best embedding method, Word2Vec, GLoVe, fastTEXT, or

CHAPTER 23

Simulation of Wireless Power Transfer for a 3 Level-based Electric Vehicle

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Abstract: Wireless power transfer (WPT) utilizing magnetic resonance is a technology that has the potential to liberate humanity from the inconvenience of wires. In essence, WPT is based on the same fundamental principles that have been refined over the past three decades under the term Inductive Power Transfer (IPT). Recent years have witnessed significant advancements in WPT technology, with transfer distances at the kilowatt power level increasing from mere millimeters to several hundred millimeters, and grid-to-load efficiency exceeding 90%. These developments have rendered WPT highly appealing for electric vehicle (EV) charging applications, both in stationary and dynamic charging scenarios. By integrating WPT into EVs, the challenges of charging time, range, and cost can be effectively addressed, rendering battery technology irrelevant for mass market penetration of EVs. It is our hope that these state-of-the-art achievements will inspire researchers to further develop WPT and expand the EV market.

Keywords: Dynamic charging, Electric vehicle, Inductive power transfer, Wireless power transfer.

INTRODUCTION

The electrification of transportation has been driven by energy, environmental, and other factors, leading to the development of electric locomotives in railway systems. Unlike trains that easily acquire power from conductor rails, electric vehicles (EVs) face challenges due to their high flexibility. To overcome this, EVs are equipped with high-power, large-capacity battery packs as energy storage units. However, despite government incentive programs, EVs have not gained widespread consumer appeal. The main obstacle lies in battery technology, which currently faces limitations in terms of energy density, lifespan, and cost. Designing an EV battery is complex, as it must meet multiple requirements

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

simultaneously, including high energy density, power density, affordability, long cycle lifespan, and excellent safety and reliability. Among the available options, lithium-ion batteries are considered the most competitive solution for EVs [1].

The development of charging infrastructure plays a pivotal role in the practicality and usability of electric vehicles (EVs). In recent years, wireless charging systems have emerged as a promising alternative to traditional wired methods [2]. Referred to as inductive charging or wireless power transfer, this technology enables EVs to charge without the need for physical cables by utilizing electromagnetic fields between a charging pad on the ground and a receiver pad integrated into the vehicle. Wireless charging offers several advantages that enhance the EV charging experience [3]. Firstly, it provides a higher level of convenience by eliminating the manual process of connecting cables. Drivers can simply park their vehicles over a charging pad, and the charging process initiates automatically. Secondly, wireless charging systems improve usability by eliminating the need to handle cables or search for specific charging ports. This streamlines the charging process and makes it more user-friendly. Moreover, these systems prioritize safety through the incorporation of features like foreign object detection and ground fault protection. These safety features reduce the risks of electric shock and potential damage caused by misalignment. Another benefit is the increased durability resulting from the absence of physical connectors. This reduces wear and tear on both the vehicle's charging port and the charging infrastructure. Additionally, wireless charging holds future scalability potential, as it enables dynamic charging while the vehicle is in motion. It is important to note, however, that wireless charging systems may exhibit slightly lower efficiency and have higher initial costs compared to traditional wired charging. Despite this, the convenience and improved user experience offered by wireless charging systems make them increasingly appealing to a wider range of consumers. Ongoing advancements in wireless charging technology are expected to address current limitations, further improving efficiency. The block diagram of wireless power transfer is shown in Fig. (**1**).

MATHEMATICAL CALCULATIONS

$$S_{12} = -U_{12}i_2^* = -j\omega MI_1I_2^* \tag{1}$$

$$= \omega MI_1I_2 sin\varphi_{12} - j\omega MI_1I_2 cos\varphi_{12}$$

$$S_{21} = -U_{21}I_1^* = -j\omega MI_2I_1^* \tag{2}$$

$$= -\omega MI_1I_2 sin\varphi_{12} - j\omega MI_1I_2 cos\varphi_{12}$$

$$P_{12} = \omega I_1I_2 sin\varphi_{12} \tag{3}$$

$$\begin{aligned} S &= S_1 + S_2 \\ &= j(\omega L_1 I_1 + \omega M I_2) I_1^* + j(\omega L_2 I_2 + \omega M I_1) I_2^* \\ &= j\omega(L_1 I_1^2 + L_2 I_2^2 + 2M I_1 I_2 cos\varphi_{12}) \end{aligned} \quad \textbf{(4)}$$

