INDIRA GANDHI DELHI TECHNICAL UNIVERSITY FOR WOMEN

RESEARCH SHOWCASE

Compendium of Abstracts

FUTURE AND TECHNOLOGY

Organized by

Department of Computer Science and Engineering,
Computer Society of India and Design and
Innovation Centre, MHRD

December 2024

MILKDELIGHTS - MERN STACK APPLICATION

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Abstract:

From a child to an adult, everyone in society needs milk, which has an ever-increasing need. Every step of the process, from the care of the livestock to the distribution of the finished product, is important to the quality of the dairy products that are consumed. The main problem today for consumers is finding these products with guaranteed quality. Our platform aims to revolutionize the agriculture industry by providing a comprehensive online solution for farmers, dairy producers, and stakeholders involved in the dairy farming ecosystem. The platform encompasses major verticals such as Basic Farm Details Dashboard, Cattle Cart, Milk Collection, distribution system, fodder, and technology, offering a range of services to streamline operations and enhance productivity. The Basic Farm Details Dashboard serves as the central hub for farmers to manage and monitor their farm activities. It provides a user-friendly interface to input and access essential information related to livestock, crops, equipment, and farm infrastructure. This dashboard offers real-time analytics and insights to assist farmers in making informed decisions regarding resource allocation and optimization. Cattle Cart is a dedicated module to facilitate efficient management of cattle inventory, health records, breeding cycles, and milk production data. The Milk Collection system enables seamless coordination between dairy farmers and milk collection centers. Our platform also focuses on fodder and technology, recognizing their critical role in the dairy farming value chain. It provides a comprehensive database of fodder types, nutritional information, and best practices for cultivation.

In summary, our platform aims to empower farmers and stakeholders in the dairy farming industry by offering a one-stop solution for managing farm operations, cattle inventory, milk collection, and leveraging the potential of fodder and technology. By digitizing and integrating these major verticals, we strive to enhance productivity, efficiency, and profitability, ultimately contributing to the growth and sustainability of the agricultural sector.

Lightweight Deep Learning Models for Automated Melanoma (Skin Cancer) Detection

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Abstract:
Skin cancer is the most common cancer worldwide, with over 1.5 million new cases diagnosed each year. Melanoma, the most dangerous type, can be life-threatening if not detected early. Early detection is essential as it significantly increases the chances of successful treatment. However, current diagnostic methods, such as visual inspections followed by biopsies, are time-consuming, invasive, and often inconsistent between different dermatologists. Our research focuses on developing a lightweight accessible melanoma detection system using deep learning techniques to help improve early screening and diagnosis.
During our research, we identified key challenges, including imbalanced datasets, the lack of standard image preprocessing techniques, and the need for accurate yet lightweight models. To address these gaps, we applied data augmentation to balance the dataset, tested various image preprocessing methods, and fine-tuned the MobileNet-v2 model using transfer learning, hyperparameter optimization, and K-fold cross-validation, achieving 94.19% accuracy with a model size of just 14 MB.
The model was trained and evaluated using the HAM10000 dataset, a widely used collection of dermoscopic images of pigmented skin lesions. Our results suggest that lightweight models can provide high accuracy and be practical for wider use in early skin cancer detection. In the future, we plan to extend our work to classify multiple types of skin cancer and develop a user-friendly web application to make early screening more accessible to everyone especially those in remote areas or without easy access to dermatologists.

Keywords: melanoma detection, ham10000, mobilenetv2, hyperparameter optimization, transfer learning

Uncovering Seasonality Trend of Respiratory Diseases in Delhi Using Machine Learning on EHR Data

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Abstract

This study explores trends in respiratory diseases using the Electronic Health Records (EHR) from Delhi's Mohalla Clinics, a trailblazing initiative in providing accessible and affordable healthcare services. The research employs advanced clustering techniques to systematically identify and isolate respiratory disease-related topics within the dataset(2016-2019). This process facilitates the extraction of relevant data for further analysis. Subsequently, in-depth Exploratory Data Analysis (EDA) and the application of machine learning models are undertaken to uncover critical temporal patterns and underlying factors influencing the prevalence of respiratory illnesses such as peak of disease trends during winter. By focusing on the seasonality trends associated with these conditions, this study aims to generate actionable insights that can inform the development of targeted healthcare interventions. Moreover, the findings are intended to assist policymakers in the future for optimizing resource allocation and designing effective strategies to enhance community health outcomes, particularly in urban settings. This work represents a significant step toward leveraging data-driven methodologies for addressing public health challenges.

Keywords: Electronic Health Records(EHR), Exploratory Data Analysis(EDA)

Anti-Money Laundering Through GNNs and LLMs: A Comprehensive Survey

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***Abstract*—**This study provides a comprehensive analysis of the advanced approaches used in anti-money laundering (AML), with an emphasis on Graph Neural Networks (GNNs) and Large Language Models (LLMs). Money laundering involves disguising financial assets so they can be used without detection of the illegal activity that produced them. Through money laundering, the criminal transforms the monetary proceeds derived from criminal activity into funds with an apparently legal source. This practice can have an impact on a number of industries, including real estate and banking. The goal is to explore the potential benefits of GNNs and LLMs in strengthening AML tactics by utilising their unique skills to analyse complicated transaction patterns and increase clarity in detecting laundering activities.

The research emphasises the limits of standard AML approaches, which frequently rely on rule-based systems and classical machine learning techniques. High false-positive rates, a lack of versatility, and concerns interpreting results for regulatory compliance are common problems with these methods. The paper suggests a unique paradigm for AML by combining GNNs, which are excellent at modelling relational data present in transaction networks, with LLMs, which improve comprehension and interaction of laundering trends. By offering an expanded review of transaction data and enhancing the explainability of irregularities found, this study attempts to fill in the gaps of current methodologies. Current AML methods are fragmented, and this integration addresses gaps, enabling adaptable, interpretable, and scalable frameworks.

This study concludes that integrating GNNs and LLMs can improve the identification of suspicious activity in financial transactions because apart from increasing the precision of detecting money laundering attempts, the proposed approach makes it easier for regulatory compliance officials to understand these results. It emphasises the need for novel approaches to AML procedures that remain up-to-date with emerging technologies and calls for a change to more complex, coherent approaches that can adjust to the frequently changing money laundering strategies.

***Index Terms*—** anti-money laundering, finance, graph neural networks, large language models, money-laundering.

Comprehensive Analysis of Deep Learning Approaches for Yoga Pose Detection

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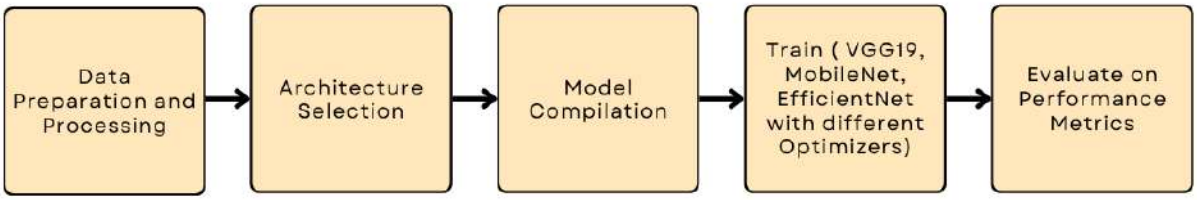
Yoga is widely practiced for its health benefits, yet improper execution of poses can lead to injuries and reduced efficacy. This project aims to build a real-time yoga pose detection system to enhance accuracy and ensure safe practice. Initially, we explored computer vision techniques like BlazePose, Movenet and YOLOv8 for keypoint detection combined with machine learning classifiers for pose classification. However, to improve efficiency and accuracy, we transitioned to deep learning approaches utilizing Convolutional Neural Networks (CNNs). Our study examined several architectures, including VGG19, MobileNet, and EfficientNet, alongside optimizers like SGD, Adam, and Adadelta. After rigorous experimentation with both traditional CV+ML techniques and CNN-based deep learning models, EfficientNet with the Adadelta optimizer emerged as the most effective. It achieved an impressive accuracy of 97.45% and an F1 score of 0.98, making it the ideal choice for developing the final system. The implemented system includes an application interface designed for seamless user interaction. The interface features a dropdown menu of five yoga poses—Downdog, Goddess, Plank, Tree, and Warrior2. Upon selecting a pose, users can activate their camera, and the system provides real-time detection of the asana being performed by the user. By integrating real-time detection with a user-friendly application, our system promotes safe and effective yoga practice. Future work will focus on expanding the dataset of poses, improving adaptability across environments, and integrating corrective feedback mechanisms. This project demonstrates how artificial intelligence can innovate traditional wellness practices for better health outcomes.



Keywords: Deep Learning, Yoga Pose Detection, Convolutional Neural Networks, Optimization

Personality Detection on Hindi and English Dataset using Machine Learning and Explainable AI

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Abstract - The ability to accurately predict personality traits has significant applications in psychology, marketing, and human-computer interaction. This study aims to enhance the classification of MBTI (Myers-Briggs Type Indicator) personality traits by combining multilingual contextual embeddings, advanced machine learning techniques, and swarm intelligence for improved performance. Data preprocessing and feature extraction leverage state-of-the-art models such as mBERT and FastText to capture nuanced semantic information across multiple languages. Contextual embeddings generated through mBERT serve as input features, effectively addressing multilingual and cultural variations.

To boost accuracy, ensemble classifiers such as XGBoost, Support Vector Machines (SVM), and Random Forest are fine-tuned through hyperparameter optimization. Additionally, swarm-based optimization techniques are applied to refine hyperparameter tuning and enhance classifier performance further. These techniques exploit the collective intelligence of particles or agents to explore the solution space efficiently, improving convergence toward optimal parameters.

Explainable AI (XAI) methods, particularly Local Interpretable Model-agnostic Explanations (LIME), are integrated to provide interpretability and transparency in the predictions. LIME elucidates the influence of features on model outputs, increasing trust in the decision-making process. By incorporating advanced embedding models, ensemble learning, swarm intelligence, and XAI, this framework ensures high accuracy while maintaining interpretability and robustness in MBTI personality trait classification.

Keywords: MBTI, Personality Prediction, Contextual Embeddings, Explainable AI, Swarm Optimization

Disk forensics tool for data categorization and keyword filtering

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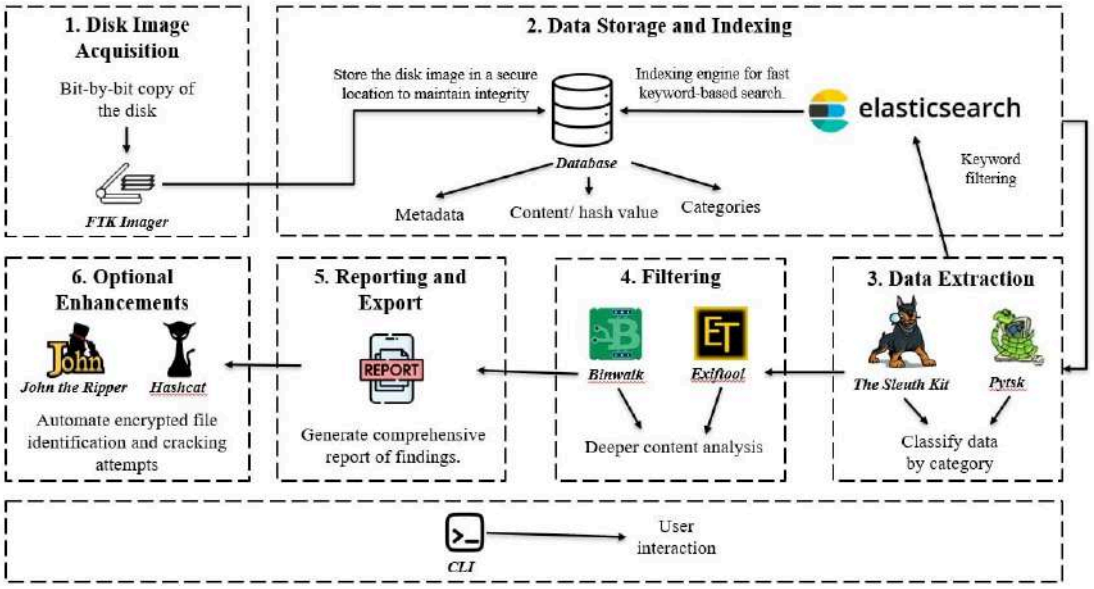
Abstract: Disk forensics is an important sub-field of digital forensics that includes the recovery, analysis, and preservation of all the data stored in storage devices like hard drives and SSDs. The increase in the cases of cybercrimes, data breaches, and insider threats, in industrial and government sectors, thus inculcates the development and release of efficient forensic tools. Conventional technologies often need the ability to combine fundamental data categorization and keyword filtering, creating an insufficient possibility of forensic investigation. This research work is associated with the design and implementation of a security-based solution that leads to the improvement of existing conventional technologies used in Disk Forensics. This research aims to optimize the process of forensic investigations while retrieving the needed data, making it possible to analyze efficiently, and reporting accurate findings. The proposed tool is developed in five phases. The first phase consists of using the FTK Imager to acquire disk images, which are then securely stored in a powerful database system in the second phase. Data categorization, done in the third phase of development, utilizes metadata and hash analysis tools such as The Sleuth Kit and Pytsk, while keyword filtering capabilities are added in the fourth phase to allow for more exact searches. The program also provides functionality in its final phase for detailed reporting. The project is currently in its first phases of development. The proposed disk forensics tool maximizes the capabilities in data collection, analysis, and reporting, bringing forensic investigations to a whole new level of efficiency compared to old technologies.

Architecture of the proposed solution:



Keywords: Disk Forensics, Data Categorization, Keyword Filtering, Digital Forensics Tools, Cybercrime Investigation

Comparative Study of Suicide Detection Using Machine Learning

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Suicide is a critical public health issues and it impacts people globally. Traditionally, the method used for detection is through self reporting and this can lead to missing early signs. The growing incidences of mental health issues makes the availability of suitable text-based technologies necessary for risk detections. This study evaluates various machine learning approaches, Logistic Regression, Linear Support Vector Classifier, Random Forest, XGBoost, Naive Bayes, Vader and Conditional Random Fields (CRF) for their efficiency in identifying suicidal intent. Although some models suggest good accuracy in recognizing the patterns within textual data, the performance was still low. Based on these results, we present here an advanced method that integrates CRFs with Term Frequency-Inverse Document Frequency (TF-IDF) and (Vader) sentiment analysis technique. CRF is a sequential model that captures contextual relationships between words in a sentence and VADER is a tool for sentiment analysis that evaluates the whole text or parts of it, assigning a sentiment score to it, thereby making sense of overall emotional tone. We have used TF-IDF and Vader here for Feature Extraction to improve the accuracy of the model. This hybrid approach presented here has performed significantly better than other ML models that we encountered in our research. The basis of such performance may conclude the potential of contextual and sentiment-based analysers for better suicide detection accuracy.

Keywords: Suicide detection, Machine learning, Text analysis, Sentiment analysis, Suicide ideation

Scalable and Secure Blockchain Voting:

A Comparison of Normal and Optimized Models

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Abstract

Decentralized application (dApp) is one of the progressing fields where voting systems show a crucial region or place in which transparency, security, and integrity matters the most. This project involves and demonstrates the implementation and benchmarking of two different voting dApps , namely, an ordinary or traditional voting dApp and a Merkle tree-based voting dApp on the blockchain i.e. Ethereum. Between these two voting dApps , the traditional voting dApp uses the smart contract operations or mechanisms to make possible secure and transparent voting processes, while the Merkle tree-based voting dApp employs and make the use of cryptographic structures to maximize data integrity, transparency and verification efficiency. We compare and regulate a complete performance analysis of both voting dApps respectively, which focuses on the key metrics such as block size, time taken, transaction fee and gas costs. After research, we discover some significant differences in performance and scalability, which highlights the pros of using and applying Merkle trees for large-scale voting applications and systems. Additionally, we discuss the assumptions and suggestions of our results for future voting systems and the ability to adopt blockchain technology in democratic processes e.g. voting processes for broader perspectives. This project research shows its contribution towards the ongoing debate on increasing the electoral integrity and transparency by using innovative or creative technical solutions, particularly Merkle trees.

