

2nd International Conference on

Hybrid Intelligence

Theories and Applications

November 20 - 21, 2025

श्री श्री विश्वविद्यालय, कटक, ओडिशा, भारत

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Dr. Gopinath Palai
Dr. Om Prakash Verma
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Dr. Deepak Panwar

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Dear Participants and Researchers,

Welcome to the book of abstracts for HITA2025! In this compilation, we embark on a journey through the diverse realms of soft computing, exploring its profound importance in addressing real-life challenges.

The aim of HITA2025 is to promote the research advancement in the theory and realization of Machine inTelligence covering topics such as Machine Learning, Deep Learning, Quantum Machine Learning, Real-time Computer Vision, Pattern Recognition, Natural Language Processing, Statistical Modeling, Autonomous Vehicles, Human Interfaces, Computational Intelligence, and Robotics. The International Conference is a one of the leading international conferences dedicated to bringing together a significant number of diverse scholarly events for presentation within the conference program. Events will run over a span of time during the conference depending on the number and length of the presentations. With its high quality, it provides an exceptional value for students, academics and industry researchers.

International Conference on HITA aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Applications of Machine InTelligence for Research & Innovations include the development and demonstration of Intelligent and Autonomous Robots (IAR), Unmanned Aerial Vehicle (UAV), Autonomous Underwater Vehicle (AUV), autonomous water surface vehicles (ASVs), Autonomous Land Vehicles (ALV), Swarm Robots, Humanoid Robots, and Autonomous Household Robots.

As you peruse these abstracts, envision the tangible impact of Machine Learning in versatile domains. Witness how these techniques transcend mere theory, actively contributing to solutions for societal challenges.

We extend our deepest appreciation to the contributors whose research showcased here represents a collective effort to bridge the gap between theoretical brilliance and practical application. Together, we forge a path towards a future where soft computing plays an integral role in shaping a smarter, more adaptive world.

Thank you for being a part of this journey.

Best Regards,

Conference Organizing Committee



Hybrid Intelligence: Theories and Applications (HITA2025) is now **Two years** International conference.

The **objective of HITA** is to provide a common platform to researchers, academicians, scientists and industrialists working in the area of machine learning to share and exchange their views and ideas on the theory and application of Hybrid intelligence in multi-disciplinary areas. Hybrid Intelligence is a cooperative collaboration between Human and Artificial Intelligence in solving intelligence tasks. It is one of the leading international conferences for presenting novel and fundamental advances in hybrid Intelligence and their applications. It serves to foster communication among researchers and practitioners working in a wide variety of scientific areas with a common interest in improving environment using hybrid intelligent algorithms. Further it will help in exploring the broader concept of a smarter future, where intelligent algorithms are leveraged to enhance various aspects of society. The scope of HITA2025 comprehends both theoretical aspects and practical applications of Hybrid Intelligent algorithms in all the spheres.

The **aim of the conference** is to highlight the latest advances, problems and challenges and to present the latest research results in the field of soft computing with a link to scientific research and its practical implementation. HITA especially encourages the young researchers at the beginning of their career to participate in this conference and invite them to present their work on this platform.

Previous HITA conference was successfully organized at the following venue

HITA2024:	Shobhit University Gangoh, India.	(October 18 - 19, 2024)

2nd in the series, HITA2025 held at Sri Sri University, Cuttack, Odisha, INDIA in hybrid mode during November 20 - 21, 2025. HITA2025 is organized in Faculty of Engineering and Technology, Sri Sri University, Cuttack, Odisha, INDIA in technical support of Dr B R Ambedkar NIT Jalandhar, National Institute of Technology Srinagar and Coal City University, Enugu, Nigeria, INTI International University, Malaysiaand; Hasanuddin University, Indonesia

The conference had 3 keynote lectures presented by eminent academicians and practitioners from different parts of the world. Totally, 80 technical papers under 6 different themes of the conference were presented during the conference in 6 oral presentation sessions. We are thankful to Springer Plc., for giving us opportunity to publish the proceedings in Lecture Notes in Networks and Systems (LNNS). All papers submitted to HITA2025 had undergone a peer-review process and subsequently revised before being finally accepted.

The credit of the success of the HITA Series, goes to our Mentors, Keynote & Invited Speakers, Chief Guests, Guest of Honor(s), Members of the advisory board (National & International), Program Committee members, Springer Team as a publishing partner (in particular Mr. Aninda Bose, Executive Editor – Interdisciplinary Applied Sciences; Research Publishing – Books), all the Author(s), participants and the reviewer's board. We sincerely appreciate your continued support, encouragement and trust in us. We look forward to have this wonderful support in the coming HITA Series as well.

Looking forward to have your significant contribution in HITA Series.



Message from the Conveners

Dear Colleagues and Distinguished Participants,

It is with great pleasure and enthusiasm that we welcome you to the Second International Conference on **Hybrid Intelligence: Theories and Applications (HITA2025)**, to be held at **Sri Sri University, Cuttack, Odisha, INDIA** from **November 20 – 21, 2025**.

Following the success of the inaugural HITA conference, we are excited to once again bring together leading researchers, academics, and industry professionals from around the globe to discuss and explore the latest advancements in hybrid intelligence. Our conference aims to foster an environment of knowledge sharing, collaboration, and innovation, pushing the boundaries of research and practical applications in this dynamic field.