$$\begin{aligned} Q &= \omega(L_1 I_1^2 + L_2 I_2^{\,2} + 2M I_1 I_2 cos\varphi_{12}) \\ f(\varphi_{12}) &= \frac{|P_{12}|}{|Q|} = \left| \frac{\omega M I_1 I_2 sin\varphi_{12}}{\omega L_1 I_1^2 + \omega L_2 I_2^2 + 2\omega M I_1 I_2 cos\varphi_{12}} \right| \end{aligned} \quad \textbf{(5)}$$

$$\begin{aligned} &= \frac{K\sqrt{1-cos^2\varphi_{12}}}{\sqrt{\frac{L_1}{L_2}\frac{I_1}{I_2}} + \sqrt{\frac{L_2}{L_1}\frac{I_2}{I_1}} + 2k cos\varphi_{21}} = \frac{k\sqrt{1-cos^2\varphi_{12}}}{x + \frac{1}{x} + 2k cos\varphi_{12}} \\ &\frac{\partial}{\partial\varphi_{12}} f(\varphi_{12}) = 0 \;,\; \frac{\partial^2}{\partial^2\varphi_{12}} < 0 \end{aligned} \quad \textbf{(6)}$$

And the solutions are

$$\begin{aligned} cos\varphi_{12} &= -\frac{2k}{x + \frac{1}{X}} \;, sin\varphi_{12} = \sqrt{1 - \frac{4k^2}{\left[x + \frac{1}{x}\right]^2}} \\ &\frac{\partial}{\partial a}\eta(a) = 0 \;, \frac{\partial^2}{\partial^2 a}\eta(a) < 0 \end{aligned} \quad \textbf{(7)}$$

The maximum efficiency

$$\eta_{max} = \frac{k^2 Q_1 Q_2}{\left(1 + \sqrt{1 + K^2 Q_1 Q_2}\right)} \quad \textbf{(8)}$$

PROPOSED METHODOLOGY

3-Level Inverter

A three-level inverter is a power electronic device shown in Fig. (**2a**) that converts DC power into AC power with three distinct voltage levels that can be seen in Fig. (**2b**): positive, negative, and zero. The working principle involves using multiple power semiconductor switches controlled by Pulse Width Modulation (PWM) [4 - 10].

CHAPTER 24

Degradation of Rhodamine B (RhB) Dye from Aqueous Solution using Fenton Oxidation Process

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Abstract: Fenton's process has established a cost-effectively, viable process for the degradation of harmful pollutants present in wastewater. Therefore, in the work, degradation of Rhodamine B (RhB) dye in aqueous medium was carried out using Fenton (Fe^{2+}/H_2O_2) process. The effects of different process parameters *i.e.*, Fe^{2+} dosage (25–200 mg/L), H_2O_2 concentration (25–150 mg/L), initial dye concentration (20-100 mg/L), and solution pH (3 – 9), on the extent of degradation have been conducted in a batch mode. It has been observed that the degradation efficiency of RhB was found to be dependent on the pH of the solution. The optimum conditions were observed to be pH (3.0), H_2O_2 concentration (50 mg/L), and Fe^{2+} concentration (150 mg/L) for an initial RhB dye concentration of 20 mg/L at a temperature of 20°C. Under the optimum conditions, nearly 77% degradation of RhB in aqueous solution was found in 30 min of reaction time. In order to confirm the obtained experimental data, a digital automated program has also been used. Overall, it can be concluded that Fenton's process may be used for the degradation of RhB dye and other similar dyes containing dye wastewater.

Keywords: Degradation, Fenton's reagent, H_2O_2, Rhodamine B, Wastewater treatment.

INTRODUCTION

In recent years, advanced oxidation processes such as ozone, photolytic oxidation, Cavitation, Fenton's reagent (H_2O_2 and Fe^{2+}), and Photo-Fenton have received more attention for the degradation of dyes in wastewater [1 - 3]. Amongst all the above methods, Fenton's reagent has been usually utilized for dye degradation

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

due to its efficiency, ease application, reaction suitability with organic molecules, and no generation of hazardous compounds throughout the oxidation process. In Fenton's process, generated hydroxyl radical (E^0 = 2.80 V, $^{\bullet}OH$) can cause the degradation of various organic molecules in water. Textile dyeing industries during the dyeing process produce large quantities of wastewater containing different types of synthetic dyes. Nearly 8 x 10^5 tonnes of dyes are generated per annum over the world [4], and it has been assumed that about 18–20% of the total production of dyes during dyeing is directly discharged into the water bodies [5, 6].