Keywords— Decentralized Applications (dApps), Ethereum, Blockchain Technology, Smart Contracts, Merkle Trees.

An Efficient Path Planning Algorithm to resolve the problem of Cold Spots in Mobile Crowdsensing

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Abstract:
Mobile crowdsensing (MCS) is a growing approach that uses mobile devices to collect and analyze data for large-scale purposes like environmental monitoring, urban development, and smart city projects. An MCS system typically includes a task requester, a service provider, and mobile users who help gather the data. However, MCS faces challenges, especially in areas with low participation or limited data collection, known as cold spots. These regions reduce the effectiveness of the system by leaving key areas underrepresented, which lowers the quality and reliability of the data. Although incentive programs have been introduced to boost participation, they often fail to integrate well with effective task assignment and route planning strategies. Route planning plays a vital role in MCS, helping users travel between locations while completing assigned tasks. Current algorithms, like Ant Colony Optimization (ACO) and other heuristic methods, mainly focus on finding one optimal route for task completion. However, this often results in repeatedly using the same paths or tasks.

To overcome these issues, we propose a new path planning algorithm that generates multiple diverse routes for users to choose from. The algorithm prioritizes tasks based on factors like additional travel distance and sensing time while improving the scores of paths that cover cold spots. It then ranks the paths by their scores, allowing users to pick a route that suits their preferences.

Our method improves task coverage in low-participation areas and offers users more route options compared to traditional approaches. Additionally, we assess users' reputations based on completed tasks and reward them with incentives. This work emphasizes the need to include user preferences and address cold spots in route planning, contributing to more advanced and flexible MCS systems.

Keywords:
Mobile Crowd Sensing (MCS), Path Planning Algorithm, Ant Colony Optimization (ACO), Reputation, Incentive Mechanism

Anomaly Detection in Air Quality Monitoring

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Anomaly detection has a very crucial role with respect to detection of adverse pollution events that can affect public health and environmental management. The dynamic and high-dimensional nature of air quality data, influenced by pollutants like PM2.5, NOx, SO2, and O3, presents significant challenges for accurate anomaly detection, for better urban planning. Our study methodology involves a systematic literature review, taxonomy development, and comparative analysis of anomaly detection techniques. This study evaluates machine learning techniques to detect anomalies in air quality datasets, including univariate and multivariate Long Short-Term Memory autoencoders (LSTM - AE), Bi-directional temporal attention based LSTM-AE, clustering algorithms like K-means, One class support vector machine (OC SVM) and statistical model using Weibull distribution. The models were further fine-tuned by training them from sensor networks in urban settings that allowed enhanced temporal dependencies and multivariate correlation. LSTM-AE was shown to have a higher ability to predict anomalies in complex time series data compared to the K-means and Weibull model, although the latter was more interpretable and computationally efficient in terms of estimating failure rates in non-high dimensional data. Multivariate LSTM and Bi-LSTM allowed us to evaluate the correlation between pollutants. Thus, this research study demonstrates the potential of different models for anomaly detection in air quality monitoring highlighting the challenges of addressing imbalanced data and the impact of ground truth selection on model performance, with our work focusing on exploring hybrid techniques for model generalization and reliability.

Keywords: Anomaly detection, Machine learning, LSTM, Autoencoders, Bi-LSTM, K-means, Weibull, Air quality, Temporal data

Secure Schulze Voting Method with Ring Signature using Elliptic Curve Cryptography

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The Schulze voting method is a preferential voting system that determines winners by identifying the strongest paths between candidates in pairwise comparisons, ensuring accurate and representative results. Despite its merits, implementing this method in electronic voting systems poses challenges in safeguarding voter privacy, ensuring security, and maintaining verifiability. Traditional online voting systems often neglect voter anonymity in preferential voting, leading to voter hesitation and vulnerabilities to election fraud. This paper proposes an enhanced Schulze voting framework that integrates ring signatures with elliptic curve cryptography (ECC) to address these challenges. Ring signatures obfuscate the link between a vote and its voter, fostering anonymity, while ECC ensures robust cryptographic security with lower computational overhead, making the system efficient and scalable for large-scale elections. The inclusion of ring signatures also prevents double or multiple voting without compromising voter privacy. The proposed system upholds key security properties, including anonymity, verifiability, and integrity, addressing scalability issues and bridging the gap between voter privacy and system reliability. This work provides a robust foundation for secure, scalable, and privacy-preserving electronic voting in modern democracies.

Keywords: Schulze Voting Method, Preferential Voting, Anonymity, Ring Signature, Elliptic Curve Cryptography, Secure Electronic Voting

Humour Detection on Social Media Data using Machine Learning and Explainable AI

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Abstract:
Humour detection in social media has become an important subfield of sentiment analysis, using machine learning (ML) and artificial intelligence techniques to identify humorous content embedded in informal creative language. Social platforms such as Twitter and Weibo allow users to express their sense of humour through emojis, slang, memes, and sarcasm, where traditional methods of emotion classification are inadequate. To solve this problem, scalable artificial intelligence models such as deep learning architectures are used. It has been used to capture subtle nuances of humour, often by analysing multiple pieces of data including text, emoticons, and visual cues. Transformer models like BERT, RoBERTa and GPT are recent advances including architecture that emphasizes interest. It has greatly improved the recognition of humour. These models differentiate between humorous and non-humorous content by integrating dictionaries for slang, emoji embeddings and contextual elements. We have incorporated fine tuning that involves adapting a pre-trained language model to better perform on the specific humor detection task by training it on a labeled dataset. Later we will be using RNNs (LSTMs or GRUs) and CNNs. The scalable AI approach incorporates transfer learning and domain adaptation techniques to ensure it adapts to evolving language trends. This makes it strong in the cultural and linguistic context. SWARM optimization will be used to enhance the model.A novel model model has been designed and implemented catering to all the above algorithms and enhancing the accuracy.
During our research, we identified key challenges, including Multimodality, Subjectivity of Humour, Real-time Processing, Data Limitations and Cultural Nuances. The model was trained and evaluated using the dataset *200k short texts for humor detection*, is a collection of short texts that have been labeled as either humorous or non-humorous. It was developed by researchers working on humor detection tasks and is particularly useful for training machine learning models that classify text based on humor. Our results have improved the accuracy in the field of humour detection. In the future, we plan to extend our work to multimodality and subjectivity based on the culture, place and gender.

Keywords: Humour Detection, Social Media, Machine Learning, Explainable AI, Transformer Models.

Optimizing Quantum Convolutional Neural Networks for Smart Parking Management Systems: A Comprehensive Analysis

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***Abstract*—** Quantum convolutional neural networks, or QCNNs, have emerged as a promising technique in the field of quantum machine learning for pattern recognition and decision-making in both classical and quantum data. In this paper, we offer a comprehensive analysis of QCNN architectures and their performance in real-world scenarios, with a focus on developing the optimal model for a Smart Parking Management System (SPMS). We analyze the techniques and results of three recent studies to evaluate various QCNN circuit designs, data encoding schemes, and hybrid quantum-classical methodologies in order to identify the best design for this application.

The work points out the benefits of shallow-depth quantum circuits in terms of their deployability on Noisy Intermediate-Scale Quantum (NISQ) devices, the usefulness of hybrid quantum-classical models to achieve a competitive accuracy at low resources, and the necessity of robust data preprocessing in image-based parking slot identification. Using insights from these previous works, we present a tailored QCNN architecture that is well-suited for the recognition of images of parking space, weighing computational overheads, and is adaptive to real-time restrictions. This work exemplifies the power of QCNNs for intelligent parking management and gives a footing for the quantum computing techniques to be merged into smart cities.

Keywords: QCNNs, Quantum Machine Learning, SPMS, Hybrid Quantum-Classical Models, NISQ Devices, Data Encoding, Quantum Circuit Design, Intelligent Parking Management

Integrating Survival Analysis and Machine Learning for Predictive Modeling of Breast Cancer Patient Outcomes Using Clinical and Omics Data

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Survival prediction is a critical task in medical research, particularly when predicting patient outcomes based on clinical, omics, and other healthcare-related data. The effectiveness of machine learning (ML) models in survival prediction can be significantly influenced by how features are selected. This study explores two distinct approaches to survival prediction: one where survival analysis is used initially to identify key features (feature selection through survival analysis), and another where machine learning models are applied directly to the raw data to automatically identify important features. By comparing these two approaches, this study aims to assess which method yields better predictive accuracy, interpretability, model efficiency, and generalizability, especially when working with high-dimensional clinical and omics datasets. The study also evaluates the computational complexity and potential for overfitting in both approaches and examines the clinical relevance of the identified features. In the first approach, survival analysis methods such as Cox Proportional Hazards and Kaplan-Meier survival curves are employed to identify the most relevant features. In the second approach, machine learning models like Random Forests, Support Vector Machines, and Neural Networks are applied directly to the dataset. Ultimately, the study aims to provide insights into the benefits and limitations of each approach and suggest a more effective, interpretable, and computationally efficient methodology for survival prediction.

Keywords: Survival Analysis, Machine Learning, Breast Cancer, Random Forest, Kaplan-Meier

Advancing Diabetes Care: Machine Learning Models for Glucose Prediction and Multidisease Impact Analysis

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The Global Burden of Disease Study predicts that by 2050, chronic diseases including diabetes will be among the leading causes of reduced quality of life worldwide. Continuous Glucose Monitoring (CGM) data provides critical information for diabetes care, but developing accurate predictive models remains challenging due to individual patient variations. This work uses machine learning approaches with temporal-aware features to predict glucose levels at various time horizons and analyze the variability of predictions across different comorbidity patient groups using the T1Granada dataset for Type 1 diabetes patients. The study compared LightGBM and XGBoost models with both 1-week and 2-week CGM data. The LightGBM model with 2-week training demonstrated superior performance, achieving 88.50% predictions within 10% error margin at 15-minute horizons with R^2 of 0.96, RMSE of 10.42, MAE of 7.25, and MAPE of 4.79%. Performance gradually declined for longer horizons, with 60-minute predictions showing 43.32% accuracy within 10% error margin with R^2 of 0.58, RMSE of 34.30, MAE of 25.71, and MAPE of 17.70%. Analysis across different patient groups revealed significant variations in prediction accuracy. Respiratory condition patients showed consistently lower error rates, while skin condition and diabetes groups demonstrated higher variations in performance metrics, particularly at extended time horizons. These findings highlight the importance of considering comorbidities in glucose prediction models. Future research focuses on leveraging longer timescale data, such as 3- and 4-week CGM windows, to enhance the accuracy and robustness of glucose prediction models. Additionally, extending the scope of testing to Type 2 diabetes patients could provide a more comprehensive understanding of the impact of patient-specific variations and comorbidities on predictive performance.

Keywords: glucose prediction, machine learning, performance analysis, continuous glucose monitoring.

Alzheimer's Disease Classification through Machine Learning and Metaheuristic Optimization Techniques

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The progressive neurodegenerative disease known as Alzheimer's disease (AD) significantly impairs cognitive abilities, making early and precise diagnosis essential for successful treatment. Hyperparameter optimization, a crucial but little-studied component of machine learning (ML) in Alzheimer's prediction, is given top priority in this study. Support Vector Machines (SVM), Convolutional Neural Networks (CNN), XGBoost, LightGBM, Random Forest, Random Forest with PCA, and other ML models are applied but we observed best accuracy through SVM. Thus we use metaheuristic optimization techniques like Genetic Algorithm (GA), Simulated Annealing (SA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Flower Pollination Algorithm (FPA) with SVM to fine-tune hyperparameters. By successfully navigating high-dimensional search spaces, these methods greatly increase model efficiency and classification accuracy. The implementation demonstrates how Ant Colony Optimization (ACO) was able to improve classification accuracy from 92% to 95% by optimizing SVM hyperparameters for a polynomial kernel. SVM outperformed conventional optimization techniques and obtained the maximum accuracy when optimized using metaheuristics. In order to guarantee model interpretability, uncover important factors impacting predictions, explainable AI (XAI) approach i.e. LIME was included. This work shows how integrating interpretable machine learning models with sophisticated optimization strategies can lead to comprehensive advances in Alzheimer's categorization. The findings offer a paradigm for using metaheuristics to improve the precision and dependability of diagnostics in Alzheimer's Disease.

Keywords: Metaheuristic optimization techniques, Alzheimer’s disease, machine learning.

Enhancing sarcasm detection in Hindi texts

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Sarcasm detection refers to the computational process of identifying sarcastic statements, particularly in text. Sarcasm detection is important as it boosts sentiment accuracy, enhances chatbot communication and delivers reliable business insights. Our goal is to analyse a variety of sarcasm detection techniques and develop methods to improve sarcasm detection performance in Hindi texts. Sarcasm detection in Hindi texts is an under-researched area, with most models being designed for English or code-mixed Hindi-English texts. The complexity of sarcasm, especially in the Hindi language, arises from the lack of resources and datasets specific to this language. We conducted our research using a publicly available Hindi dataset that underwent rigorous preprocessing and noise removal. Recognizing the potential of transformer models in capturing contextual relationships, we implemented IndicBERT, a transformer model specifically designed for Indian languages, as it had not yet been applied extensively to Hindi sarcasm detection tasks. The model was trained and evaluated on the processed dataset of 2000 pure hindi tweets, with performance measured using standard metrics like accuracy and F1 score, and compared against a baseline model. IndicBERT outperformed the baseline, demonstrating its effectiveness in classifying sarcastic and non-sarcastic tweets. Our findings highlight the potential of transformer-based models in sarcasm classification for Hindi texts. Future research should focus on refining the model architecture.

Keywords: Sarcasm Detection, Hindi texts, Sentiment Analysis, Machine Learning, Social Data

Early Detection and Diagnosis in Neurological Diseases(Dementia) Using ML

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Abstract:
The growing prevalence of dementia necessitates early detection to enable timely interventions. This research presents a robust and scalable framework leveraging deep learning techniques for the early prediction and classification of dementia stages—demented, non-demented, and mild dementia—from brain MRI scans. The proposed model was implemented using Python and its ecosystem of libraries, including Keras, Pandas, Matplotlib, Seaborn, Pillow (PIL), and OS. The deep learning architecture incorporates Convolutional Neural Networks (CNNs) with layers for convolution, pooling, dense connections, and batch normalization, ensuring efficient feature extraction and regularization for improved generalization. Training and testing processes were conducted using Google Colab, chosen for its GPU acceleration, and Visual Studio Code (VSCode), used for code development and debugging.

Key methodologies include preprocessing MRI scans to enhance model interpretability and applying OneHotEncoding for categorical label transformation. The model demonstrated an accuracy of 85%, showcasing its ability to classify dementia stages effectively. Evaluation metrics such as confusion matrices, precision, recall, and F1-score were used to validate performance. The study also highlights the advantages of CNN-based approaches over traditional rule-based systems and machine learning models, particularly in automatic feature extraction and scalability for large datasets. This research fills gaps in existing studies by providing a computationally efficient, end-to-end deep learning pipeline for dementia detection. It lays the groundwork for integrating artificial intelligence into healthcare systems, with broader implications for improving diagnostic accuracy and accelerating clinical decision-making. Future work includes expanding datasets, incorporating 3D imaging, and applying transfer learning techniques for enhanced performance.