HITA2025 promises an engaging program, featuring keynote speeches from world-renowned experts, insightful panel discussions, and presentations of cutting-edge research. Attendees will have the opportunity to network with peers, gain insights into emerging trends, and explore potential collaborations. The conference will cover a diverse range of topics, including but not limited to artificial intelligence, machine learning, data science, robotics, and their applications across various industries.

We are honored to host this prestigious event in the picturesque region of Odisha, known for its rich cultural heritage and breathtaking natural beauty. We hope that you will not only benefit from the academic and professional interactions but also take the time to enjoy the serene landscapes and warm hospitality that Srinagar has to offer.

We extend our heartfelt gratitude to the organizing committee, sponsors, and all participants for their contributions and support in making HITA2025 a successful and memorable event. We look forward to your active participation and to a stimulating and enriching conference experience.

Warm regards,

Conveners, HITA2025



Invited Talks



Dr. Viabhav Gupta
Sr. Technical Officer
IRDE, DRDO, Ministry of Defense, GOI, Dehradun

Dr. Gupta, obtained his M.Sc. in Computer Science from MD University, Rohtak in 2002, M.Phil. Computer Science from Madurai Kamaraj University, Madurai in 2005 and P.hD. in Computer Science Engineering with Specialization in Neural Networks from Uttarakhand Technical University, Dehradun in 2021. DRDO He joined DRDO in 2002 at DRDO Delhi where he played lead role in major routing centre and developed intelligent mail server and routing tables. He joined DRDO premium electro-optical laboratory IRDE Dehradun in June 2005. He started his work in the area of automation and developed AI based algorithms for detection and tracking, Bad weather imaging, generative image reconstruction, passive ranging and super resolution for electro-optical systems. In 2016 he made significant achievement in the development of AI based battle tank detection system using artificial neural network approach for implementation of smart mines. During COVID Pandemic he has developed an intelligent system for fever detection from a safer distance using thermal imager among the crowd instantly for multiple persons. His important contributions includes development of automated VIPERS-HD for human detection during day/night conditions. Successful night trials were also conducted in Ladhak region at -25 celcius. In continuation to this VIPERS-AD (Anti Drone) has been developed with the capability to detect, track and classify miniature size flying object and UAV in the sky even in the pitch dark conditions using trajectory, acoustic and spatial models. As an eminent designer he has pushed himself beyond limits and achieved significant success in the development of AI based DRONE surveillance model to autonomously detect and classify various objects on the ground surface in the battle field region. He has also conceptualized a model for dropping of payload release mechanism using remote control operation or autonomously mounted on Drone. In his recent contributions he has also achieved facial recognition of humans from a substantial height through the optical sensor mounted on a flying Drone. The succesful trials were conducted at Uttrakhand Police Headquaters facility in Dehradun. He has been awarded patent for his contributions and published many research papers in the journals & conferences of high repute. He has been awarded DRDO Laboratory award for his outstanding contributions in the development of AI based systems in the year 2021.





Dr. Satyajit Rath
Sr. Principal Scientist - Head
CSIR - Institute of Minerals and Materials Technology
Council of Scientific and Industrial Research (CSIR)
Ministry of Science and Technology, Govt.of India

Dr. Satyajit Rath, with B. Tech from College of Engineering & Technology (OUAT), Bhubaneswar, in 1997 started his career as a Software Professional with M/s Geo-Informatics, Bhubaneswar through campus placement. In September 1998 he joined Centre for Development of Advance computing (C-DAC), Noida, Ministry of Communication & IT, Govt. of India and worked in various capacities. At C-DAC, he was heading the Geomatics group and leading all GIS based MIS projects of several Ministries and Development Authorities. Notable among them is the successful NELP campaign of Directorate General of Hydrocarbons (DGH), MoP&NG, Govt. of India and the Land Management & Information System of Delhi Development Authority (DDA). With a knack of learning he completed his M.S. in Software Systems from BITS, Pilani in 2002. In April 2008 Dr. Rath joined CSIR-Institute of Minerals and Materials Technology (IMMT), Bhubaneswar. Currently as a Principal Scientist and Head of Computer Networking & e-Management Department, he is managing the ICT Infrastructure with live servers and 600+ nodes, leading software related project consultancy and IT applied research in the allied field. As a faculty (Associate Professor) under AcSIR, he is actively involved in teaching computer allied subjects in PhD programs being conducted at IMMT. He is also the Nodal Officer for implementation of OneCSIR, ERP at IMMT and a key resource member in central team at CSIR for implementation of ERP across all the laboratories in India. For his distinguished contribution and meritorious achievement as Project Champion for the CSIR Transformation Initiatives and Enterprise Application for Automation of Operations, he has received “Outstanding Achievement Award” by Dept. of Scientific and Industrial Research, Ministry of Science & Technology, Govt. of India, New Delhi in the year 2013. In addition to his professional commitments, in 2015, he completed his Ph. D. in Computer Science from Utkal University, Bhubaneswar.