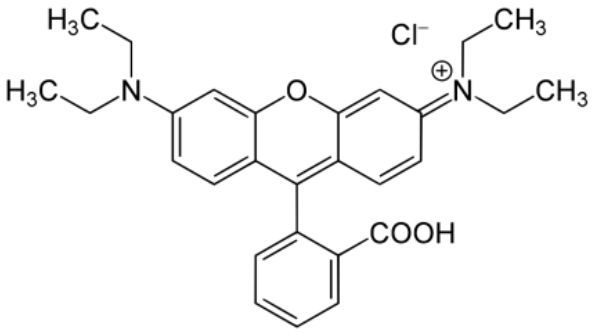
The aim of the current study was to check the efficiency of Fenton's oxidation process towards the percentage colour removal of Rhodamine B (RhB) from aqueous solution. The present work focuses mainly on the effect of different process parameters like Fe^{2+} dosage, H_2O_2 concentration, initial RhB dye concentration, and pH, on the decolorization efficacy of the dye. The degradation of RhB in terms of Chemical Oxygen Demand (COD) removal was also explored.

MATERIALS AND METHODS

Chemicals

Rhodamine B dye was procured from Central Drug House (CDH) Pvt. Ltd. The characteristics of the dye are shown in Table **1**. The ferrous sulphate heptahydrate ($FeSO_4 \cdot 7H_2O$) was used to provide the Fe^{2+} ions. $FeSO_4 \cdot 7H_2O$ and H_2O_2 (30% w/w) were achieved from Fisher Scientific. All the chemicals used in the study were prepared using distilled water. All the chemicals were used in this work without any further purification and were of analytical grade.

Table 1. Characteristics of Rhodamine B dye.

Name of Dye	Molecular Formula	Molecular Structure	λ_{max} (nm)	Molecular Weight (g/mol)
Rhodamine B	$C_{28}H_{31}ClN_2O_3$		554	479.02

Experimental Procedure

Experiments were carried out with a 20 mg/L concentration of RhB. All experiments were conducted in a 500 mL beaker containing 300 mL of RhB dye. The pH was adjusted using 0.1N HCl and 0.1N NaOH. Initially, the effect of the initial Fe^{2+} concentration from 25 to 200 mg/L on the decolorization was studied. The effect of H_2O_2 concentration from 25 to 150 mg/L was examined . Then, experiments were conducted over the solution pH range of 3-9 to optimize the pH of the solution. Also, the effect of initial dye concentration on the decolorization of RhB was studied in the range of 20-100 mg/L.

Analytical Procedure

Concentration of RhB with respect to time was determined by UV/Vis-Spectrophotometer at the maximum wavelength (λ_{max}) of 554 nm. Firstly, the calibration curve was prepared using known RhB concentrations in the range of 20–100 mg/L to determine the concentration of the unknown sample. Reproducibility of experimental results was checked by performing the experiments at least two times, and the experimental errors were found to be within ± 4%. The chemical oxygen demand (COD) of the mixed dye in aqueous solution was measured by the standard open reflux titrimetric method [7]. The degradation efficiency of RhB was determined using the following Eq. (1):

$$\text{Degradation efficiency} = \frac{C_o - C_t}{C_o} \text{ X } 100 \qquad \textbf{(1)}$$

where C_0 (mg/L); the initial RhB concentration, and C_t (mg/L); the concentration of RhB with reaction time t (min).

RESULTS AND DISCUSSION

Effect of Initial Fe^{2+} Dosage

To examine the role of initial Fe^{2+} dosage on the degradation efficiency of RhB, the experiments were conducted with different Fe^{2+} dosages from 25 to 200 mg/L, and the observed results are depicted in Fig. (**1**). The degradation of RhB was significantly changed by varying the dosage of Fe^{2+} concentration. The lowest degradation efficiency of 36.73% was recorded at a Fe^{2+} dosage of 25 mg/L, whereas the maximum degradation efficiency of almost 77% was observed at a Fe^{2+} dosage of 150 mg/L within 30 min. The lower degradation efficiency of RhB at small Fe^{2+} concentration may be due to the lowest $^{\bullet}OH$ radicals generation during oxidation [8], whereas the highest degradation obtained may be due to the generation of higher $^{\bullet}OH$ radicals as per the following Eq. (2) [9]:

CHAPTER 25

The Influence of Polypropylene Fiber Composition on the Strength Characteristics of Geopolymer Concrete

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Abstract: It is commonly believed that a geo-polymer concrete has a lower global warming potential than OPC concrete. Numerous studies examining the mechanical qualities of geo-polymer concretes have been based on this notion. As per a study, geo-polymer concrete produces 80% less CO_2 emissions than ordinary Portland cement. This concrete's improved performance qualities and sustainable qualities have made it a viable substitute for traditional Portland cement-based concrete. Polypropylene is a type of thermoplastic polymer that finds extensive usage across a diverse range of applications. These applications include, but are not limited to, strapping materials such as ropes, thermal garments, and blankets. Polymer cement is a type of cement that utilizes a polymer to serve as a coating and facilitate bonding. The various types of materials in this category comprise polymer-filled solids, polymer cement, and Portland polymer bonded concrete. The aim of the research was to achieve the highest possible concrete strength through the utilization of the most suitable weight of polypropylene fibres. The utilization of fibre reinforced concrete has become prevalent in diverse engineering applications owing to its commendable and exceptional characteristics in the domains of industry and construction.

Keywords: Compressive test, Durability, Geo polymer concrete, Polypropylene fibers, Split tensile strength, Sustainable materials.

INTRODUCTION

In 1978, Daidovits introduced the term “geopolymer” to denote substances that possess networks or chains of inorganic molecules. Ground-granulated blast furnace slag and fly ash are two examples of materials that are used in the production of geopolymer cement concrete (GGBS) [1, 2]. Fly ashes are developed as a byproduct in thermal power plants, whereas ground-granule blast

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

furnace slag is composed as a waste substance in steel plants. Fly ash and GGBS are used in the construction of geopolymer concrete projects after undergoing the proper treatment procedures [3]. By reducing the need for Portland cement, the use of this concrete reduces waste inventories and carbon emissions. Materials used for geopolymer concrete are shown in Fig. (**1**).

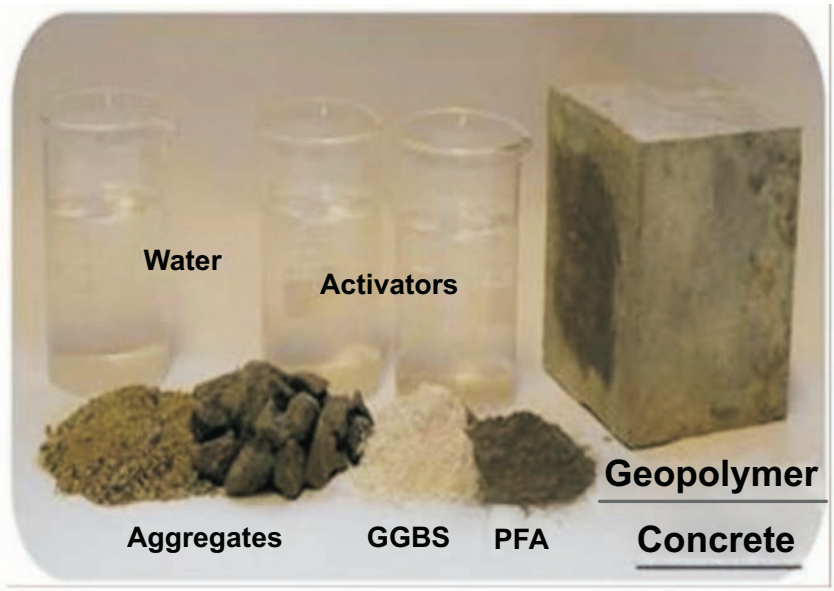

Fig. (1). Materials used for geopolymer concrete.

Geopolymers are primarily composed of silicon and aluminium, which are derived from either naturally occurring materials, such as kaolinite, or artificially produced materials, like fly ash and slag, that have undergone thermal activation. Subsequently, the polymerization of these chemicals into molecular chains and systems is then triggered by the use of an alkaline activating solution, which forms a solidified binder. It is sometimes referred to as alkali-activated cement and inorganic polymer cement.