REAL-TIME SIGN LANGUAGE RECOGNITION OF WORDS THROUGH FINGERSPELLING

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Sign language represents an essential communication tool that benefits the Deaf and hard-of-hearing community, yet the lack of effective communication with non-signers often leads to social isolation. This research emphasizes on the development of an application using Tkinter for recognizing words in American Sign Language (ASL) through fingerspelling and turning them into sentences. It presents an approach to recognize American sign language as text in real time, utilizing cutting-edge computer vision and deep learning techniques. The proposed method uses a webcam-based self-made training dataset of 15,025 images, categorized into 25 classes, which are subsequently preprocessed, and a custom model with the MobileNetV2 architecture as the basic model to categorize the letters via transfer learning. The recognized letters were then progressively combined to form words, which were further computed into meaningful sentences. Model refinement occurs over 12 epochs, each with a batch size of 16, culminating in training and testing accuracies of 99.8% and 93%, respectively. Our approach focuses on improving recognition with real-time processing for minimizing the communication gap and contributing to promote social inclusivity of the deaf and hard of hearing community. Future advancements are envisaged, including expanding the system to speech translation and integration with mobile or edge AI devices.

Keywords: Sign Language Recognition, Deep Learning, InceptionV3

Hybrid Model of Chaos Theory and Quantum Techniques for Portfolio Optimisation

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Financial markets increasing complexity and unpredictability demand advanced approaches for precise stock market predictions. Our research paper offers a comparative examination of machine learning (ML) models utilized in predicting stock market trends. Traditional ML models- linear regression, logistic regression, k-nearest neighbors, support vector classifiers, and random forests - were evaluated using companies' historical stock data - Infosys, Tesla, and Google. This shows the Random Forests network as the best-performing algorithm. However, these traditional models often fail to grasp the chaotic and sentiment-driven dynamics of financial markets to ultimately determine an optimized portfolio for investments. To effectively capture the chaotic behavior of stock markets and balance the risk and returns of various stocks to build an optimized portfolio, our research integrates Chaos Theory, sentiment analysis, and Quantum Approximate Optimization Algorithm (QAOA) into a hybrid methodology to improve predictive accuracy and optimize investment strategies. Through our approach, 65,000 tweets from 95 organizations were analyzed using Chaos Theory to uncover hidden patterns in stock price movements, achieving 95.71 % accuracy with Random Forests. To balance the risk and return of different stocks accurately and build an optimized portfolio for investments, Quantum Approximate Optimization Algorithm (QAOA) is utilized to predict portfolios of up to 15 companies using the results of Chaos Theory. We have used sentimental analysis, and chaos theory with QAOA which is a combinatorial algorithm, being used to optimize the stock portfolio based on specific stock metrics- inclusive of F1 score(from sentimental analysis) and chaos theory assessments, it researches for organizations with stability and low risk-high returns in the stock market. This aids investors and traders in making informed decisions regarding where to invest with low risk and high returns.

Keywords: Stock market prediction, Machine learning, Quantum Approximate Optimization Algorithm, Chaos Theory, Sentiment analysis, Portfolio Optimisation

DeiTFAS: Data Efficient Transformer for Face Anti-Spoofing

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Identity Access Management (IAM) plays a critical role in modern-day security systems, and biometric technologies, particularly Face Anti-Spoofing (FAS) algorithms, are gaining prominence for their convenience and reliability. Face recognition systems, however, are increasingly vulnerable to sophisticated adversarial attacks, necessitating stronger defenses. A recent development in this area, Vision Transformers (ViTs), has shown exceptional performance in face recognition tasks due to their ability to capture global dependencies in images. However, training ViTs requires massive computational resources and access to large datasets, which limits their practical applicability. In this paper, we propose the **Data Efficient Transformer (DeiT)**, an innovative distillation-based method that mirrors the ViT architecture but is designed to be more computationally efficient. DeiT significantly reduces the need for vast datasets while maintaining or even surpassing the performance of traditional ViT models. By leveraging knowledge distillation, DeiT can achieve high accuracy with fewer resources, making it a more practical solution for real-world applications. We evaluate the performance of DeiT on the CASIA-FASD dataset, demonstrating that it achieves an accuracy of **92.84%**, outperforming ViT, which achieves an accuracy of **88.68%**. These results highlight DeiT's superior efficiency and effectiveness in face recognition tasks. Furthermore, the performance of DeiT can be further improved through fine-tuning, offering additional potential for higher accuracy in real-world applications. The proposed DeiT model, therefore, provides a promising solution to the challenges of resource-intensive face recognition systems, enabling better security without sacrificing performance.

Keywords: Identity Access Management (IAM), Face Anti Spoofing (FAS), Vision Transformers (ViTs), Data Efficient Transformer (DeiT), CASIA-FASD

Mental Stress Detection From Biomarkers Measurable by Smart Devices Using Deep Learning and Explainable AI

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ABSTRACT

Mental stress significantly impacts physical and psychological well-being, making timely detection critical. This research focuses on building stress detection models using physiological biomarkers measurable by wearable smart devices. The benchmark WESAD dataset has been preprocessed for modeling. We now aim to explore advanced deep learning techniques, such as Convolutional Neural Networks (CNNs) and Artificial Neural Networks (ANNs), for stress level classification. To further optimize performance, we plan to experiment with feature selection using Genetic Algorithms, dimensionality reduction techniques, and ensemble methods to combine model outputs for improved robustness and accuracy. We are developing a novel model that uniquely combines these techniques, presenting a new approach to stress detection. A key focus of this work is incorporating Explainable AI (XAI) to ensure transparency and interpretability of the models. By combining advanced modeling techniques with explainability, this research aspires to develop reliable and interpretable solutions for stress detection.

Keywords: Mental Stress, Deep Learning, Explainable AI, Stress Detection, Smart Devices.

Design and development of End-to-End Deep Learning Framework for Indian Real-Time English Gesture Recognition and Translation

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Abstract:

Hand gesture recognition has emerged as a crucial component in the development of natural and intuitive human-computer interaction systems. While traditional methods rely heavily on computationally expensive models and external devices, this project influences the lightweight and efficient Mediapipe framework to address the gap in accessible and real-time gesture recognition solutions.

The objective of this research is to implement and evaluate a system capable of recognizing static and dynamic hand gestures using Mediapipe's Hand Tracking module, combined with a custom machine-learning classifier. The study aims to answer whether such a system can achieve high accuracy while maintaining low inactivity in real-world applications.

The methodology involved collecting a diverse dataset of hand gestures, preprocessing it with Mediapipe for keypoint extraction, and training a neural network-based classifier to distinguish between predefined gesture classes. The system was tested for performance across various conditions, including different lighting and hand orientations.

The results demonstrate a recognition accuracy exceeding 90% on the test set, showcasing the agility of Mediapipe's keypoint detection and the classifier's reliability. The implementation achieved real-time performance on standard hardware, making it suitable for interactive applications.This research highlights the potential of combining lightweight frameworks like Mediapipe with machine learning for gesture recognition. Future work will focus on extending the gesture library, improving robustness to occlusions, and exploring applications in assistive technology and augmented reality.

Keywords: Hand gesture recognition , Mediapipe , Keypoint Detection , Neural Network , Human-Computer Interaction

Air Pollution Risk Analysis on Pregnant Women Using a Hybrid CNN-Fuzzy Logic Model

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ABSTRACT. Air pollution is a severe environmental hazard with serious consequences for human health, with pregnant women especially vulnerable. Exposure to air pollutants, particularly particulate matter (PM), can have a variety of detrimental health consequences for both the mother and the growing foetus. $PM_{2.5}$, tiny particulate matter with a diameter of 2.5 micrometers or smaller, can penetrate deep into the lungs and reach the bloodstream, making it a serious issue. Prolonged exposure to $PM_{2.5}$ during pregnancy can lead to difficulties such preterm birth, low birth weight (LBW), delayed fetal development, and higher risk of respiratory and cardiovascular concerns for the mother.

The purpose of this study is to improve the assessment of exposure risk of PM2.5 that pregnant women are subject to, while applying newly developed deep learning methods that enhance the explanatory power of classical techniques such as Random Forest and Generalized Linear Models (GLM). Such linear models, although applicable in some instances, tend to underestimate air pollutant exposure assessment with regards to its association with maternal health as the relationship may sometimes be complex and nonlinear.

In the initial step, we employ Random Forest and GLM models, which, although beneficial, offer limited precision. To address this, we present a deep learning strategy that incorporates Convolutional Neural Networks (CNNs) with fuzzy logic to increase prediction accuracy. Predicting trimester-specific $PM_{2.5}$ effects, evaluating seasonal impacts, and investigating intricate non-linear relationships between pollutants and maternal health are the objectives. With a threshold of 0.5, the hybrid CNN-Fuzzy Logic model obtains an excellent accuracy rate of 95.53%, greatly improving prediction reliability.

Furthermore, this model provides insightful information for assessing the connection between particular air contaminants and low birth weight (LBW) outcomes. By categorizing LBW rates according to air quality data, it makes it possible to better assess the impact of pollution on maternal health. Building on these results, a secondary model attains a 72% accuracy rate, so confirming the approach's potential for successful health risk prediction.

Additionally, the suggested system has an easy-to-use interface for displaying the findings of risk assessments, which helps researchers and medical professionals assess the health effects of exposure to different air pollutants and make well-informed decisions on maternity care.

Keywords: Air pollution, $PM_{2.5}$, CNN, fuzzy logic, risk assessment, maternal and fetal health, low birth weight (LBW), trimester-specific effects, interpretability, and pregnant women's health risk are some of the keywords.

Assessment of ML Models for Stock Trend Prediction using News Headlines

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The need for precise market movement forecasting, which is essential for making well-informed financial decisions, has increased due to the globalization and growth of stock exchanges. However, conventional forecasting techniques are put to the test by the financial market's volatility and unpredictability. Our study addresses these constraints by combining sentiment analysis of financial news headlines with historical stock data and technical indicators like Moving Averages (MA) and Exponential Moving Averages (EMA), to improve stock trend forecasts. Sentiment analysis was performed to capture market sentiment by categorizing headlines into Positive, Neutral, or Negative feelings using SentiWordNet, Flair, and TextBlob. A comprehensive dataset was created by combining these sentiment scores with technical markers. A number of machine learning models were trained and their predicting accuracy assessed, including Support Vector Machine (SVM), k-Nearest Neighbors (kNN), Naive Bayes, Decision Tree, Random Forest, AdaBoost, XGBoost, and Gradient Boost. When it came to stock trend prediction, the SVM model performed better than the others. It was further optimized for hyperparameters using the Optuna framework. SentiWordNet was a key component of the model's performance and showed the highest accuracy among the sentiment analysis technologies. This study demonstrates how sentiment analysis, technical indicators, and machine learning can be combined to improve stock trend prediction. The results open the door for more reliable financial forecasting methods that adjust to changing market conditions and offer insightful information to researchers and investors.

Keywords: SentiWordNet, Stock Trend Prediction, Machine Learning (ML), Support Vector Machine (SVM), Optuna

Tomato Disease Detection Model

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Abstract
Tomato disease detection plays a vital role in precision agriculture by enabling timely and accurate identification of plant diseases, thereby reducing crop losses and improving yield quality. This study focuses on developing a robust machine-learning model to classify ten different tomato diseases using leaf images. Advanced deep learning techniques, specifically Convolutional Neural Networks (CNNs), were employed to extract complex patterns and features, ensuring accurate disease classification.

The ResNet-50 architecture was utilized for its ability to effectively capture and analyze intricate visual features in tomato leaf images. A comprehensive dataset of labeled tomato leaf images, categorized into healthy and diseased classes, was used for training and evaluation. The dataset underwent preprocessing steps, including normalization, augmentation, and resizing, to ensure robustness and enhance the model's generalization across varying conditions.

The model achieved a high classification accuracy, highlighting its capability to handle challenges such as variations in leaf appearance caused by environmental factors and differences in disease severity. It addresses the growing need for scalable AI solutions in agriculture, providing farmers with a reliable tool for early disease diagnosis and intervention.

This work establishes a framework for applying deep learning models in agricultural disease detection, supporting sustainable farming practices, and minimizing crop losses. Future work aims to extend the model to other crops and disease classes to broaden its applicability.

Keywords: Tomato Disease Detection, Deep Learning, ResNet-50, Convolutional Neural Networks, Precision Agriculture, Image Classification, Plant Pathology.

Accurate and Energy Efficient Localization in WSN using weighted DV-HopPSO

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Localization is a critical aspect of wireless sensor networks (WSNs) because the utility of data collected by sensor nodes often depends on knowing the origin of that data. Accuracy is a crucial metric in location estimation, which is widely used in applications such as warehousing, tracking, monitoring, security surveillance, and more. Various localization algorithms have been proposed to accurately determine the positions of unknown nodes based on known anchor nodes. These algorithms are typically categorized into range-based and range-free techniques.**Range-based techniques** provide high accuracy but require additional hardware, which increases costs and complexity. On the other hand, **range-free methods** like Distance Vector Hop (DV-Hop) are more cost-effective as they do not require extra hardware. However, DV-Hop suffers from significant accuracy issues, particularly in anisotropic networks, where irregular network topology and radio patterns degrade performance. Addressing this limitation is essential.In this study, an optimized DV-Hop localization algorithm is proposed. To reduce unnecessary communication overhead caused by traditional flooding during anchor information broadcasting, a refined approach is introduced. The error in the Average Hop Size calculation is minimized by employing a **weighted average hop size** method. Furthermore, the coordinate estimation step is improved by replacing the conventional least squares method with a **weighted 2-D hyperbolic approach**, which mitigates the impact of anisotropic factors caused by irregular radio patterns. To further refine the accuracy, a **metaheuristic Particle Swarm Optimization (PSO) algorithm** is applied to optimize the initially estimated coordinates.This comprehensive approach aims to enhance the accuracy of DV-Hop localization while addressing the challenges of anisotropic networks and reducing communication overhead.

Keywords: Wireless Sensor Networks(WSNs), Distance Vector Hop (DV-Hop), anchors , Particle Swarm Optimization (PSO), energy efficiency

Predictive Modeling Techniques for Genetic Disorder Prediction

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Genetic disorders occur due to changes in DNA that represent significant health problems and have prolonged effects on individuals and families. The ability to accurately predict genetic disorders helps in early diagnosis, personalized treatment and prevention strategies. Machine learning models are proficient at analysing large amounts of genetic data, identifying complex patterns, and providing predictive insights which are difficult for traditional methods to achieve.

To determine which machine learning models produced the highest accuracy, a recon was carried out for models such as Random Forest, Decision Trees, K-Nearest Neighbours, Support Vector Machines, Gaussian Naïve Bayes, Gradient Boosting, XGBoost, Voting Classifier, Stacking Classifier, and Logistic Regression. The Synthetic Minority Oversampling Technique, or SMOTE, was utilized to address the dataset's class imbalance and provide a more representative and balanced dataset. The study highlights how the use of existing machine learning models along with proper data cleaning and EDA techniques can improve the prediction of genetic disorders. Amongst all other research done on this dataset which used the above ML models, we were able to achieve the highest accuracy of 71%.

The results highlight the potential of machine learning models to predict whether a genetic disorder is present and classify its specific type, such as mitochondrial, multifactorial, or single-gene inherited disorders.