In his 25 years of experience, Dr. Rath has successfully completed more than 12 R&D Projects and several consultancy projects. Currently he is guiding 05 PhD Scholars in the field of Computer Science mainly on AI and Data Analytics. During his research career he has guided more than 50 B.Tech, MCA, M. Tech students and published several technical research publications. He has three patents (filed by CSIR in India) and one copyright to his credit. In addition to research career currently he is the CPIO and Nodal officer, National Knowledge Network at IMMT. Dr. Rath is a member in Strategic Planning and Business Development at CSIR-IMMT and involved in policy decisions. As a Rotarian he is also actively involved in several flagship social activities in and around the Bhubaneswar City.





Mr. Chirag Agrawal
Senior Software Development Engineer
Amazon

Mr. Chirag Agrawal, is a seasoned technology professional with over a decade of experience in building large scale AI platforms, distributed systems, and developer tooling. As a Senior Engineer and Tech Lead at Amazon, he specializes in LLM infrastructure, advanced AI-powered conversational systems and multi-agent orchestration including agent execution, system prompt engineering, AI tool use, AI memory, Software Development Kit, and Compilers. Chirag leads cross-functional architectural initiatives, driving lower latency, reliability, and scale for Alexa and its developer ecosystem.



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6 HHBA-GA: Hybrid Hitchcock Bird Algorithm and Genetic Algorithm based Dynamic task scheduling in Edge-Cloud Computing

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Edge computing, a geographically distributed set of computing platforms, is crucial in modern IoT applications for faster processing and application execution. Effective task scheduling in edge-cloud computing enhances resource utilization, lowers makespan, reduces energy consumption, and achieves cost-effectiveness, meeting new time measure requirements for the modern world. This paper presents a new Hybrid Hitchcock Bird Algorithm (HHBA) and Genetic Algorithm (GA)-based dynamic task scheduling method that combines the advantages of HHBAâ€,and GA algorithms. While GA operates on the solution space to evolve a more effective solution through selectionâ€,and mutation operations, refining the task allocation by promoting the use of two-point crossover and uniform crossover for the topic planning in trades, HHBA can be considered as the optimizer, honing in on the set of sub-tasks through local comparisons while ensuring an equal workload among the resources. Experiments indicate that HHBA-GA achieves the best performance in makespan, energy consumption, andâ€,cost efficiency compared with GA, PSO, and standalone HHBA. The proposed pathway leads to an increase in energy savings of up to 24% and a reduction in cost reduction of about 22% when compared to traditional approaches. Furthermore, the model significantly enhances resource usage, proving its effectiveness in large-scale edge-cloud applications.

27 Fusion of Object Detection and Transformer-Based Classification for Robust Driver Distraction Recognition via YOLO-Guided ViT-CNN Hybrid Networks to prevent accidents

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Deep learning has become increasingly prominent due to its ability to deliver high accuracy and automatically extract features from raw data. Numerous studies have proposed techniques for recognizing distracted driving behaviors. This study introduces a novel deep hybrid learning approach that integrates object detection with transformer-based classification to identify driver distraction. The



framework captures key visual indicators related to driver actions such as gaze direction, hand placement, and object interactions using a region-of-interest (ROI) extraction mechanism powered by YOLO. These focused visual cues are then processed by a Vision Transformer (ViT) with a CNN-based classification head, which leverages both localized features and global image context for enhanced behavior recognition. To improve generalization and tackle class imbalance, the training strategy incorporates transfer learning, class-weighted sampling, and sophisticated data augmentation. Experimental validation on a 13-class driver distraction dataset shows that the proposed model achieves 89% accuracy, with a macro-average F1-score of 0.82 and a weighted-average F1-score of 0.89.

33 Characterization and Experimental Evaluation of a 2D LiDAR Sensor for Indoor Robotic Navigation

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Accurate range sensing is critical for autonomous indoor mobile robot navigation, with LiDAR a widespread selection for high-resolution spatial sensing. In this paper, a comprehensive experimental characterization of a 2D LiDAR sensor mounted on a differential drive mobile robot navigating structured indoor environment is reported. Performance was tested based on three criteria: datapoint density over a range of scan rates (5â€“10 Hz), detection performance for angularly distinct targets, and range error over target distance (1â€“11 meters). Measurements reveal a drastic decrease in datapoint density with increasing scan rate, decreasing from ~230 to ~110 points per rotation. Detection performance held high (~98%) for proximal targets (1Â°â€“2Â°) diminishing to ~80% at greater angles and distances. Further, mean range error grew linearly with distance, from ~0.015 m at 1 m to ~0.06 m at 11 m. The findings point out trade-offs among scan rate, spatial resolution, and range accuracy. The results of this characterization are useful for optimizing the configuration of LiDAR in indoor mobile robotics for localization and mapping.



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36 Reinforcement Learning based Advanced Driver Assistance System for Unmarked Road Scenarios

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Autonomous driving in unstructured environments, particularly in regions where lane markings are absent or inconsistent, presents significant challenges to traditional navigation systems. Developing countries like India often have roads with faded or missing lane boundaries, irregular traffic flow, and a wide variety of obstacles and diversions, making traditional navigation systems ineffective. This paper introduces a hybrid Reinforcement Learning (RL) framework designed to enhance self-driving capabilities in such unmarked and structurally ambiguous road settings. The proposed system integrates a perception module with a RL based control agent. The perception module is trained using the lighter version of the India Driving Dataset (IDD Lite) which applies semantic segmentation and object detection to extract drivable areas and identify surrounding obstacles. These processed images serve as input for the RL agent operating in a discrete state-action space where states are defined by lane density, vehicle speed, and proximity to obstacles. A shaped reward function encourages correct lane markings and safe navigation by assigning positive rewards for successful behavior and negative rewards for deviations or collisions.