LITERATURE REVIEW

Arunkumar *et al*. [4] conducted an experiment to ascertain whether low calcium wood ash could replace fly ash in geopolymer concrete. Test results indicated that 30% of the absolute binder substance should be composed of residual wood ash in order to achieve the maximum flexural and compressive strengths.

Al-Nazi and his colleagues [5] conducted a research centered on the microscopic composition of a geo-polymer concrete. The findings of the study indicate that

geo-polymer concrete demonstrated enhanced Interfacial Transition Zone (ITZ) characteristics in comparison to traditional concrete. The observed phenomenon could potentially be attributed to the matrix's heightened affinity towards the particles.

Ouda *et al*. [6] found a solid and more impenetrable tiny structure after heating the geopolymer pattern to 800 °C for two hours at a standard of 5 °C/min while integrating brick detritus and 5-30% calcined dolomite concrete dust, raising the RA concentration to prevent the development of cracks in the geopolymer mixture.

Rajini *et al*., along with others [7], analyzes the costs of geo polymer concrete compared to those of traditional concrete. Cement, fine aggregate, coarse aggregate, and superplasticizer were used as components for traditional concrete. GPC was made up of coarse aggregates, bottom ash, NaOH particles, GGBFS, river sand, foundry sand, and Na_2SiO_3 solution. GPC was around 1.7% more expensive to create 1 m3 of M30-grade concrete than normal concrete, whereas M50-grade concrete resulted in savings of about 11%.

Sultana *et al*. [8] use the composition of cement kiln dust that differs between FA and GGBFS while producing geopolymer cement. The raw ingredients for the geopolymer were activated by crystalline sodium metasilicate penta hydrate ($Na_2SiO_3.5H_2O$). The geopolymer cement's mechanical characteristics were examined. According to the results, the compressive strength of the geopolymer pastes rose as the concentration of ($Na_2SiO_3.5H_2O$) increased.

Paiva *et al*. [9] tested the mechanical performance of the geopolymer system generated by the potassium-based metakaolin formulation containing mineral fiber, retarder, and micro silica. The outcomes demonstrated that, with appreciable mechanical performance gains, geopolymers constitute a competitive alternative to the oil well cementing method.

METHODOLOGY

The process of creating geopolymer concrete is a meticulous one that integrates ingredients, ratios, and curing methods. An environmentally beneficial substitute for conventional Portland cement-based concrete is geopolymer concrete. Fly ash, slag, metakaolin, and other materials high in silicon (Si) and aluminum (Al) can be activated in alkaline solutions to generate geopolymers. The geopolymer concrete is synthesized by mixing silicate-bearing and aluminates. The caustic activating agent is also used, and during the synthesis of GPC, no heat is used and therefore no carbon dioxide is generated [10]. Whereas, in standard Portland cement, the heat is required and therefore carbon dioxide is also generated.

CHAPTER 26

A Brief Review of Biometric Template Security Schemes: Advantages and Drawbacks

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Abstract: Nowadays, biometrics is so prevalent within critical regions and other access control systems. This broad applicability of biometrics has also provided assaulters with new opportunities. As a result of the proliferation of technology, cybercriminals have also become more intelligent. Now, rather than trying to crack passwords, they are more interested in breaking into biometric-based systems. Because a human's biometric is not something that can be regenerated, it stays remarkably consistent throughout his lifetime. As a result, if such information falls into the wrong hands, a person cannot modify their features and there is no way to recover it. Although numerous researchers have developed techniques for securing such information, there are still many unfilled gaps. In order to accomplish the goal of data protection, this paper first describes the need for the protection of biometric data. It next offers a brief analysis of the strategies recommended by various researchers, along with their benefits and drawbacks.

Keywords: Authentication, Cancellable biometrics, Multimodal biometrics, Template security.

INTRODUCTION

The term “biometric” describes a person's undeniable characteristics that can be utilized as a key to access certain restricted locations. Because each individual is unique, their biometric information can be used as a distinctive key to perform a range of identification and authentication-based tasks [1]. Utilizing biometrics has been found to increase security for crucial applications, unlike conventional password or token-based systems. Biometric-based systems also have some weak areas that need to be addressed, since no authentication system is completely safe.

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

Table **1** lists these vulnerable points, the various attack types that could target them, and the appropriate countermeasures. The attack on the storage system is the most hazardous of the susceptible modules indicated in the table below since it would provide hackers access to users' biometric templates.

Table 1. Vulnerable points of biometric systems: Attacks and Countermeasures.