Keywords: Genetic Disorders, Machine Learning, SMOTE, Classification Models, Healthcare

SummarEase: A Multimodal Summary Generator for People with Disabilities

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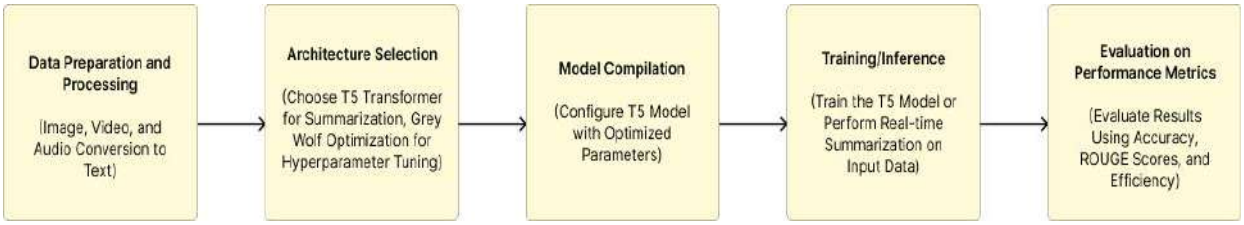
SummarEase: A Multimodal Summary Generator for People with Disabilities addresses the growing need for efficient multimedia data processing to support accessibility and inclusivity. This project develops an innovative system that converts image, video, and audio data into text and subsequently generates meaningful summaries. For image captioning, the system utilizes the BLIP (Bootstrapped Language-Image Pretraining) model. Video transcription is accomplished using MoviePy for audio extraction and SpeechRecognition for converting the audio to text. Audio data is transcribed using AssemblyAI's robust Automatic Speech Recognition (ASR) technology.

The text summarization component incorporates two approaches: an extractive method using NLTK to identify critical sentences and an abstractive approach leveraging the T5 Transformer model. To enhance performance, the T5 model is fine-tuned with the Grey Wolf Optimization (GWO) algorithm, optimizing hyperparameters such as learning rate and batch size.

This multimodal solution aims to empower individuals with disabilities by simplifying content consumption and making multimedia information more accessible. Future work includes developing a multilingual system to support diverse languages and creating a mobile application for real-time usage, further enhancing usability and reach.



Keywords: Multimedia Processing, Image Captioning, Video Transcription, Audio Summarization, Text Summarization, T5 Transformer, Grey Wolf Optimization.

Smart City Waste Management: Waste Forecasting using LSTM

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The need for waste management especially in smart cities is currently at an all-time high due to an immense increase in population and urbanization that leads to increased waste generation. Although there have been significant advancements in forecasting techniques, issues regarding waste forecasting models' accuracy and scalability coupled with their struggle in identifying complex, non-linear relationships in waste datasets still need to be worked upon. This work aims to develop a waste forecasting model using the Long Short Term Memory (LSTM) technique to predict future waste quantities and help optimize the entire waste management process. This model helps answer the question of the roles that environmental and geospatial factors play in waste prediction. We made use of the historical month-wise waste dataset spanning over 5 years with geospatial and environmental factors. A sliding window technique was used to prepare the training data to be fed into the 2-layered LSTM model- this made sure that the model trains itself to predict future values based on past trends while continuously updating itself as time goes by. The performance metrics like Mean Squared Error (MSE), Relative Absolute Error (RAE), and Relative Squared Error (RSE) are used to evaluate the performance of the proposed model and shows comparable results. The output of the model provides valuable insights for smart cities, aiding long-term urban planning, and is sure to enhance resource allocation and waste collection schedules. In future, real-time image processing can be incorporated to the model.

Keywords: Waste Forecasting, Long Short Term Memory (LSTM), Mean Squared Error (MSE),Relative Absolute Error (RAE), Relative Squared Error (RSE)

A Hybrid Defense Framework for IoT Security: Combating Adversarial Machine Learning Attacks with Rule-Based Systems and GANs

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The Internet of Things (IoT) leverages Machine Learning (ML) to enhance its capabilities, but faces significant security challenges from adversarial machine learning (AML) attacks. These attacks are broadly classified into white-box attacks, where attackers have complete knowledge of the ML model, and black-box attacks, which operate with limited access through queries. Black-box attacks are more prevalent in real-world scenarios, particularly in cloud-based IoT systems.This research evaluates three key attack strategies: Fast Gradient Sign Method (FGSM), which provides efficient white-box attacks through gradient-based perturbations; Projected Gradient Descent (PGD), which enhances attack effectiveness through iterative optimization; and Malicious Generative Adversarial Network (MalGAN), designed for black-box scenarios to simulate adversarial traffic without model knowledge. Traditional defense mechanisms typically rely on either rule-based systems, which are efficient but struggle with sophisticated attacks, or GANs (Generative Adversarial Networks), which are adaptive but computationally intensive.To address these limitations, we propose a hybrid defense framework that combines both approaches. Rule-based systems deployed at the Network Layer provide efficient initial screening of explicit anomalies, while GANs at the Cloud Layer handle sophisticated attack detection by simulating advanced adversarial traffic. This layered approach demonstrates significantly improved detection accuracy and reduced false positives while maintaining resource efficiency. The framework provides a comprehensive solution for securing IoT environments against both known and emerging threats, establishing a practical advancement in IoT security that balances effectiveness with computational efficiency.

Keywords: Internet of Things (IoT), Adversarial Machine Learning (AML), Black-box Attacks, Fast Gradient Sign Method (FGSM), Projected Gradient Descent (PGD), Malicious Generative Adversarial Network (MalGAN), Rule-based Systems, Generative Adversarial Networks (GANs), Hybrid Defense Framework, IoT Security

Performance Evaluation of Machine Learning Models for Detecting Illegal Content in Text and Images

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Illegal content detection on the web is a pressing concern due to the proliferation of harmful and unlawful materials. This study bridges the research gap in detecting illegal content by addressing the limitations of traditional search techniques, which struggle to adapt to evolving illegal activities such as scammers' use of misspellings, alternative keywords, and diverse content formats. The objective is to evaluate the performance of machine learning models and identify the best-performing models for each modality. Two datasets, Dynamically Generated Hate Dataset for text and NSFW and Explicit Content Dataset for images, are employed for evaluation. For text data, we utilized models—RoBERTa, Flair, and XLNet—trained on datasets labeled as legal or illegal, focusing on identifying explicit keywords and semantic patterns. For image data, we employed models—Inception V3, EfficientNet, and CREIC—trained on datasets with labeled graphical and photographic depictions of legal and illegal content. The models were evaluated based on accuracy, precision, recall, and F1-score. The results revealed that RoBERTa outperformed other text models with an accuracy of 91%, showcasing its robustness in understanding contextual nuances. Among image models, EfficientNet achieved the highest accuracy of 94%, demonstrating superior feature extraction capabilities. In the future, we intend to explore a combined multimodal approach using the resultant best model for each format. We aim to find resources to retrieve data and implement algorithms for its classification as well.

Keywords: Illegal Content Detection, RoBERTa, XLNet, EfficientNet, Machine Learning

An Automatic Trading Application using Machine Learning

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Predicting stock market trends is crucial for effective investment strategies. This research focuses on utilizing the **Simple Moving Average (SMA)** crossover strategy, a widely used technical indicator, to identify buy and sell signals in stock market trading. The study addresses the gap in combining traditional technical analysis with advanced computational techniques to improve decision-making accuracy.

The primary objective of this research is to evaluate the effectiveness of SMA-based strategies for predicting stock price movements and compare them against baseline buy-and-hold approaches. It further explores the optimization of short-term and long-term SMA parameters to maximize returns and minimize risks.

The methodology involves leveraging Python and libraries such as Pandas and NumPy for data preprocessing and analysis, along with Matplotlib and Seaborn for visualization. Historical stock price data was collected using the yFinance API for major companies like Apple (AAPL) and the S&P 500 Index (SPY). Backtesting of strategies was conducted using a customized SMABacktester class, enabling systematic evaluation of the performance and risk metrics.

The results indicate that the SMA crossover strategy outperforms the buy-and-hold strategy in terms of cumulative returns while exhibiting lower volatility. Adjusting the strategy to a long-only bias further enhanced the overall performance. Moreover, statistical analysis highlighted reduced drawdowns, ensuring a better risk-return trade-off.

This research underscores the potential of integrating traditional technical analysis with data-driven approaches for strategic investment. Future work includes incorporating machine learning models such as Random Forests and targeting any specific area to further enhance predictive capabilities and portfolio optimization.

Keywords: Simple Moving Average (SMA), Stock market prediction, predictive accuracy, Investment Strategy, Risk-Return Tradeoff, real-time data.

Harnessing EHR Data for Pediatric Care: Machine Learning Approaches to Health Trends and Predictions

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Abstract

This study analyzes healthcare trends and performs time series analysis on a temporal Mohalla clinic dataset for children under 12 across West Delhi cities. The aim is to uncover patterns in health conditions, treatment outcomes, and service utilization, providing insights to enhance healthcare strategies for the age group under 12 years. The dataset includes age, gender, diagnosis, prescribed medications, and city of residence. Machine learning techniques like K-means clustering, Gaussian Mixture Model Clustering, and time series methods such as XGBoost and SARIMA were employed to identify trends. PCA (Principal Component Analysis) facilitated effective cluster visualization, while predictive models forecasted future trends in diagnosis and drug prescriptions. The analysis revealed distinct clusters based on age groups and diagnoses, with respiratory infections, skin conditions, and gastrointestinal issues as prominent concerns. Seasonal patterns emerged, with fluctuations in acute nasopharyngitis cases, highlighting trends linked to specific months. While the predictive model captured general trends effectively, it struggled with sharp spikes and sudden drops, especially in March and June 2019. These deviations emphasize the need for improved models to handle extreme variations and outliers. The findings suggest that EHR data from initiatives like Mohalla clinics can optimize resource allocation and address health challenges by integrating these insights into policy decisions. Future steps involve refining predictive models for better accuracy, addressing outliers, and continuously monitoring trends for adaptive strategies.

Keywords: Exploratory Data Analysis(EDA), Machine Learning, AI in Healthcare, Clustering, Time Series Analysis

RetinaFace Powered Automated Attendance Management System on Real-Time Video

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Attendance is crucial for evaluating daily participation of students in classroom. In this work, the authors have focused on automating the attendance management system as manual system is cumbersome, prone to errors and time consuming. The main aim is to mark attendance of students from the real-time video with high accuracy. The objective is to collect data, determine the list of enrollment numbers, monitor the attendance, document the results and deploy it on the mobile application. The mobile application takes in basic information of students and teachers. The process starts with the professor recording a short video using their mobile camera. In the backend, the video is divided in frames along with frame selection, followed by Face Detection using RetinaFace algorithm. Followed by refining of the Region of Interest (ROI) and Face Recognition using ArcFace, comparing with pre-stored images from database returning list of students present in video. The system utilises technologies like Flutter for mobile application, along with Python (and its related libraries), MongoDB and firebase for database. The system has been deployed in a real-time environment and operates with an average accuracy of 99.19% for face detection. On a M.Tech classroom of 24 students, it gave 100% accuracy for face recognition assuming an illuminated room, absence of shadows or facial occlusions and a guided environment. This work can be further extended to sending email or app notifications and establishing alert systems for declining attendance. Errors can be resolved by notification system, where the student will be notified in case of absence and can be rectified by either manually updating or other automating methods. Our system addresses the gap with an innovative Flutter-based application designed to simplify and modernize attendance management, introducing efficient approach to attendance tracking by the university.

Keywords: RetinaFace, Face Recognition, Flutter Application

Stress Level Prediction Using Wearable Devices and Machine Learning: A Survey

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Stress is a major concern in contemporary society, significantly affecting mental health and physical well-being. If left unmanaged, chronic stress can lead to debilitating conditions such as anxiety disorders, depression, hypertension, cardiovascular diseases, and compromised immune function. The advent of wearable technology combined with machine learning (ML) has enabled the development of advanced systems capable of predicting stress levels in real time. These systems utilize physiological signals, including heart rate (HR), heart rate variability (HRV), electrodermal activity (EDA), skin temperature, and respiratory patterns, to provide continuous, non-invasive stress monitoring. This project presents a comprehensive review of the latest research/ development on stress prediction, with a focus on the integration of wearable sensors and ML algorithms. It examines the key physiological markers used for stress detection and discusses the application of various ML techniques, including supervised, unsupervised, and deep learning approaches. Benchmark datasets, such as WESAD, SWELL-KW, WEAR, and Affective ROAD, are analyzed to highlight their role in the development and evaluation of stress prediction models.

Fig. Flowchart

Sign Language Detection and Translation in English Using Machine learning

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ISL is one of the modes of communication to millions of deaf and hard-of-hearing Indians. This is an essential mode, yet tools connecting these people with speakers are very limited. It is against this backdrop that this research develops a system able to recognize and translate gestures in ISL to text, with the aim of inclusion and tearing down barriers to communication. The study involves testing three machine learning algorithms-SVM, k-NN, and RNN-for determination of their efficiency in gesture recognition in ISL. We have made our own hand-gesture dataset with all alphabets in 20 frames for each alphabet, and both accuracy and practicality comparisons are done with each algorithm for their testing. Highest over 90% accuracy using preprocessing techniques such as For Pattern recognition in data normalizing. The RNN approach is suitable for Dynamic Gesture recognition. RNN has an element called LSTM Long short-term memory, which represents modeling temporal dependencies. In SVM and k-NN also simple static gestures were given best but could not handle it by considering dynamic sequences. The testing with webcam input in real-time validated the adaptability and responsiveness of RNN, making it ideal for practical applications. The study compares the strengths of these algorithms and hence provides a pathway for developing systems that could bridge the communication gap for ISL users, which could be integrated into mobile applications and public service platforms to promote accessible and inclusive communication. Future work would involve extended datasets, better recognition of complex gestures, and contextual understanding that can enhance the capabilities of this system.

Keywords: ISL - Indian Sign Language (ISL), Gesture Recognition, Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM) , Support Vector Machines (SVM), k-Nearest Neighbors (k-NN), Real-time Communication

Predictive Modeling of the Bidirectional Impact of COVID-19 and Systemic Comorbidities Using Longitudinal EHR Data

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The COVID-19 pandemic has presented unprecedented challenges in global healthcare, necessitating advanced computational methodologies to analyze complex pathophysiological interactions. While the immediate effects of the pandemic are well-documented, the long-term consequences on health, especially for individuals with comorbidities, remain underexplored. This research implements a comprehensive framework to explore the bidirectional impact of SARS-CoV-2 infection and associated comorbidities, including acute kidney injury (AKI), cardiovascular diseases, diabetes, and hypertension and many more, through sophisticated clinical data analysis techniques.

Leveraging diverse clinical datasets and advanced machine learning algorithms, the study analyzes the intricate relationships between COVID-19 and comorbidities, classifying patient outcomes into four distinct severity categories: Mild, Moderate, Severe, and Severe with End Organ Damage. It incorporates subgroup-level insights, including gender-specific variations in disease progression, highlighting nuanced interactions across multiple physiological domains. Given the emerging evidence of long-term health effects, such as post-acute sequelae and exacerbated chronic conditions, understanding these interactions is crucial for long-term healthcare planning and preparedness.

The findings underscore the critical role of computational methodologies in addressing complex medical challenges, offering a scalable framework for understanding subgroup-level risks and disease trajectories. By advancing data-driven strategies for personalized medical assessment, this research contributes to the emerging field of medical informatics and aids in future pandemic preparedness, ensuring that healthcare systems are better equipped to address both immediate and long-term consequences of viral infections.