52 A Comparative Study of Lexicon-Based, Machine Learning, and Deep Learning Methods for Sentiment Analysis in Indian Languages

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Sentiment analysis is an important component of NLP or Natural Language Processing which is used for tasks like evaluating sentiments from various sources like social media, political opinion and customer feedback. The three primary methods of sentiment analysis are- machine learning based, lexicon based and deep learning are thoroughly compared in this paper in regard to Indian languages like Hindi, English, Tamil etc. Because of the languages having so much diversity, complex grammar and code-switching blending of languages like Hindi and English and etc. Indian languages are especially difficult. This study



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compares pre trained models, cross-language learning and building datasets for low-resource languages to compare the advantages and disadvantages of these methods. This study also looks at possible methods for improving sentiment analysis in Indian languages in future.

53 A Deep Learning Framework for Enhancing Accuracy in Early Cancer Detection through Medical Imaging Analysis

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Cancer detection in its early stage and precise determination was still among the key problems of modern medical diagnostics. This study investigates the use of deep learning framework for automatic analysis of medical imagery to detect cancerous situations early. In order to analyze microscopic images of blood sample, a ResNet50-based convolutional neural network was used. The model was trained on a categorized dataset that clearly shows two classes of malignant and benign malignancies which allows for high accuracy in identifying abnormal patterns representative of the hematological malignancies. Reliability and clinical relevance of the predictions was assessed using performance metrics such as F1-score and confusion matrix. At the same time, MobileNetV2 was used to extract the features of dermoscopic skin images for classifying them into several diagnostic classes. Based on an exhaustive collection of the image and metadata data, the model was trained to be efficient in recognizing the features of different versions of a lesion with lightweight computational requirements. Both models were combined and implemented in an easy-to-use interface, designed based on Streamlit, where it was possible to interactively choose the image for prediction and its display with the following clinical recommendations. The framework shows the promise of customized models of deep learning for medical experts to assist them in the decision-making process and shorter diagnostic delays. The results demonstrate a great potential for the implementation of optimized models in clinical settings in the real world. However, more validation on larger datasets and real-time deployment aspects are needed to move forward in the direction of robust, generalizable alternatives.



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64 MRMDS: A Blockchain Based Medical Report Management and Distribution System

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Modern healthcare software solutions manage either Electronic Health Records storage or secure file sharing functions without integration capabilities. The MedShare platform maintains secure access through its design features although it does not incorporate deep integration with analytics applications. The proposed MRMDS system allows users seamless access to analytic tools and generates live patient information for personalized medical care. Small and medium-sized clinics benefit from MRMDS due to its cost-effective and customizable design which makes the platform affordable for various healthcare institutions beyond Epic and Cerner's higher price points.

65 Revolutionizing Medical information Systems: Blockchain-Driven Patient Data Management

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Blockchain technology focuses primarily on improving information security and efficiency through solving problems within current information-sharing systems. The healthcare sector is undergoing a transformation due to this technology, which provides secure, transparent, and immutable management of medical records. Blockchain technology strengthens medical data protection while creating better system-wide data exchange capabilities, gives healthcare customers complete access to their health



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records, and cuts expenses and document fraud occurrences. The regulatory control of health information sharing exists to protect against both unsecured systems and medical privacy breaches. Medical diagnosis requires access to complete patient medical records, which must be available effectively and accurately. This research presents a blockchain-enabled structure that provides healthcare providers along with patients with mutually beneficial medical record sharing capabilities. Review studies demonstrate that blockchain systems create protected medical information databases, which lead patients to offer their medical histories freely. The implementation process for this blockchain solution is demonstrated by developing an Android application to illustrate its feasibility.

72 A Multi-Stage Hybrid Framework for Classifying Ovarian Cancer from High-Dimensional Microarray Gene Expression Data

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Gene expression profiling is a pivotal tool in bioinformatics, enabling early cancer detection and tailored therapeutic strategies. This study presents a new multi-stage model that uses Linear Discriminant Analysis (LDA), Genetic Algorithm (GA), and Support Vector Machine (SVM) to improve ovarian cancer classification using microarray data. The framework is applied to a dataset containing 15,154 gene expression features across 153 patient samples, divided into two classes for binary classification. The process begins with LDA to reduce the dataset's high dimensionality while maintaining class-distinguishing characteristics. Next, GA optimizes the feature space by selecting the most relevant gene subset. Finally, an SVM classifier is trained on this refined feature set to achieve precise classification. Experimental results indicate that the LDA-GA-SVM model surpasses traditional single-stage methods in classification accuracy, sensitivity, and computational efficiency, demonstrating its potential as a scalable and effective solution for complex cancer genomics challenges.