Vulnerable Modules	Attacks possible	Countermeasures
Sensor	Spoofed input	Liveness detection
Feature Extractor	Overriding extractor, replaying old data.	Digital signature
Matcher	Overriding matcher, matching score manipulation.	Secure transmission channel, multi-biometrics
Database or Storage System	Modified template, compromising the database.	Template security, encrypted template, *etc*.
Decision module	Overriding final decision.	Debugger hostile environment, secure channel, *etc*.
Data transmission	Eavesdropping, replay, brute force attack, and man-in-the-middle attack.	Encrypted data transmission, incorporating the TTL field within the data.

NEED FOR BIOMETRIC TEMPLATE PROTECTION

Biometric template protection is the application of security techniques to safeguard biometric templates that reside in databases [2]. Biometric templates, often known as digital representations of an individual's distinguishing physical or behavioral attributes, are essential for comparing and validating a person's identity in biometric authentication systems. This section highlights the importance of biometric template protection measures, which pose a major concern due to the fact that, similar to separate tokens and passwords, compromised biometric templates cannot be cancelled. This is a common problem with biometric authentication [3]. Passwords are frequently utilized in order to protect digital data; nevertheless, there are several compelling reasons why they are not utilized in order to preserve biometric templates. One reason is that each time authentication is attempted, the user must remember and enter the password. The other one is that the level of protection offered by a password is insufficient to safeguard biometric templates. As previously mentioned, unlike passwords, there is no method of restoring hacked biometric data. This makes storage structure security a very important issue that researchers must focus on. Biometric template protection is essential due to concerns like safeguarding privacy, the irreversible nature of biometric data, widespread usage across systems, defense against various attacks, and compliance with strict regulations. Furthermore, maintaining

user trust and acceptance is crucial for the successful adoption of biometric systems. Different biometric template security methods, including encryption, hashing, salting, fuzzy extractors, secure template storage, and multi-factor authentication, have been developed to address these issues. Combining these methods ensures that biometric data is secure and may be utilized successfully in a variety of applications without jeopardizing system integrity or user privacy. Some of these techniques are described in depth in the next section.

TEMPLATE PROTECTION SCHEMES

The requirements of security, diversity (the distinctiveness and variance of biometric templates, which guarantee that each person's data is hard to copy or mimic), revocability (the capability of invalidating or replacing a compromised biometric template, enabling users to change their information without losing system access), and performance should be addressed in order to construct a flawless biometric template protection system that guarantees a high level of protection [1]. Various template protection schemes can be described as follows:

- **Cryptographic techniques:** They entail protecting biometric data using encryption, hashing, or other cryptographic techniques, guaranteeing confidentiality, integrity, and privacy while permitting safe authentication or verification.
- **Fuzzy vault:** With the use of a polynomial and a collection of randomly generated points, this cryptographic scheme turns biometric data into a secure "vault" that permits safe biometric template storage and retrieval while enabling dependable matching even when there are minor discrepancies or errors in the biometric data.
- **Cancellable Biometrics:** It is a biometric template protection technique that allows for safe authentication and privacy preservation by converting biometric data into an irreversible form that may be used to replace the compromised template.
- **Biometric cryptosystems:** In order to create secure keys for authentication, this technology combines biometric information with cryptographic methods, guaranteeing data security and identity verification.
- **Trusted platform modules:** They are specialized hardware parts made to guarantee platform integrity, offer safe storage for cryptographic keys, and facilitate trusted computing by shielding private information and processes from manipulation or unwanted access.
- **Template transformation:** By changing the original biometric data into a different format, this biometric template protection method ensures security and privacy while preserving the capacity for precise matching.

CHAPTER 27

Exploring Data Acquisition Techniques: A Comparative Study of Web Scraping Libraries

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Abstract: Web scraping emerges as a computational technique capable of efficiently harvesting substantial data from websites. This paper presents a comprehensive exploration of various web scraping strategies, backed by empirical research findings. Prominent libraries like BeautifulSoup and LXML, along with external libraries like Requests and Selenium, are scrutinized in the pursuit of extracting valuable data. The primary objective of this research is to assess the efficacy of different web scraping libraries. To achieve this, each approach is rigorously tested while attempting to extract data from targeted websites. The evaluation criteria encompass process time, memory consumption, and data usage. Our experimental results demonstrate a significant performance gap between web scraping libraries. Compared to BeautifulSoup, Selenium and LXML were notably more efficient, consuming 81% less memory and utilizing 12% less processing time, which is reduced by 28%. Our findings underscore the importance of library choice in web data extraction research. The performance disparities observed among the libraries highlight the need for practitioners to carefully consider their specific requirements and select the most suitable tool for their web scraping tasks.