Q-MIND: Enhancing ADHD Diagnosis using Quantum Machine Learning for Advanced Neuroimaging Analysis

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Attention Deficit Hyperactivity disease (ADHD) is a neurobehavioral disorder of a heterogeneous nature that is common among children and adolescents. It is marked by symptoms like inattention, hyperactivity, and impulsivity that have a substantial impact on the everyday living and well-being of an individual. Due to the complicated nature of the disorder, it is extremely difficult to obtain an accurate and timely diagnosis despite its prevalence. The problem is further deepened by the lack of standardized testing techniques. As a result, the number of undiagnosed cases is alarmingly high.

The primary objective of this study is to use advanced machine learning techniques to aid the clinical diagnosis. The publicly available ADHD-200 dataset is used for this purpose. It consists of neuroimaging, behavioural, and cognitive data collected from diverse subjects across eight universities.

The study presents a novel methodology using the DE-Swarm algorithm for selecting features extracted by employing a Quantum Convolutional Neural Network (QCNN) on the dataset. The selected features are processed by employing Automated ML (AutoML) to streamline model selection and find corresponding tuned hyperparameters that provide optimal performance.

The proposed DE-Swarm algorithm performed better than all the previous existing research by achieving a superior testing accuracy of 98.53% using Gradient Boosting Classifier. The empirical results of the study highlight the effectiveness of the proposed framework. This research works towards the advancement in the clinical diagnosis of ADHD by incorporating both neuroimaging and phenotypic data, and leveraging the power of quantum computing and evolutionary algorithms.

Keywords: Neuroimaging Analysis, ADHD Detection, Quantum Machine Learning, Auto ML, Evolutionary Algorithm

Optimization of 8x8 Discrete Cosine Transform (DCT) with Minimal Computational Complexity

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The Discrete Cosine Transform (DCT) is fundamental in image and video compression due to its energy compaction efficiency. However, traditional 8x8 DCT implementations are computationally intensive, posing challenges for real-time processing in resource-constrained systems. This research aims to optimize DCT computation by exploring approximation methods and incorporating butterfly-based factorization techniques to reduce computational overhead significantly.

Our approach leverages orthogonality and symmetry properties of the DCT matrix to simplify calculations. We replaced multiplications with bitwise shift operations, reducing the complexity to 8 operations per row/column, and investigated different approximation methods that eliminate bitwise operations altogether. To evaluate the algorithm, a synthetic dataset of 8x8 pixel patches featuring edge, gradient, and noise patterns was generated, providing diverse image characteristics. The optimized algorithm was implemented and tested in C, with results stored and analyzed through CSV files. Experimental results demonstrated a reduction in additions and bitwise shift operations while maintaining high transform accuracy.

This work highlights the potential of approximation techniques combined with butterfly structures for improving computational efficiency in DCT. Future efforts will focus on enabling user-driven generation of approximation matrices through interactive AI-assisted tools, addressing the challenge of manual approximation refinement as observed in earlier generations. This will provide a bridge between traditional manual methods and modern computational advancements, fostering further innovation in image and video compression.

Keywords: DCT, Butterfly Transform, Approximation Methods, Image Compression, Computational Optimization

Integrating Web Accessibility in Design Systems

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***Abstract*—** Digital accessibility continues to pose significant challenges in contemporary user interface design, with many existing design systems failing to provide actionable, integrated solutions for creating truly inclusive digital environments. While accessibility guidelines have long been discussed, practitioners consistently encounter substantial obstacles in systematically implementing Web Content Accessibility Guidelines (WCAG) across their development workflows.

Our research introduces an innovative digital platform that fundamentally reimagines accessibility integration by presenting a comprehensive, pragmatic toolkit for designers and developers. The proposed solution transcends traditional compliance checklists by offering a dynamic, interactive ecosystem that transforms accessibility from a theoretical concept to a tangible, implementable design strategy. Key innovations of the proposed design system include meticulously crafted, WCAG-aligned component libraries with contextual implementation guidance. The system also provides advanced interactive tools for real-time colour contrast analysis, validation and semantic colour strategy frameworks that balance perceptual clarity with aesthetic sophistication. Nuanced documentation exploring diverse user interaction states and accessibility considerations is incorporated. This paper discusses reusable, production-ready code implementations that accelerate accessible design processes. Additionally, detailed educational resources elucidating complex accessibility design principles

By converting abstract accessibility standards into executable design protocols, this research aims to dismantle existing barriers between theoretical guidelines and practical application. User feedback and initial evaluations reveal promising outcomes, demonstrating the system's potential to streamline accessibility implementation and enhance practitioners' understanding of inclusive design principles.

***Index Terms*—** web accessibility, design system, WCAG, UI Components

TESS : Threshold Encryption Security System for Examinations

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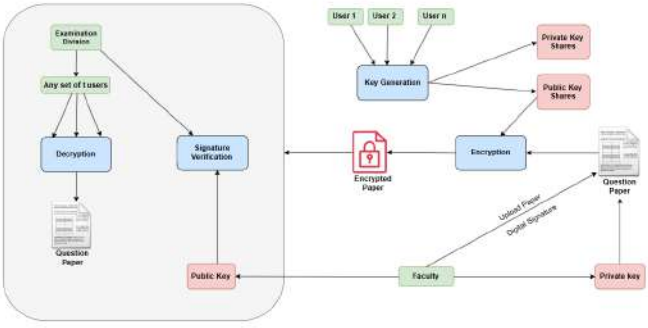
In recent years, the leakage of university exam papers has emerged as a significant issue, raising concerns about data security and the integrity of academic and professional assessments. Traditional encryption methods, while effective, are vulnerable to single points of failure and unauthorized access if keys are compromised. Ensuring the confidentiality and integrity of question papers is essential in this digital age.

Over time, some examination frameworks have proposed the integration of encryption but to date, no framework has implemented a threshold decryption scheme, highlighting a critical gap in securing such sensitive information. The research involved interaction with faculty members, industry and security experts in order to understand the current examination process in the college and to successfully integrate our scheme within existing system with little or no modifications.

The system ensures security by combining various cryptographic algorithms at every stage of the examination process. The process begins with faculty digitally signing the examination paper using their private key and uploading it to the portal. The paper is then encrypted using the ElGamal Encryption with the examination division parties' combined public key for confidentiality and stored in the database.

The system uses a threshold-based decryption scheme that requires at least t out of n people from examination division to decrypt the paper. This ensures that no single person can access it independently, eliminating the risk of single point of failure, which occurs when a multiparty scheme is used where absence of any single member will cause the scheme to fail. After decryption, the faculty's digital signature is verified using ECDSA to ensure the paper's integrity.

This project secures examination papers using cryptographic algorithms from unauthorized access and leaks



Keywords: Cryptography, Threshold Decryption, ECDSA, Elgamal Encryption

HINGLISH TEXT PHISHING DETECTION MODEL USING MACHINE LEARNING ALGORITHMS

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ABSTRACT

Phishing detection in multilingual and code-mixed languages like Hinglish (a blend of Hindi and English) presents unique challenges due to its informal structure, diverse word usage, and lack of robust linguistic resources. Phishing texts are often characterized by deceptive language aimed at eliciting sensitive information, leveraging urgency, emotional cues, and cleverly disguised calls to action. Detecting such attempts is particularly complex in Hinglish due to informal grammar, varied spellings, intermixing of scripts, and frequent use of abbreviations or slang.

This study explores two distinct approaches for Hinglish phishing detection. The first is a traditional rule-based model that uses keyword-based phrase matching with fuzzy matching techniques to capture variations in phishing-related phrases. It incorporates negation handling to reduce false positives (e.g., "don’t share your OTP") and uses urgency and emotional cues for enhanced detection accuracy. Machine learning classifiers such as Multinomial Naïve Bayes, k-Nearest Neighbors, Support Vector Machines, Random Forest, and Gradient Boosting are also implemented and evaluated to enhance traditional methods' performance.

The second approach emphasizes the use of a fine-tuned BERT model specifically adapted for Hinglish. This model leverages the capabilities of transformer-based architectures to understand the complexities of code-mixed language, capturing nuanced patterns and contextual dependencies in phishing attempts with high accuracy. The BERT model significantly outperforms traditional methods in identifying sophisticated phishing texts, showcasing its robustness in handling the inherent ambiguities of Hinglish.

Experimental results highlight the strengths and limitations of each approach, with traditional methods providing simplicity and explainability and the BERT model delivering superior performance and contextual understanding. This research offers insights into effectively addressing the challenges of phishing detection in multilingual and low-resource language settings.

Decline in pulmonary function in patients with idiopathic pulmonary fibrosis (IPF)

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The focus of this research is to predict the decline in pulmonary function in patients with idiopathic pulmonary fibrosis (IPF) using the OSIC Pulmonary Fibrosis Progression dataset. This dataset integrates anonymized clinical data, baseline CT scans, and temporal Forced Vital Capacity (FVC) measurements collected over 1–2 years, addressing the challenge of combining heterogeneous data to model disease progression effectively. The study aims to bridge gaps in existing literature by developing advanced methodologies for accurate IPF prognosis prediction.

Initial experiments employed techniques like ElasticNet and Deep Neural Networks (DNNs), providing a foundational understanding but revealing the need for more robust models. To enhance predictive accuracy, hybrid architectures were implemented, including combinations of DNN with NGBoost, Gradient Boosted Decision Trees (GBDT), and LightGBM (LGBM). LSTM was also implemented for the clinical data. Pre-trained convolutional architectures like ResNet-18 and EfficientNet-b0 were leveraged for CT feature extraction, yielding error metrics of -6.70 ± 0.29 and 183.68 ± 23.52, demonstrating their efficacy in medical image analysis.

Advanced spatial-temporal models, such as CNN-LSTM and LSTM-QRNN, were developed to integrate clinical and sequential FVC data, further improving predictive accuracy. The implementation of FibroCoSANet capitalized on convolutional self-attention mechanisms and hybrid feature fusion, outperforming baseline models. Challenges like irregular FVC intervals and effective data integration were addressed iteratively.

This research highlights the potential of hybrid and ensemble learning approaches to improve predictions on metrics like the modified Laplace Log-Likelihood. Future work involves optimizing FibrosisNet, refining ensemble methods, and exploring additional spatial-temporal architectures. The findings contribute a robust framework for IPF prognosis, blending machine learning advancements with clinical insights.

KeyWords: Idiopathic Pulmonary Fibrosis (IPF), OSIC Pulmonary Fibrosis Progression Dataset, Forced Vital Capacity (FVC), Hybrid Architectures, Spatial-Temporal Models.

Object Recognition Using Deep Learning and Computer Vision for Providing Vision to Visually Challenged People

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This research aims to develop a model that does object recognition and detection by using the modern Yolov8 and COCO dataset with the help of images, captured by the live webcam. Genetic algorithm is used to leverage the learning rate of Yolov8, enhancing its training performance. The model also takes into consideration of spatial relationship between the user and the obstacle and gives output by prioritizing the nearest object from the user followed by the subsequent ones. The model provides structured audio feedback in multiple languages making it effective in all the regions across the world. This research paper ensures a invaluable contribution in the realm of computer Vision.

This research aims to develop a model that does object recognition and detection by using the modern Yolov8 and COCO dataset with the help of images, captured by the live webcam. Genetic algorithm is used to leverage the learning rate of Yolov8, enhancing its training performance. The model also takes into consideration of spatial relationship between the user and the obstacle and gives output by prioritizing the nearest object from the user followed by the subsequent ones. The model provides structured audio feedback in multiple languages making it effective in all the regions across the world. This research paper ensures a invaluable contribution in the realm of computer Vision.

Keywords: YOLOv8, Visually Impaired People, Deep Learning, Computer Vision, COCO, Genetic Algorithm

Enhancing Data Structures and Algorithms Mastery: A Domain-Specific Language Model for Technical Interview Preparation and Academic Purpose

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In computer science education, Data Structures and Algorithms (DSA) is a critical subject for students who prepare to appear for technical interviews. While there are numerous resource materials available, the questions are often too technical; thus, the answers get delayed, which hampers the learning procedure. This project proposes a domain-specific Large Language Model (LLM) to help the student to understand the concepts of DSA. Our goal is to fill that gap between questions by the students and correct, appropriate relevant answers available in the textbooks. Our model was trained on a highly diverse dataset of DSA problems, explanations, and solutions drawn from textbooks. This ensures that the answers generated are accurate and contextually aware. The domain-specific LLM showed impressive improvements in the accuracy and relevance of responses compared to generic language models. Students reported saving significant time in seeking answers and increasing confidence in understanding DSA concepts. In the future, the model's capacity will be improved, and it will be integrated with educational platforms for the further support of students. Such integration will help the students get deeper insights into DSA and thus master the subject for the success of technical interviews.

Keywords: Data Structures and Algorithms (DSA), Domain Specific Large Language Model (LLM), Educational Technology Integration, Natural Language Processing (NLP), Technical Interview Preparation

InsightMed: Leveraging SequentialRotatE and Mixture-of-Medical-Advisors (MoMA) for Medical Decision Support Systems

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ABSTRACT

The healthcare domain faces persistent challenges in delivering timely diagnosis and personalized care due to resource constraints, including limited access to medical experts and delayed interventions. This work proposes InsightMed, an AI-driven medical assistant that combines SequentialRotatE and the Mixture-of-Medical-Advisors (MoMA) framework. InsightMed addresses these issues by integrating SequentialRotatE model and the MoMA framework to provide accurate, personalized, and explainable medical recommendations. Leveraging SequentialRotatE, a novel knowledge graph embedding model, InsightMed captures temporal and contextual relationships between medical entities, enhancing diagnostic accuracy and treatment planning. Meanwhile, the dynamic routing mechanism within MoMA ensures queries are directed to specialized advisors—focused on diagnosis, treatment, and specialist recommendations—based on their complexity and relevance.

InsightMed achieved a Top-1 accuracy of 90.07% and a Top-2 accuracy of 96.03% in advisor selection, with an overall accuracy of 86.32% surpassing state-of-the-art benchmarks. Additionally, SequentialRotatE Knowledge Graph embedding model demonstrated higher MRR (Mean Reciprocal Rank), Hits@3, and Hits@10 scores on benchmark datasets. This work also highlights advancements in medical knowledge representation through customized knowledge graphs, efficient query processing, and robust evaluation metrics.
By reducing the workload on healthcare providers and empowering patients with actionable insights, InsightMed bridges critical gaps in accessibility and quality of care.

Keywords:
knowledge graph (KG), mixture-of-experts (MoE), medical decision support system, large language models (LLMs), personalized healthcare recommendations

Secure Anonymous Authentication for University Feedback Management using Elliptic Curve Cryptography

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Effective feedback systems play a significant role in improving the quality of education and teaching. However, ensuring anonymity and authentication of students in their feedback poses significant challenges. In fact, the current systems compromise user privacy through sharing identifiable information with the administrator or third parties. This research intends to design secure and anonymous certified authentication for university feedback systems using ring signatures. This is to fill the research gap where anonymity and authentication balance each other and reduction in computational complexity is employed. The feedback system uses Elliptic Curve Cryptography for the ring signature and all users need to create their public-private key pair, and the user who wants to give feedback sends the feedback by including ciphers that signature and authenticate without disclosing the identity of the signer. The architecture proposed includes a web-based front-end and SageMath based backend for operations in cryptography. The prototype has shown success in effecting the submission of anonymous feedback securely and efficiently. The database kept feedback confidential and secured as data with a form of encryption for data integrity. Validation tests proved effectiveness of ring signatures using ECC where user anonymity was sustained while the authenticity of the submission was ascertained. Hence, our system works towards enhancing privacy and security in providing feedback given by users and can be soon used for broad-based anonymous communication. The next scope of work is going to be on advanced cryptographic deployment techniques and on scalability in real-world deployment.