73 Symptoms-Based Multi-Disease Prediction with Machine Learning Approach

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Diseases such as diabetes, heart disease, and cancer are significant world health problems and therefore require early and accurate diagnosis to be effectively treated. Conventional techniques are time-consuming and prone to human errors, and therefore, reasonable alternatives are necessary. Machine Learning (ML) can transform the healthcare industry by its ability to detect and predict diseases at an early stage from patient information. This is achievable by creating an efficient and accurate disease prediction system with the use of machine learning algorithms. In this work, a complete dataset of disease outcomes, patient symptoms, and disease history was gathered. The dataset was processed thoroughly, imputation methods were applied to deal with missing values, label-encoding was applied to categorical variables, and numerical features were normalized to ensure uniformity. Dimensionality reduction through Principal Component Analysis (PCA) was then applied to enhance computational efficiency while preserving data integrity. After preprocessing, the dataset was divided into training and testing sets. Two classification models, i.e., Support Vector Machine (SVM) and Gaussian NaÃ¯ve Bayes (NB), were developed and trained to predict disease categories. The SVM model achieved superior results with an accuracy of 96.24% and precision, recall, and F1-score values of 0.97, 0.96,0.96, respectively. In comparison, the NaÃ¯ve Bayes model achieved an accuracy of 89.95%, with precision, recall, and F1-score values of 0.93, 0.90, and 0.90, respectively. To optimise model performance even further, hyperparameter tuning is employed. This concluded that Support Vector Machine balances the performance and computational cost of the model better than that of NaÃ¯ve Bayes, making it more acceptable for real-world medical applications.

78 YOLO vs ViT: A Performance Analysis for Drone Detection in Anti-Drone Systems

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Unmanned aerial vehicles (UAVs), also known as drones, are often considered to pose threats to security-bound areas such as airports, military bases, and public gatherings. Due to their size and agility, they are difficult to identify and to mitigate and neutralize when needed, especially as they have a similar



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structure and pattern to that of birds. This leads to an increased rate of false positives; hence, to address this issue, anti-drone system are embedded with object detection algorithms. This study presents a comparative analysis of YOLO-v5, YOLO-v8, and ViT models. During this analysis, it was found that YOLO models prove to be more easily extensible and can be feasible in real-time detection scenarios, whereas the ViT model can be configured in post-analysis scenarios where high-resolution images and video frames are to be analyzed. These findings help advance AI-powered anti-drone systems, making them more reliable and capable of detecting aerial threats in real time—even in complex and changing environments.

79 Combating Fraud in the Digital Age: Analysis of Mechanisms, and Preventive Strategies

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The detection of financial fraud is one of the most urgent issues of digital economy as credit card fraud is one of the factors that cost billions of money yearly. This paper proposes an integrated machine learning architecture to detect fraud solvers imbalance of classes, engineering features, and optimizing models. We apply and test four state-of-the-art algorithms: Logistic Bayesian hyperparameter optimization of Tree-structured Parzen Estimator (TPE), regression, Randow Forest, XGBoost, and LightGBM. Our methodology uses SMOTE-ENN to manage class imbalance and comes up with a weighted ensemble. Experimental findings of the Kaggle Credit. Card Fraud Detection dataset (284,807 transac tions and 0.172 percent fraud rate) perform better, and our ensemble model has 99.89%. Precision, accuracy, 0.6364, recall, 0.8514, and PR-AUC, 0.8133. The proposed framework has cost-sensitive optimization of threshold and offers 95 percent bootstrap analysis confidence interval. The findings of the study are relevant to ours, development of automated fraud detection and give strategic information for financial institutions.



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80 I2MR: Intelligent Inventory Management in Retail by Integrating SVM classification with ARIMA

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In today's competitive retailing environment, stock optimization is critical to attaining operational effectiveness and customer happiness. Conventional inventory management is usually inadequate to manage demand volatility and does not possess the capacity to facilitate timely data-driven decisions. This paper introduces a hybrid predictive analytics model that pairs Support Vector Machines (SVM) to classify demands with the AutoRegressive Integrated Moving Average (ARIMA) model for forecasting time-series demands. Firstly, SVM is used to classify products from past sales data into low, medium, or high levels of demand, so that inventory strategies can be set with a focus. Then ARIMA is used to predict future demand in each category and provide detailed and prospective insights. By combining machine learning and statistical forecasting, it is possible to achieve more proactive and accurate inventory control system. Experimental. Validation on actual retail datasets shows dramatic stock availability improvements, inventory excess reduction, and improved decision-making abilities. This solution provides an intelligent and scalable answer to the inefficiencies of traditional inventory systems and sets a foundation for AI-powered retail operations.

81 A Comprehensive Approach towards Diabetes Prediction Using Ai-Driven Methods

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One among the most common and expensive chronic ailments is diabetes, which is characterized because of raised blood sugar caused by low insulin secretion. It focuses on developing an accurate and efficient system to detect the probability of diabetes in individuals de-pending on medical and lifestyle data. Important parameters such as age, gender, BMI, hypertension, history of heart disease, smoking, HbA1c, and blood glucose are explicitly used for predicting the diabetes. This paper utilizes three



machine learning algorithms Random Forest, K-Nearest Neighbors (KNN) and Logistic Regression to model trends in a patient record database. In order to determine the most precise classifier, each framework is compared in terms of metrics and the highest-performing model was adopted into an online plat-form designed to provide real-time prediction of diabetes risk, accessible and data-driven healthcare is made possible. Among them, the Random Forest model demonstrated the highest performance, getting an accuracy of 0.97 creating it the most efficient for accurately identifying diabetic cases.