Keywords: BeautifulSoup, HTML DOM, LXML, Web Scraping, XPath.

INTRODUCTION

The internet is a source of data for many applications, including business analytics, industry analysis, opinion mining, agricultural economics, computational biology, social media analytics, and many more data-driven applications [1].

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Nitin Tyagi & Satya Prakash Yadav (Eds.)

Data collection serves as the initial phase of research, involving the systematic measurement of relevant variables. Data collection methods vary based on the discipline, desired information, and researcher goals. Adapting these methods to specific objectives and circumstances ensures data integrity, accuracy, and reliability. Extracting data or information from websites on the internet is referred to as web scraping.

Multiple studies and surveys [2 - 5] have explored the diverse landscape of web scraping tools and applications, highlighting their varied forms and distinct characteristics.

Vast amounts of web data are in HTML, challenging automated extraction meant for human readers. Abundance of both structured and unstructured online data poses a new challenge for specific inquiries, shifting focus from scarcity to relevance [6], it is about navigating the tangled masses of web data. Without these methods, it would be impossible to gather the volume of data frequently and affordably.

Several methods for extracting data from websites, including the basic manual approach of copying and pasting, include [1], Regular Expression [7], HTML DOM [8], and XPath [9]. This paper focuses on the overall efficiency of web data extraction methods, especially those using Python libraries like BeautifulSoup, Selenium, and lxml. We will evaluate the efficiency of these libraries by measuring their speed, memory usage, and data consumption. The data used for this research is sourced from a specific website that offers data services for the scraping process. http://books.toscrape.com/index.html .

RELATED STUDIES OF WEB SCRAPING METHODS

Web scraping techniques have developed alongside the internet. Initially, many current methods were not explored [10]. Initial methods like HTML parsing directly extracted data from the webpage code. Later, the Document Object Model (DOM) - a structured webpage representation- enabled DOM parsing, efficiently targeting specific elements. The youngest, but potentially most impactful technique is Application Programming Interfaces (APIs). APIs offer programmatic access to structured website data, often eliminating scraping altogether. Their adoption as a data source began around 2005 and has seen explosive growth, as evidenced by the surge in available APIs documented by ProgrammableWeb.com [11]. This shift from raw HTML to structured data sources like DOMs and APIs signifies a move towards more efficient and reliable web data extraction.

Manual Scraping

Manual scraping is viable when the data is minimal, not repetitive, or when setting up automation takes longer than collection. Security measures or website characteristics may restrict automated methods [7].

HTML DOM

It is a benchmark for retrieving, modifying, appending, or removing HTML elements [10]. All elements are treated as objects with associated methods and properties. Analyzing HTML structure identifies recurring elements, allowing the use of a script or web scraping tool for data extraction [12]. DOM Parsing is an advancement in HTML, with JavaScript and CSS relying heavily on DOM.

XPath

XPath is a language for navigating XML elements and attributes. It is used to locate specific nodes within an XML tree [13]. XPath essentially provides a language for the selection of nodes within XML documents, and it can also be applied to HTML documents. The most valuable aspect of XPath is its ability to express location paths. It is important to note that XPath requires a more precisely structured webpage compared to DOM but provides an equivalent capability for targeting specific segments within the webpage.

Computer Vision-Based Web Page Analyzers

Computer vision and machine learning are being used to automatically analyze web pages and extract key information, similar to how a human would visually scan the content [14].

Vertical Aggregation Platform

Vertically tailored harvesting platforms create and keep track of a large number of bots for particular verticals without any operator intervention and with effort focused on a single target site. Prior to the platform building the bots on its own, the entire vertical must first have a knowledge base created. Scalability is mostly used to select the Long Tail of websites from which content extraction *via* standard aggregators is too challenging or time-consuming [15].

API (Application Programming Interfaces)

APIs enable applications to communicate and exchange data. Directories like Programmable Web provide an overview of APIs, allowing users to search for specific ones. APIs respond to HTTP requests, and each has its unique parameters

SUBJECT INDEX

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U

V

W

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