Keywords: Anonymous feedback, Ring signature, Elliptic curve cryptography, Secure authentication, Feedback management.

HNQSM: A Novel Hybrid Neural-Quantum Approach for Advanced Speaker Verification and Identification

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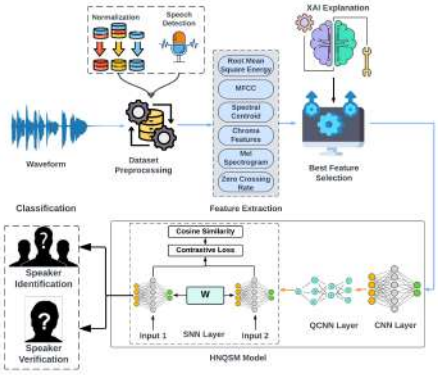
The human voice, a symphony of unique qualities like gender, age, emotion, and language, has immense potential in biometrics. The Hybrid Neural Quantum Speaker Model (HNQSM) represents a groundbreaking advancement in Speaker Identification (SI) and Speaker Verification (SV), addressing critical challenges in noisy environments and feature redundancy. By combining Convolutional Neural Networks (CNN), Quantum Convolutional Neural Networks (QCNN), and Siamese Neural Networks (SNN), HNQSM isolates essential speech features, leveraging quantum techniques for unparalleled accuracy and efficiency. HNQSM transforms caller authentication by enabling swift, secure identity verification, reducing reliance on cumbersome security protocols, and delivering faster resolutions in telecommunications and customer support. For smart home and IoT security, the model ensures only trusted voices can access sensitive systems, safeguarding against unauthorized breaches. In e-commerce and retail, it personalizes shopping experiences by recognizing returning customers and tailoring recommendations—all powered by their voice. Traditional deep learning methods, while effective, often struggle in noisy environments and with high-dimensional redundant features. HNQSM overcomes these limitations, achieving exceptional results even in challenging conditions. Early findings reveal the model's ability to achieve high accuracy and a remarkably low Equal Error Rate (EER), outperforming state-of-the-art methods. Blending the precision of deep learning with the power of quantum computing, HNQSM sets a new benchmark for speaker recognition technology. By enabling trust, security, and personalization across industries, it redefines how we interact with the world, making the voice not just a tool for communication but a cornerstone of modern identity.

Keywords: Quantum Computing, Convolutional Neural Networks, Siamese Neural Network, Speaker Verification, Speaker Identification



Flow of Methodology

Emotion Detection through Text using Machine Learning :Detecting and Combating Mental Health Issues through an Interactive chatbot

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The rapid pace of modern work environments and hectic modern lives often leads to significant mental health issues such as stress, anxiety, and burnout, negatively impacting human well-being, engagement, and productivity. Traditional methods for addressing mental health concerns, such as surveys and HR evaluations, are reactive and often fail to detect emotional distress in real-time. This research aims to develop and implement a chatbot designed to identify emotions and early warning signs of mental health issues through text-based interactions. Using machine learning algorithms and natural language processing (NLP) techniques, the chatbot analyzes linguistic patterns and anonymized insights are provided, enabling users to make data-driven decisions to improve mental health policies and create a supportive culture. The chatbot successfully detects emotional distress in real-time, offering a proactive solution to mental health challenges. This approach not only facilitates early intervention but also fosters a compassionate, supportive environment. Moving forward, we aim to enhance the chatbot's capabilities further, incorporating additional mental health resources and support tools to make a lasting, positive impact on the person's mental health.

Keywords: Mental Health; Emotion Detection; Chatbot; Machine Learning; Natural Language Processing (NLP)

Efficient Threshold-Optimal Schnorr Signature Scheme in Image Authentication

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The presence of data necessitates the need for security protocols. With gazillions of data being circulated every second, data leaks and privacy breaches have managed to worm their way past stringent protocols and mechanisms. Thus, continuous research and innovations must be introduced in the domain of data security. High priority data such as confidential state files, official documents in organisations, contracts and agreements must include multi-party consents and signatures due to complex hierarchy, making the data even more susceptible to data stealing, fabrication or corruption. Multi-party schemes often demand active participation from all or a majority of participants. Any unavailability or uncooperative behaviour from even a single party can disrupt the process, causing delays or system failure. Moreover, existing cryptographic schemes rely on a centralized trusted authority (TA) for key generation or authentication. However, if this TA is compromised or becomes unavailable, the entire system risks collapse. In light of these limitations, Threshold Signature Scheme has proven to be a powerful asset in the quest for secure algorithms that can protect classified information while ensuring ease of access for the authorised parties. If at any time, t out of the n authorised participants are present, only then the data could be recovered for use. As a result, any attacker would require to corrupt $(t+1)$ parties to be able to get hold of the data, threshold scheme serves as a relatively strong protocol to enable data security in multi-party systems. In this study, we propose threshold implementation of the Schnorr signature algorithm incorporated together with a primary step performing identity authentication through face capture and recognition. The threshold Schnorr scheme is optimised to generate public-private keys pairs without any third-party involvement, instead using commitment for verification. Along with the distributed key generation, the linear signature computation in Schnorr allows for easier implementation while maintaining the security standard and improving the efficiency of the scheme.

Keywords: *data security, threshold signature, distributed key generation (DKG), multiparty, two-step authentication, identity authentication*

Bridging Modalities: A Unified Approach to Lung Cancer Diagnosis

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Abstract: Lung cancer remains a significant global health concern where the number of new cases as well as deaths recorded due to lung cancer every year is beyond count. The foremost studies were aimed at using traditional machine learning models, including but not limited to support vector machine, random forest, gradient boosting and convolutional neural networks applied to imaging modalities such as CT scan and histopathological images. Despite the fact that these models showed some prospects, their real-life application encounters problems, most especially with the heterogeneity in the nature of imaging modalities, and the setting in which the imaging is done. Single models in most of the cases do not perform well at handling the changes that are caused by employing a single imaging modality.

To overcome the aforementioned difficulties, more recently, research has been directed towards ensemble learning approaches which are capable of combining multiple models with the aim of improving the performance as well as robustness. But several reports have indicated that much of these techniques lack the ability to be cross-modal and generalizable over heterogeneous datasets.

This paper proposes an advanced ensemble method that seeks to merge the strengths of various machine learning models in its implementation across different imaging modalities to improve performance and adaptability. To rigorously evaluate the model's efficiency, we have utilized a comprehensive set of metrics, including precision, recall, and F1-score, as many reports have indicated that accuracy alone is not a good index of performance. This method demonstrates significant improvements in both performance and generalizability, offering a promising pathway for advancing lung cancer detection in real-world clinical applications.

ANONYMOUS FEEDBACK SYSTEM

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Collecting genuine feedback in workplaces and educational institutions is often hindered by individuals' fear of being identified, leading to biased or withheld opinions. Existing solutions, such as anonymous survey platforms and token-based systems, provide some level of anonymity but rely on intermediaries, making them prone to identity breaches, manipulation, or fraud. Moreover, mixing protocols, while effective in preserving anonymity, are computationally expensive and less scalable. To address these limitations, we propose an Anonymous Feedback System that leverages **ring signatures** combined with **RSA** encryption and **SHA-256** hashing. Ring signatures ensure that feedback can be authenticated without revealing the contributor's identity by embedding the signature within a "ring" of potential signers, making it computationally infeasible to trace the feedback back to its origin. RSA is employed for secure key pair generation, while SHA-256 guarantees data integrity and resistance to collision attacks during signature creation and verification. Developed on Google Colab, this system eliminates intermediaries, ensuring trust and reducing risks of tampering. Experimental results demonstrate its effectiveness in verifying feedback authenticity, safeguarding user anonymity, and preventing fraudulent submissions, even under adversarial conditions. Advantages include enhanced privacy, scalability, and adaptability to diverse use cases. By combining advanced cryptographic techniques, this system sets a new standard for privacy-preserving feedback collection, fostering transparency and trust in sensitive environments where honest feedback is critical for growth and decision-making.

Keywords: Anonymous Feedback, Ring Signatures, Cryptography, RSA, SHA-256

Causality Extraction and Reasoning from Text

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Understanding causality in textual data is critical for knowledge-based reasoning and decision-support systems applications. This study introduces a novel hybrid framework combining rule-based methods and deep learning models, particularly leveraging the RoBERTa transformer, to extract and reason causality from the text. Our approach effectively identifies complex causal patterns, including explicit cause-effect relationships and implicit causal connections, by fine-tuning RoBERTa for contextual analysis. A reasoning component employing graph-based methods further enhances the framework's ability to reveal multi-hop and latent causal linkages, making the results interpretable and actionable.
Through comprehensive evaluation of benchmark datasets, the hybrid method demonstrates superior accuracy and robustness compared to existing approaches, addressing challenges such as context-dependent causality and domain-specific dependencies. These findings highlight the potential of this framework for real-world applications in fields like healthcare, legal analytics, and financial decision-making. Future work aims to improve computational efficiency and expand the model's applicability to multilingual and highly unstructured text domains.

Keywords: Causality Extraction, Textual Reasoning, RoBERTa, Transformer Models, Graph-Based Reasoning

Detection of Phishing Websites based on URL, Response and Image Analysis

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Phishing attack is an analogy derived from “fishing” for victims. It is a malicious practice of deceiving individuals into divulging sensitive information. It remains a persistent threat in the digital landscape, undermining the integrity of communication networks, financial systems, and personal data security. Attackers trick people online by making fake web pages that look real, trying to get personal information. People have come up with ways to stop this, like blacklists or whitelists, and other smart methods, but users still get attacked. In this paper, we suggest a machine learning and deep learning-backed way to check if a URL is safe before someone clicks on it and gets attacked. Methods, especially those employing statistical learning algorithms for classification, have the issue of false positives. This paper adds to the expanding realm of cybersecurity knowledge by offering a novel way of detecting phishy websites using the header analysis as well as exploration of URL phishing, along with practical strategies for reducing its risks.

Logistic Regression outperformed in URL analysis, followed by Random Forest and Support Vector Machine, meanwhile, CNN-backed ResNet50 excelled in image analysis, followed by Support Vector Machine backed with feature extraction. ResNet50 maintained superiority across datasets, affirming its effectiveness for phishing image detection tasks.

Keywords: Cyber-Attacks, Phishing Detection, Machine Learning, Deep learning, URL

Tracking Parkinson's Disease Progression Using Voice Analysis: A Machine Learning Approach for Treatment Monitoring

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Parkinson's Disease (PD) is a progressive neurodegenerative disorder characterized by motor and non-motor symptoms, including significant changes in vocal patterns. Traditional diagnostic methods for PD are often invasive, costly, and rely heavily on subjective assessments, leading to challenges in early detection and monitoring disease progression. This study aims to develop a machine learning model to predict PD progression based on voice analysis, specifically focusing on identifying vocal biomarkers that can distinguish between early, mid, and advanced stages of the disease. The data was split patient-wise, with 80% of each patient's entries used for training and 20% for testing. Features were normalized using StandardScaler to ensure consistency across variables, including age and test time. A Decision Tree Regressor (CART model) was applied to predict both motor_UPDRS and total_UPDRS scores. The model's performance was evaluated using Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and R^2. The results showed strong predictive accuracy, with the motor UPDRS model achieving an R^2 of 0.99 for training and 0.98 for testing. Similarly, the total UPDRS model had an R^2 of 0.99 for training and 0.99 for testing. These results highlight the effectiveness of voice-based biomarkers in monitoring PD progression and suggest that this approach could serve as a promising tool for treatment evaluation. Future research should focus on developing a multimodal system that combines voice analysis with other clinical data such as gait, handwriting, and cognitive assessments, to provide a more comprehensive and accurate monitoring system for tracking PD progression and evaluating treatment outcomes.

Keywords: Parkinson's Disease (PD), Machine Learning (ML), Voice Analysis, Disease Progression

Med Health App

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The Med Health App is a pioneering mobile healthcare solution designed to streamline patient care and improve accessibility to medical resources. Developed using Flutter and Dart, this application serves as a comprehensive platform for users to manage their healthcare needs effectively. The app bridges the gap between patients and healthcare providers by offering features such as appointment scheduling, real-time consultation, medication reminders, and health monitoring.

The Med Health App leverages the versatility of Flutter for cross-platform development, ensuring seamless performance across Android and iOS devices, while Dart's robust framework underpins the application's functionality. This paper highlights the app's key components, its impact on improving healthcare access, and the technical methodologies employed during development. It also addresses the challenges encountered in integrating various healthcare services within a unified system and discusses future enhancements, such as AI-powered diagnostic tools and blockchain for secure medical record management.

By simplifying access to healthcare and empowering users with tools for proactive health management, the Med Health App exemplifies the potential of technology in transforming the healthcare industry.

Keywords: Healthcare App, Flutter, Dart, Mobile Health, Medical Assistance

Convolution Neural Network based Model for driver drowsiness detection

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Fatigue increases the effect of inattention and can be considered as the threat to various spheres including transport, learning, and media use. This work aims at exploring some of the sophisticated techniques to identify drowsiness using modern machine learning approaches, such as convolutional neural networks(CNN) and long short-term memory(LSTM) models. To ensure a comprehensive evaluation, we utilized four diverse datasets: Driver Drowsiness Dataset (DDD), MRL Dataset, YAWDD Dataset, Drowsiness-Dataset. It aligned these datasets with real-world conditions such as different lighting environments, facial emotions, and body language, which form a strong basis for training and evaluating the models. We tested various classifiers for the model for the text classification, with KNN, SVM, Random Forest, ANN, RNN, and CNN; the different models were then analyzed based on their accuracy, precision, recall, and F1-score. Of all, CNN was determined to be the most suitable for feature extraction of visual signs of drowsiness. However, since the patterns of drowsiness are sequential: the temporal variations in closure of eyes, yawning, head movement ; we developed a CNN-LSTM model. This model combines CNN ability to extract spatial features in images with LSTM ability to temporal features in time series data and therefore comprehensively capture static and dynamic patterns of drowsiness.

The proposed CNN-LSTM model was extensively tested and delivered superior performance in relation to earlier models in all four datasets. Significantly, the hybrid model provided better results in comparison with other models for processing the multimodal data inputs and in terms of real-world scenarios including the occlusion, demographic variations, and environmental variations and so on. These outcomes demonstrate the model's applicability for utilisation in real-time contexts including driver vigilance monitoring, fatigue recognition in online learning contexts and safety in multimedia interfaces.

To that end, this study fills certain research gaps that are crucial for applying deep learning to real-world drowsiness detection: (i) consideration for how the fused data modality should be integrated into a single pipeline; (ii) ways of accommodating diversity in demography; and (iii) how the approach might be optimized for real-time performance. It is in this regard that the proposed CNN-LSTM model provides the basis for future developments explaining how it can be used to increase safety, productivity, and user satisfaction in important fields.

Keywords :- Driver Drowsiness, Convolutional Neural Network (CNN), Long Short Term Memory (LSTM), Driver Drowsy Dataset (DDD)

Prediction of Crop Prediction of Crop Yield Based on Environmental Factors Using Edge AI

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Abstract: Accurate crop yield prediction is crucial for farmers, policymakers, and the agricultural industry to ensure food security and optimize resource allocation. Reliable predictions help farmers make informed decisions about planting, harvesting, and resource management, while also enabling stakeholders to anticipate market trends, reduce losses, and improve supply chain efficiency. However, traditional forecasting methods often fail to account for dynamic environmental conditions. This study undertakes a comprehensive review and comparative analysis of various machine learning models applied to crop yield prediction.