86 Hate Speech Detection on Twitter Using TF-IDF and GAT with Imbalance Handling Techniques

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Identifying hate speech on social media sites like Twitter is becoming crucial due to its harmful impact on people and communities. This work is challenging due to the infrequent occurrence of hate speech compared to neutral or offensive content, resulting in a significant class imbalance. We introduce a hybrid methodology that integrates Term Frequencyâ€“Inverse Document Frequency (TF-IDF) with Graph Attention Networks (GAT) to improve twitter representation. TF-IDF quantifies the global statistical importance of words, while GAT analyses the contextual associations between words via attention-based learning. The features derived from both methods are combined and fed into a Fully Connected Neural Network (FCNN) to categorize tweets as hate speech, offensive, or neutral. To address the data imbalance, we used two resampling methods: Synthetic Minority Over-sampling Technique (SMOTE) and Random Under-sampling. Experimental findings demonstrate that our model attained an accuracy of 90.25% using SMOTE, markedly surpassing the 77.72% accuracy achieved with Random Under-sampling. The model's capacity to accurately identify hate speech was assessed using a variety of parameters, including accuracy, precision, recall and F1-score. The suggested TFIDF + GAT method shows encouraging results and provides a practical way to improve automated hate speech identification on social media sites.



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87 Advanced Computational Study of Herbal Extracts for Treating Pseudomonas aeruginosa Infections

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A major worldwide health concern is the emergence of multidrug-resistant (MDR) Pseudomonas aeruginosa, which calls for investigating other antibacterial approaches. By opting the method of agar well diffusion method, this study integrates experimental evaluation with smart computational approaches to assess the antibacterial potential of twelve herbal extracts, including clove, amla (leaf and fruit), cinnamon, lemon, neem, ginger, basil, moringa, bael, garlic, and thyme. Clove had the most antibacterial potential of all the studied extracts (zone of inhibition: 24.33 Â± 2.05 mm), followed by cinnamon (23.0 Â± 1.63 mm), amla leaf (24.7 Â± 1.44 mm), and amla fruit (23.5 Â± 1.22 mm). Important bioactive substances that target bacterial cell walls, prevent the formation of biofilms and interfere with quorum sensing include eugenol, tannins, cinnamaldehyde, and flavonoids. Ginger, basil, and moringa extracts exhibited little effect, but neem and thyme extracts showed moderate efficacy. Interestingly, garlic did not exhibit any inhibition, most likely because allicin is unstable during extraction. ANOVA and Tukey's test, two statistical analyses, verified significant differences between the extracts ($p < 0.05$). Furthermore, an advanced computational approach was conceptualized to model the correlation between phytochemical composition and antibacterial performance, enabling prediction of extract efficacy through data-driven analysis. The results highlight how herbal extracts, especially those of clove, amla, and cinnamon, might be used as environmentally friendly substitutes to fight antibiotic-resistant P. aeruginosa. The result causes the isolation & rendering of bioactive compounds to develop sustainable and effective antimicrobial therapies.

92 Comprehensive Study of Machine Learning Models for the Prediction of Diabetes and Improving the Performance Matrices

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Today a fast-going era, millions of people are affected by many diseases, out of which, diabetes mellitus is the most common, rapidly growing non-communicable chronic disease, characterized by HYPERGLYCEMIA, a condition where there is an abnormally high amount of sugar in the blood which leads to harm to various body parts. Early diagnosis and treatment can help in minimizing long-term convolutions like heart disease, kidney damage, blindness etc., and lead to higher chances of recovery. The most complex problem in the arena of data mining (DM) is dealing with the imbalanced datasets. Here, the PIMA imbalanced diabetes dataset is used. In such types of cases, classes have different ratios



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of specimens, which unfortunately leads to bias and also misclassified by many classifiers. So, to determine diabetes and to solve the imbalanced data issues, certain distinct machine learning (ML) and data mining (DM) techniques are used. For balancing, the random oversampling method is applied. Also, performance metrics are evaluated by using techniques like CatBoost, Logistic Regression (LR), Random Forest (RF) and XGBoost and finally, an ensembled model is applied to the dataset. The CatBoost model performed the highest in performance metrics. However, considering the AUC-ROC, RF performed better (â‰ˆ0.9349). The main aim of the research is to provide a general guideline for those who wish to dive into the broad field of data mining using large-scale imbalanced datasets. These findings are encouraging for medical professionals as they will assist in the early detection of diabetes and enhance the overall well-being of affected individuals.

95 Hybrid Logical-Statistical Metadata Analysis for Qualitative and Quantitative Study

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The aim of this paper is to present a hybrid logical-statistical approach for metadata analysis from biomedical articles. A key problem in data science is the availability of high-quality data, especially in terms of veracity. The approach proposed develops a situation-based modal logic semantics in which the zones of a scientific article along with their atomic metadata are mapped onto an algebraic space of situations. This semantic framework will subsequently serve as the foundation for a statistical analysis of the extracted metadata. The result is a well-motivated qualitative and quantitative analysis of the descriptive metadata extracted from biomedical articles.

105 Advanced Crude Oil Refining Process Optimization and Yield Enhancement in Machine Learning with Aspen Simulation

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This study optimizes crude oil refining processes by combining Aspen Plus simulation and machine learning techniques, motivated by the growing global energy demands and the need for sustainable refinery operations. When processing various kinds of crude feedstocks, such as light, medium, and



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heavy, the simulation program allows the evaluation of operation parameters, such as temperature, pressure, and flow rate. Using the vast amount of data generated by the simulations, a Random Forest model was trained to forecast energy consumption in real-time as well as the yields of diesel, kerosene, and atmospheric gas oil product outputs. Using ML-based techniques results in exceptional yield predictions with high accuracy rates (R2 â‰ˆ 0.96) and accelerates optimization. After Aspen optimization, the diesel yield rate rose from 26.7% to 29.1%; however, the ML model indicated that it could reach 33.3%, suggesting further optimization opportunities. Refinery operations used 11.8% less energy as a result of process reconfiguration. Ac-cording to the study, AI-assisted simulation has evolved into a revolutionary tool for re-fining that offers scalable, data-driven optimization solutions that improve refinery operations' economic outcomes and energy efficiency.

115 AI-Powered Kidney Stone Detection: A Deep Learning and Explainable AI Approach

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Kidney stones are a prevalent urologic disease that demands timely and precise diagnosis to enhance the quality of patient outcomes and clinical proficiency. In this paper, we introduce an AI-aided web-based application specially tailored for detecting kidney stones and clinical decision-making to surmount the diagnostic challenges of traditional imaging methods. The architecture includes state-of-the-art deep learning models: YOLO11n for object detection, InceptionV3 for binary classification (stone/no stone), and the BLIP model for descriptive image captioning, which enhances diagnostic ac-curacy and medical imaging data clinical interpretation to a significant extent, e.g., for CT scans and ultrasounds. The application also employs a Groq based LLaMA model to combine detection outcomes with patients' reported symptoms, offering clinicians complete, context-specific clinical examination and tailored recommendations. Stream was used to create the simple-to-use application, with the ability to handle various image files with standard and DICOM medical images, and to produce extensive PDF reports, further facilitating clinical tasks. The interactive nature of the application allows medical professionals to integrate AI-based insights into day-to-day clinical practice easily, offer accelerated and precise diagnosis, remove potential delays, and substantially enhance patient care and treatment planning.



126 Smart Multimodal Perception System for Road Safety Enhancement

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Advanced Driver Assistance technologies (ADAS) are sophisticated technologies integrated into the vehicle that support the primary driver in several capacities. ADAS are designed to assist the driver in driving tasks. Numerous technological options exist, such as Adaptive Cruise Control (ACC) and Intelligent Speed. Adaptation (ISA) or Collision Warning Systems (CWS). An ADAS, when equipped with a secure Humanâ€“Machine Interface (HMI), should enhance vehicle safety and comfort. These systems can also deliver essential information regarding traffic, road closures, and obstructions; detect objects beneath the vehicle; evaluate driver fatigue and distraction to issue precautionary alerts; and assess driving performance to provide recommendations. The primary benefit of using assistance systems is their facilitation of communication among various vehicles, vehicular infrastructure systems, and transportation management centers. This facilitates the sharing of information to enhance vision, localization, planning, and decision-making for the vehicles. Driver fatigue is a significant contributor to vehicular accidents, underscoring the need for improved detection methods to promote automotive safety. This work delineates a multi-modal tiredness detection system that utilizes data from an internal camera, a front camera, and vehicular parameters to accurately evaluate driver alertness. The technique surpasses conventional approaches in detecting accuracy by using advanced machine learning algorithms. Simulations and empirical testing demonstrate significant improvements in reliability and performance. This comprehensive plan presents a viable solution for mitigating the risks linked to driver fatigue and enhancing overall traffic safety.

127 A Smart and Autonomous Traffic Monitoring System for Traffic Optimization and Traffic Jam Reduction - Case of the Benin Republic

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Environmental pollution, increased fuel consumption, and poor quality of life were some of the problems that 41% of the Beninese surveyed as part of this research experienced due to spending 30 minutes to two hours in traffic jams in their daily lives. 54% of them agreed that inefficient traffic lights operating on default timing are one of the main causes of traffic jams in the Republic of Benin. This research focused on an intelligent, autonomous traffic monitoring system that will not only manage traffic based on traffic flow and density using live cameras and Artificial Intelligence, but will also detect infractions



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of the highway code and record the vehicle's number plate, as well as use a sound sensor to detect emergency or priority vehicles, such as ambulances. The entire system was supported by monitoring software that displayed live traffic data, including the quantity of each vehicle type at various times of the day, peak hours, and traffic jam predictions for the future. This innovative system used YOLO-NAS (You Only Look Once - Neural Architecture Search), a modern object detection algorithm, to detect vehicles and road congestion levels, optimize traffic light timing, and reduce traffic congestion. This research aimed to utilize modern technology not only to reduce traffic congestion but also to enhance road safety and emergency responses, thereby contributing to the improvement of mobility in urban areas in Benin.