Traditional models such as Support Vector Machines (SVM), Random Forest, Decision Tree, and Linear Regression were evaluated alongside advanced models, including Transformer networks, Long Short-Term Memory (LSTM), and XGBoost. advancing precision agriculture and promoting sustainable farming practices.Additionally, a novel hybrid model that combines the strengths of traditional approaches has been developed and is currently being tested for comparative analysis. These models are rigorously evaluated using key metrics, including Mean Squared Error (MSE), Mean Absolute Error (MAE), R-squared (R^2), and additional features such as training efficiency and robustness against overfitting. An interactive dashboard has also been created to visualize the predictions and provide actionable insights for stakeholders. Preliminary results highlight the potential of these models in delivering accurate, reliable, and scalable predictions, emphasizing the role of machine learning in advancing precision agriculture and promoting sustainable farming practices.

Keywords: Crop Yield Prediction, Machine Learning, Transformer Models, Long Short-Term Memory (LSTM), XGBoost, Support Vector Machines (SVM), Hybrid Models, Predictive Analytics, Sustainable Agriculture

PARKINSON'S DISEASE PREDICTION USING MACHINE LEARNING

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Parkinson's Disease (PD) is the second most common neurodegenerative disorder, characterized by disruptions in both motor and non-motor functions that severely impact patients' quality of life. Early diagnosis is essential for effective treatment, yet traditional clinical evaluation methods often miss the subtle early indicators, delaying timely intervention. Advances in machine learning (ML) and deep learning (DL) offer new possibilities for improving diagnostic precision by analyzing diverse data sources, including speech patterns, gait analysis, neuroimaging, and clinical records, providing non-invasive and cost-efficient screening solutions.

After reviewing existing literature and analyzing prior research efforts on Parkinson's Disease (PD) diagnosis, we have identified that existing approaches predominantly use feature extraction methods like MFCC for speech analysis and PCA for dimensionality reduction to uncover meaningful patterns. Techniques such as SMOTE are commonly employed to address class imbalance, while machine learning models, including Random Forests and SVM, along with deep learning architectures like LSTM-GRU combinations, have demonstrated potential in detecting early-stage PD. Ensemble techniques have been effective in improving model reliability and performance, as evidenced by better sensitivity, specificity, and AUC-ROC metrics.

However, these studies highlight notable gaps, particularly in the preprocessing and integration of multimodal data, which often result in noisy and inconsistent inputs. To address these limitations, we aim to develop advanced preprocessing techniques to enhance data quality through cleaning, normalization, and augmentation. Our research also focuses on curating diverse, high-quality datasets to facilitate seamless integration of speech, gait, and clinical data, ultimately improving feature extraction and model performance.

Segmentation of Endometrial Lesions in Laparoscopic Images

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Abstract: Endometriosis is a chronic gynecological condition in which a tissue or lesion similar to the endometrial lining of the uterus, called the endometrial tissue or endometrial lesion, grows outside the uterine cavity. Endometriosis affects around 10% of women of age around 18-50 globally. Machine learning and deep learning techniques help radiologists in the diagnosis of the condition of patients. ML or DL has been used to detect, segment, and localize endometrial lesions in laparoscopic, MRI, and ultrasound images.

To diagnose the presence and location of endometrial lesions, ML or DL segmentation techniques are applied to laparoscopic images. Segmentation techniques such as U-Net++ and transformer-based models hold significant potential in advancing the segmentation of endometriotic lesions, thus contributing to more accurate and non-invasive diagnostic approaches for endometriosis than the previously used U-Net approach. The project intends to improve segmentation results in the case of endometriosis on the GLENDA dataset, which consists of laparoscopic images.

Keywords: Endometriosis, Segmentation, Medical Image Diagnosis, Machine learning, Deep learning, Laparoscopic Images.

Credit Fraud Detection using Machine Learning Algorithms

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Fraud detection in financial systems is critical due to the significant economic implications of false positives and negatives. The imbalanced nature of fraud datasets poses challenges for traditional machine learning models, necessitating tailored approaches. This study aims to develop and evaluate machine learning algorithms optimized for fraud detection by addressing the challenges of imbalanced data and ensuring high precision and recall. Data preprocessing included cleaning, handling missing values, and standardizing features to ensure compatibility with scale-sensitive models such as Support Vector Machines (SVM), AdaBoost, XGBoost, Multi-Layer Perceptron (MLP) classifier, Logistic Regression, Decision Tree, Random Forest, k-Nearest Neighbors, and Naïve Bayes. Models were trained and tested on data split using Scikit-Learn's `train_test_split` method. Hyperparameter tuning was conducted using GridSearchCV and RandomizedSearchCV. Performance was evaluated using accuracy, precision, recall, F1-score, and AUC-ROC, with a focus on precision and recall to mitigate the effects of class imbalances. The best-performing models demonstrated robust performance on test data, highlighting the efficacy of the tailored preprocessing and optimization strategies. The study underscores the importance of customized approaches for fraud detection in financial systems and offers a scalable framework for handling imbalanced datasets. Future work will focus on enhancing algorithm adaptability and exploring ensemble methods for improved performance.

Keywords: Recall, AUC-ROC, GridSearchCV, RandomizedSearchCV, Hyperparameter Tuning

SFos: Smart Food Ordering System

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The **Smart Food Ordering System** is a modern solution designed to simplify the process of ordering food and enhance the overall customer experience. This system allows customers to effortlessly browse restaurant menus, place orders from the comfort of their homes or offices, and track the status of their deliveries in real time. By streamlining the food ordering and delivery process, the system minimizes delays, reduces waiting times, and ensures customer satisfaction through timely and accurate service. A key feature of the system is its ability to provide personalized recommendations to users. Using advanced data analysis techniques, it suggests dishes based on user preferences, order history, and trending items, thereby making the ordering process more engaging and tailored to individual tastes. Real-time tracking enables customers to monitor their order's journey, providing transparency and reassurance about the delivery status.
For restaurants, the system offers tools to efficiently manage menu content, monitor order preparation, and enhance communication with customers. By creating a direct link between restaurants and diners, the platform not only improves operational efficiency but also fosters a better connection between businesses and their customers. The ultimate goal of this system is to deliver a smooth, reliable, and enjoyable food ordering experience. It is designed to meet the demands of modern users who value convenience, speed, and personalization in their dining experiences.

Keywords: Smart Food Ordering System, Personalized Recommendations, Real-Time Tracking, Enhanced Customer Experience, Seamless Food Delivery, Modern Dining Solutions.

Enhancing Endometrial Cancer Segmentation in PET and CT Imaging with Hybrid CNN-Transformer Models

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Among the various women's cancers that exist, endometrial cancer is one of the most common, in which early and accurate diagnosis is needed to be conducted to identify optimal patient treatment. The imaging techniques used in medical imaging mainly use the old-school approach of getting data from humans and tracking the progress of the tumor, usually by using computerized tomography (CT) scans, which sometimes have low quality resulting in the human operators failing to recognize the presence of a tumor. PET/CT hybrid imaging is a technology that integrates metabolic and anatomical data and has thus proved to be a diagnostic method, however, segmentation of these tumors in images is still a major problem. As a solution to the problem, the research suggests a hybrid deep learning architecture that combines CNNs and Transformers to improve the semantic segmentation of endometrial cancer in PET/CT images.

The hybrid architecture capitalizes on the strengths of both the local features of CNNs, such as drawing sharp tumor edges, and the global and long-distance relationships recognized by Transformers to extract the information that is crucial for cancer affection. This format equips the model to outsmart ordinary-of-the-conventional-methods which suffer from CT images that contain low contrast vulnerabilities. The procedure adopts sturdy preprocessing steps such as image normalization and denoising, together with data augmentation techniques which consist of rotation and contrast adjustments to create a set of data that undergoes such a procedure that makes it suitable for the training of models and improves its ability to generalize in various scenarios.

The main purpose of the present research is to create an accurate segmentation model that can clearly give out the tumor area, thus, the early detection and effective planning of personalized treatment can be achieved. Post-processing techniques have been developed a step further in the field of image segmentation by smoothing the boundaries of tumors for high precision. The model is then tested with the help of the commonly used metrics such as Dice Coefficient, Jaccard Index, and Hausdorff Distance to see if it is performing better than the existing standards.

This proposed methodology tries to fill in the main problems in the present segmentation methods by blending CNNs and Transformers, thereby coming up with a fresh way of

solving the difficulties of low-contrast and noisy imaging which are the most essential aspects of good segmentation. The hybrid architecture besides the segmentation accuracy also facilitates the progression of a stiff, mechanized diagnostic tool that can be used to provide necessary information to doctors in the early stage of endometrial cancer treatment and thus, a patient can receive better healthcare.

Keywords: Endometrial Cancer, PET/CT Imaging, Semantic Segmentation, Deep Learning, CNN-Transformer Hybrid, Jaccard Index, Dice Coefficient

Ransomware Detection Using CPU and Memory Utilisation Snapshots Charu Chabria; Krishika Sahni; Tanishka Rawat
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Ransomware attacks have become a critical cybersecurity challenge, threatening digital assets globally. Existing detection methods often fail to preemptively identify ransomware activity, underscoring the need for robust and adaptive detection frameworks. This research focuses on the mathematical formulation of a novel ransomware detection approach, leveraging CPU and memory utilization metrics for precise and early-stage detection. Our framework introduces key mathematical constructs, including a Malicious Score (Maliscore) formulation to quantify suspicious behavior and threshold determination techniques to identify anomalies. Additional components include the development of the System Anomaly Ratio (SAR) and honeypot ratio metrics, designed to enhance the detection process by integrating insights from decoy systems. These formulations were derived through the analysis of ransomware behavior patterns and resource utilization models. The results of this study consist of rigorously developed formulas that provide a foundation for future implementation. The Maliscore model enables a scalable and systematic assessment of potential threats, while the SAR and honeypot ratio calculations offer a structured approach to determining when an alarm should be triggered. This work establishes a mathematical basis for an innovative ransomware detection framework, offering valuable tools for researchers and practitioners in cybersecurity. Future efforts will focus on validating these formulations through real-world implementations and extending them to other types of malware detection. **Keywords:** Ransomware, Malicious Score (Maliscore), System Anomaly Ratio (SAR)

Enhancing Agricultural Resilience: Machine Learning-Driven Disease Detection for Cotton Crops

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ABSTRACT

Agriculture is a cornerstone of India's economy, contributing around 18% to the national GDP and employing nearly 60% of the population. Among the various crops grown in India, cotton holds paramount importance as a major cash crop supporting the textile industry, oil extraction, and several allied industries. Cotton production not only caters to domestic demand but also contributes significantly to export revenues, making it a crucial crop for economic growth. However, cotton cultivation is severely impacted by a range of pests and diseases, including Fusarium Wilt, Bacterial Blight, and Cotton Leaf Curl Virus, leading to significant reductions in yield and fiber quality. These pest-related issues result in considerable economic losses for farmers, affecting their livelihoods and the textile sector as a whole.

This research presents a lightweight and efficient model for detecting pests and diseases in cotton plants using advanced image processing and machine learning techniques. A dataset of 1,711 annotated cotton plant images, representing various pest and disease conditions, is employed to train the model. To enhance feature extraction and classification accuracy, the model integrates a Convolutional Block Attention Module (CBAM) with the ResNet50 architecture. The CBAM mechanism applies spatial and channel-wise attention to prioritize critical features, improving the model's ability to distinguish between healthy and diseased plants. The model benefits from Transfer Learning by leveraging pre-trained weights from large-scale image datasets, further enhancing its performance.

In addition to deep learning, Support Vector Machine (SVM) classification is used to optimize the feature extraction process. Hyperparameter tuning through GridSearchCV ensures the model's accuracy and efficiency in real-world applications. The lightweight architecture ensures that the model can be easily deployed in resource-constrained environments, making it an accessible solution for farmers in rural areas.

The proposed model achieves a remarkable 98% accuracy, making it a reliable tool for early pest and disease detection. By identifying diseases and pests at an early stage, the model can significantly reduce economic losses, improve crop yield, and promote sustainable agricultural practices. Through this solution, farmers will be empowered with an easy-to-use, efficient tool that helps them make timely decisions, thereby enhancing their productivity and contributing to the overall agricultural economy.

KEYWORDS: ~Indian agriculture ~Cotton pest detection ~Fusarium wilt ~Convolutional Block Attention Module (CBAM) ~ResNet50 ~Transfer Learning ~Support Vector Machine (SVM)

Fake News Detection on Online Social Media using Machine Leaning and Explainable AI

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Abstract - The dissemination of fake news through digital networks has become an alarming phenomenon with detrimental consequences such as erosion of public confidence and manipulation of decision-making processes. The existing detection systems still need to grapple with low performance levels and a need for interpretability, making comprehending and accepting their outputs challenging. This research addresses these gaps by proposing a novel hybrid machine learning-based fake news detection system integrated with explainable artificial intelligence (XAI). Our novel approach combines advanced feature embedding techniques with swarm optimization to enhance feature selection and classification performance. This ensures increased accuracy without compromising interpretability. The system is designed to leverage a hybrid framework, combining traditional and modern machine-learning models to maximize complementary strengths. A key innovation lies in integrating XAI methods to make the detection process transparent, providing feature-importance insights and example-based explanations. This fosters user trust and a better understanding of system outcomes. Initial testing on the LIAR dataset demonstrates promising results in identifying fake news articles, emphasizing this hybrid approach's potential to overcome existing methods' limitations. Future work will focus on refining detection speed, developing accessible remote applications, and incorporating real-time misinformation alerts. This study highlights a novel balance between precision, interpretability, and scalability, offering a practical and trustworthy solution to combat fake news.

Keywords: Fake News Detection, Hybrid Models, Swarm Optimization, Feature Embedding, Explainable AI

Enhancing Autism Spectrum Disorder Using Classification and Ensemble Approaches: A Study on Hyperparameter Tuning and Outlier Detection

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Autism Spectrum Disorder (ASD) is a major health issue globally due to its increased prevalence and complexity in diagnosis. This study proposed an Outlier-Driven Prediction Framework that combines predictive machine learning models with outlier detection and hyperparameter tuning to strengthen ASD detection. We examined the performance of Decision Trees, Random Forests (Entropy and Gini), Gaussian Naive Bayes, and Extra Trees, focusing on their effectiveness with high-dimensional, highly imbalanced datasets, which are the norm in clinical settings for ASD diagnosis. Feature scaling and efficiency were optimized, and the local outlier factor (LOF) method was utilized for outlier robust outlier detection. The dataset used for this study was obtained from the UCI ML Repository, focusing on adult patients diagnosed with ASD. The proposed ensemble classifier method achieved 98.97% accuracy using the Extra Trees classifier. This framework justifies combining ensemble models and outlier detection methods to enhance diagnostic techniques for ASD, which introduces a new dimension within machine learning in healthcare.

Keywords: Outlier detection, ensemble algorithms, Hyperparameter tuning, Local outlier factor, Neurodevelopmental disorders.

A Predictive Modelling study for Automated Detection of Polycystic Ovary Syndrome (PCOS) Using Machine Learning Techniques

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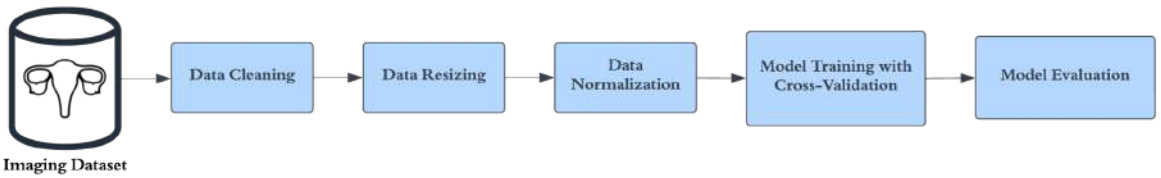
Polycystic Ovary Syndrome (PCOS) is a prevalent endocrine disorder affecting reproductive-aged women. Early and accurate detection of PCOS is crucial for timely intervention and treatment. In this study, we performed a comprehensive comparative analysis of six deep learning models, Custom Convolutional Neural Network, VGG16, EfficientNet V2B3, DenseNet121, ResNet50, and Inception V3, to distinguish between PCOS and non-PCOS images. Applying cross-validation to improve model evaluation and address the issue of overfitting is a novel contribution of this work, not previously documented in the literature. Our findings came up with VGG16 as the best-performed model with a validation accuracy of 99.61% and test accuracy of 100%. Further, this study is the first to report the AUC-ROC metric to provide deeper insight into model effectiveness. The study highlights the potential of other evaluation metrics for performance evaluation and paves the way for future improvements and real-world clinical applications.



Keywords: Polycystic Ovary Syndrome, Deep Learning, Convolutional Neural Networks, Transfer Learning, Cross-Validation.

A Study on Heart Failure Prediction Using Machine Learning and Explainable AI Techniques

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Cardiovascular diseases (CVD) including heart failure (HF) remain one of the main causes of mortality worldwide and contribute considerably to the burden of health systems. In this group of diseases, Heart failure is a critical condition that requires accurate prediction models to improve patient outcomes. An extensive literature review was conducted to explore existing methodologies and identify gaps in heart failure prediction models. This study proposes an advanced predictive model incorporating feature selection, hyperparameter optimization, and machine learning techniques to overcome these gaps. SMOTE (Synthetic Minority Over-sampling Technique) is used to address class imbalance. Recursive Feature Elimination (RFE) is employed to identify the most relevant features for prediction. To further enhance performance, Artificial Cell Swarm Optimization (ACSO) is applied for hyperparameter optimization, resulting in an optimized Random Forest Classifier. The model achieves an impressive accuracy of 97%, demonstrating its potential for reliable heart failure prediction. This paper focuses on the evaluation of all machine learning models used for early Heart Failure Prediction, highlighting the necessity of using LIME as interpretable machine learning models. that provide valuable insights into the model's decision-making process. This approach highlights the effectiveness of combining these techniques to create a robust, interpretable, and high-performing predictive model for heart failure.

Keywords: Heart Failure Prediction, Cardiovascular Disease (CVD), Machine Learning, Explainable Artificial Intelligence (XAI), XGBoost, SHAP, LIME

Parkinson's Detection: A New Era with AI

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Parkinson's disease (PD) is a progressive neurological illness that needs to be diagnosed early and accurately in order to be effectively managed and improve patient outcomes. This study focuses on the developments in explainable AI (XAI) and machine learning (ML) methods used for PD identification with multimodal, handwriting, and voice datasets. Incremental learning techniques, including In cremental Support Vector Machines, have demonstrated efficacy in predicting UPDRS scores, overcoming the difficulty of updating predictive models with out starting over from scratch. Using advanced feature selection approaches and strategies like SMOTE to handle imbalanced datasets, ensemble techniques like XG Boost-Random Forest and Nearest Neighbour Boosting (NNB) have shown great diagnostic accuracy. In order to improve accuracy and lower computational costs, nature-inspired optimization techniques, such eagle-inspired algorithms, have been developed to optimize feature selection in speech signal analysis. By lowering the dimensionality of the data while preserving feature integrity, these models have shown promise in improving diagnostic performance. Furthermore, the effectiveness of these techniques is demonstrated by performance indicators such as sensitivity, accuracy, and area under the curve (AUC). The revolutionary impact of ML and XAI in PD diagnosis is highlighted in this study, with a focus on interpretability, computational efficiency, and multimodal integration as crucial elements for clinical adoption. These developments open the door to more reliable and expandable AI-powered medical treatments for neurodegenerative diseases.

Keywords: Parkinson's · neurodegenerative · multimodal · SMOTE · XG Boost

Twitter-Based Disaster Detection: A Study Comparison between Deep Learning and Machine Learning Models

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This study shows the significance of different machine learning and deep learning models to optimize the disaster detection using twitter. Word embeddings such as TF-IDF and Word2Vec have been used to achieve the highest overall accuracy along with the models. The TF-IDF bigram in conjunction with Multinomial Naive Bayes beats alternative models in terms of accuracy, according to our empirical investigation. This study emphasizes how important it is to use the right feature representations and classification models to improve Twitter disaster event detection and situational awareness. The findings advance the field of crisis informatics by offering a comprehensive understanding of how various models might be successfully applied for real-time disaster response and management.

Keywords: Disaster Management, Twitter Data Analysis, TF-IDF, Situational Awareness, Data Preprocessing, Machine Learning, Deep Learning, Word2Vec

Leveraging Longitudinal EHR Data and Machine Learning to Optimize Female Healthcare Outcomes

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This study applies machine learning techniques to analyze longitudinal Electronic Health Records (EHR) data from Mohalla Clinics, focusing on female healthcare. The dataset spans from August 2016 to June 2019, providing nearly three years of insights into healthcare trends. As chronic diseases grow and treatment strategies need personalization, understanding regional, age, and temporal healthcare trends becomes crucial. This research aims to optimize treatment through data-driven insights. The dataset, segmented into six-month intervals, enables clustering to identify patterns in disease progression and treatment regimens. Notably, fever and respiratory diseases show a seasonal trend with peaks in January. Using exploratory data analysis (EDA) and advanced clustering, distinct patient profiles emerge, revealing how healthcare needs evolve over time and vary across regions and age groups. Results highlight significant temporal trends and the need to tailor treatment strategies to specific demographic profiles. This research underscores the potential of machine learning to drive evidence-based healthcare decisions, improving outcomes for female patients. Such studies can guide personalized treatment and sustainable healthcare policies. Future work will refine clustering methodologies and extend this approach to larger populations, paving the way for more effective healthcare solutions.

KEYWORDS:Electronic Health Records (EHR), Female Healthcare, Timestamp-Based Clustering, Longitudinal Data Analysis

Synergy of Digital Twins in Cardiovascular Disease: A Personalized Modeling Approach

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Cardiovascular disease (CVD) is the leading cause of global mortality, accounting for approximately 18 million deaths annually. Early detection and personalized interventions are vital to mitigating risks and improving outcomes. This study integrates machine learning and digital twin technology to predict CVD risks and simulate the impact of personalized interventions, addressing limitations in traditional diagnostic methods. A synthetic dataset, including features such as age, cholesterol levels, systolic blood pressure, diabetes status, BMI, and smoking status, was used to develop a Random Forest Classifier for CVD risk prediction. The model achieved an accuracy of 70%, although class imbalance affected metrics like the F1-score (0.08). Using digital twins, the study simulated cholesterol reduction as an intervention, resulting in significant decreases in predicted CVD risk probabilities for most cases. The findings emphasize the potential of digital twins in enabling personalized healthcare by providing actionable insights through simulated interventions. However, limitations such as reliance on synthetic data, class imbalance, and a narrow feature set were identified. Future work aims to integrate real-world datasets, explore advanced algorithms, and incorporate additional variables like genetic markers and family history. This research highlights the transformative potential of combining digital twin technology and machine learning in cardiovascular risk prediction, paving the way for more personalized and effective healthcare strategies.

Keywords: Cardiovascular Disease (CVD), Digital Twin, Precision Medicine, Ischemic Heart Disease (IHD).

Empirical Analysis of Class Imbalance Problem and its Techniques

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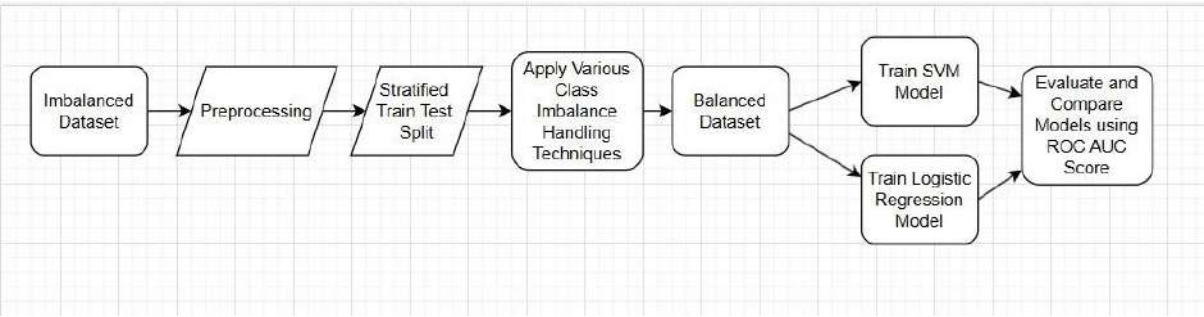
Class imbalance is a critical issue in machine learning, where minority classes are underrepresented, leading to biased predictions and poor performance. Despite numerous techniques, there remains a lack of systematic evaluation across diverse datasets and classifiers, particularly for multi-class tasks. This study aimed to identify five benchmark binary and five benchmark multi-class datasets with varying imbalance ratios and evaluate the effectiveness of class imbalance mitigation techniques. Techniques such as undersampling, oversampling, hybrid sampling, cost-sensitive learning, and hybrid ensembles were applied and evaluated using Logistic Regression, and SVM classifiers. Performance was assessed with the ROC-AUC metric, and stratified cross-validation ensured robust comparisons. Hybrid sampling and hybrid ensemble methods consistently achieved higher ROC-AUC scores, particularly for multi-class datasets like Pageblock and Abalone. Cost-sensitive approaches demonstrated strong performance for highly imbalanced datasets such as Ecoli (imbalance ratio 71.5) and slightly imbalanced dataset like Breast Cancer (imbalance ratio 1.68), but underperformed for moderately imbalanced datasets such as Haberman (imbalance ratio 2.77). Hybrid ensembles demonstrated robustness across both binary and multi-class datasets, achieving the highest ROC-AUC of 0.9847 for Pageblock. This research highlights the effectiveness of hybrid approaches in addressing class imbalance and provides dataset-specific recommendations for technique selection. Future studies should explore dynamic and adaptive methods to enhance generalizability across diverse domains.



Keywords: Class Imbalance, Machine Learning, Hybrid Sampling, ROC-AUC score

Speech Emotion Recognition using Deep Learning

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Humans rely on emotions to express thoughts and engage in everyday activities such as interaction, learning, and decision-making. Speech Emotion Recognition (SER) systems process audio inputs to detect emotions, with applications in sectors like customer service, healthcare, education, and market research. This paper presents a method for SER using Mel spectrograms and Convolutional Neural Networks (CNNs). Audio samples are converted into Mel spectrogram images representing the frequency spectrum on the Mel scale and these images are then used to train a CNN model. The system predicts emotions such as anger, fear, disgust, neutral, happy, surprise, and sad. We evaluate the model using RAVDESS, SAVEE, TESS, and the combined dataset, attaining accuracies of 70% for RAVDESS, 60% for SAVEE, 99.89% for TESS, and 87% for the combined dataset. This approach demonstrates the effectiveness of combining Mel spectrograms with CNNs for robust emotion recognition from speech.

Keywords: Speech Emotion Recognition (SER), Mel Spectrogram, Convolution Neural Networks (CNN)

A Data-Driven Longitudinal Analysis and Forecasting of Biomedical Waste Generation

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Biomedical waste management forms a crucial aspect of both environmental and public health, which warrants effective strategies to mitigate its hazardous impacts. This study utilizes a dataset from the Central Pollution Control Board from the years 2008 through 2022 to analyze biomedical waste management in India. After cleaning and preprocessing with comprehensive data, key trends, and gaps were identified, thus showing that around 10.5% of biomedical waste is untreated despite being covered by protocols.

The analysis focused on identifying the most significant factors influencing biomedical waste generation, with an emphasis on healthcare infrastructure metrics, such as the number of healthcare facilities and available hospital beds in each region. Predictive modeling was employed using advanced machine learning techniques, including Long Short-Term Memory (LSTM) networks, Random Forest Regressor, and XGBoost. The dataset was divided into an 80-20 training-to-testing split to ensure model robustness. Among these models, the Random Forest Regressor emerged as the best performer, achieving the highest R^2 score.

The results suggest the need for better monitoring systems and prediction instruments to enhance waste treatment efficiency toward sustainable management strategies. The study, therefore, opens up some significant insight into potential solutions for policymakers and relevant stakeholders facing the continuous challenges that occur in biomedical waste management.

Keywords: Biomedical Waste, Machine Learning, Emerging Technologies, Secure waste management

Enhancing Slang Detection and Ranking across Reddit and YouTube Using Fuzzy Logic

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The rapid evolution of internet slang creates crucial challenges for recognition as well as contextual interpretation and ranking across digital platforms. The paper presents an enhanced version of the SLANGZY [10] model for the extraction and ranking of slang terms from Reddit and YouTube. Key improvements include the introduction of fuzzy logic with Gaussian membership functions for slang factor computation, the use of Fuzzy Inference Systems (FIS) for handling the fuzzified inputs and building accurate rankings, integration of contextual embeddings (BERT) for a better understanding of slang meaning, and additional features based on TF-IDF for enhanced syntactic analysis. The model automates the data gathering, cleaning, and contextual enrichment of slang by using the Urban Dictionary API for its definitions and examples. Upvotes, upvote-to-downvote ratios, and definition length are fuzzified variables in calculating a single slang factor, ranking terms by their prominence and frequency. Clustering techniques and t-SNE visualization are used to display the distribution of slang across platforms. Although the model has made good progress in slang detection as well as ranking, it reveals scope for improvement in terms of accurate classification into specific groups. Modular design of the advanced SLANGZY model provides greater adaptability and precision in the understanding of changes in usage and shifts in culture within online communities. This development leaves broad scopes for future applications in sentiment analysis, social media monitoring, and the study of changes in language in digital space.

Keywords: Slang analysis, Fuzzy logic, Urban dictionary. BERT embedding, t-Distributed Stochastic Neighbor Embedding (t-SNE).

Heterogeneous Clustering in Wireless Sensor Networks Using ReputationIndex and Multi-Criteria Decision Analysis

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In Wireless Sensor Networks (WSNs), ensuring network efficiency and longevity is a critical challenge, particularly in heterogeneous environments where nodes vary in energy, computational capacity, and communication capabilities. This study introduces an innovative approach to heterogeneous clustering that combines a Reputation Index (RI) and Multi- Criteria Decision Analysis (MCDA) to optimize cluster head selection and enhance network performance. The Reputation Index evaluates node reliability through metrics such as residual energy, communication range, and historical performance, facilitating the selection of robust and reliable cluster heads. Meanwhile, MCDA considers multiple criteria, including energy efficiency, node density, and proximity to the base station, to enable balanced and informed clustering decisions. By integrating RI and MCDA, the proposed method ensures equitable energy distribution, mitigates the challenges of node heterogeneity, and significantly extends network lifetime. Simulations reveal marked improvements, including reduced energy consumption, prolonged network lifespan, and enhanced data transmission reliability, positioning this approach as a scalable and effective solution for next-generationWSN applications.

Keywords: Wireless Sensor Networks, Heterogeneous Clustering, Reputation Index, Multi-Criteria Decision Analysis, TOPSIS, Energy Efficiency, Cluster Head Selection, NetworkLifetime, Fault Tolerance

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