130 A Comparative Analysis of RNN and LSTM for Handwritten Odia Numeral Recognition in Low-Resource Settings

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Character recognition is a challenging task in Artificial Intelligence and Image Processing. While machine-printed character recognition has seen significant progress, handwritten script recognition remains complex due to issues like distortion and overlapping. This study focuses on Optical Numeral Recognition (ONR) in Odia Language. Comparative evaluation of two recurrent deep learning models Simple Recurrent Neural Networks (SimpleRNN) and Long Short-Term Memory networks (LSTM) for recognizing handwritten Odia numerals. A curated dataset of 5,000 handwritten numeral samples has been collected from individuals across various age groups, with each contributing a full set of numerals on grid based A4 sheets. The result of both the models are measured using key evaluation metrics such as precision, recall, F1-score, and class-wise support. The results indicate that while both models exhibit competent performance, the LSTM model consistently outperforms the Simple RNN, particularly in handwritten Odia numerals with complex strokes or variable positioning. This research contributes to the ongoing efforts in advancing OCR capabilities for low-resource Indian languages.



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142 Reversible Watermarking for IoT Image Security Using 2/6 and 2/10 Integer-to-Integer Discrete Wavelet Transforms

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In Real-time applications, processing multimedia content requires low latency, high bandwidth, scalability, and secure data transmission. There is also a significant demand for handling input data of various resolutions based on application domains such as smart cities, drone-based monitoring, and surveillance. This creates a requirement for Multimedia-IoT (M-IoT) devices in a secure and robust environment. This paper proposes a new invisible watermarking technique for M-IoT applications based on reversible integer-to-integer discrete wavelet transforms. In this methodology, the watermark is embedded into the integer-to-integer discrete wavelet transformed image in the high-frequency sub-band of the host image. The paper uses reversible 2/6 and 2/10 integer-to-integer discrete wavelet transforms. For the evaluation of the proposed method, well-known open-source images such as Lena, Barbara, Pepper, and Baboon are considered. Subsequently, the proposed method is evaluated both qualitatively and quantitatively using parameters such as PSNR, MSE, SSIM, and embedding capacity. Detailed performance evaluations and comparisons with conventional wavelet transform methods are presented, demonstrating better performance with 2/6 and 2/10 ITI discrete wavelet transforms.

147 Critical Mass & Radius Calculation of Tamped Nuclear Fissile Material by Using Machine Learning

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Critical radius and critical mass calculations for nuclear fissile materials are essential for ensuring nuclear safety and supporting defense applications. Traditional methods such as Monte Carlo simulations and diffusion theory, while accurate, are computationally intensive and require substantial domain expertise. To address this limitation, a machine learning-based approach is proposed for predicting the critical mass and critical radius of fissile materials. A synthetic dataset was generated using physics-informed equations, including a modified form of empirical relation, incorporating key nu-clear parameters such as enrichment, density, neutron yield, and microscopic cross-sections. Random Forest Regression was used to model the relationship between these inputs and the critical parameters, and Bayesian optimization was applied to enhance model accuracy. A MATLAB-based Graphical User Interface (GUI) is also developed to enable real-time prediction based on user input. Results show that the proposed ML



framework offers a fast, accurate, and user-friendly solution for criticality prediction, making it valuable for research and safety evaluations.

151 Image Forgery Detection Using SIFT and SURF Algorithms

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The term Image Forgery describes the electronic alteration of an image to hide any important or useful information. These days, Image Forgery is a prevalent threat that infringes on the rights of numerous people. The requirement of authenticity and image integrity drives the detection of forged images. Copy-move, Resampling, Retouching and image sampling are the main four methods which comes under image forgery detection. We mainly discuss Forgery Detection using Copy-Move method that is again classified as Keypoint-based and Block-based. We focus on Keypoint-based approach, which primarily extract distinguishing elements such as image corners, edges and blobs. The most commonly used methods of Keypoint-based are Scale Invariant Feature Transform as well as Speeded-Up Robust Features notably known as SIFT and SURF respectively. Both these algorithms work by reducing the image content to set of points and detects similar patterns in other images. We presented the results of each of the methods for the number of feature points, accuracy, percentage of matched points and execution time. The primary goal of this paper is to investigate and analyze these detection methods and utilize them in as many different contexts as possible.

155 MRI-Based Brain Tumor Segmentation Using Deep Learning

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Magnetic Resonance Imaging (MRI) is a widely used non-invasive technique that offers detailed insights into brain anatomy. MRI scans are used to detect and diagnose brain tumors, including gliomas. This study aims to explore and critically analyze the latest deep learning-based approaches designed for brain tumor segmentation from MRI data. Several state-of-the-art deep learning models have been employed to tackle the segmentation task, each chosen for its unique strengths in feature extraction, spatial understanding, and generalization capabilities in medical imaging. This paper conducts a comparative



review of the state of the art models, evaluating their performance, strengths, and limitations. ResNet50 emerged as the top-performing model, demonstrating superior effectiveness relative to others tested. It achieved 97.82% accuracy, with ResNet outperforming CNN and VGG16. The future of brain tumor diagnosis using MRI images shows promise with advancements in technology and collaborative research.

165 Probing the Effects of Engineering Noise and Quantum Bioinformatics on DNA molecules

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According to this study, bend and twist are reliant on one another rather than being independent factors. Additionally, the Berry phase changes when two DNA molecules entangle and one of them inserts a spin-echo into the other, which is exactly the same as calculating entanglement. Because of the entanglement of spins, DNA molecular are viewed as spin systems reach the entanglement free energy. We may assume the spinning connected to every DNA ring in a molecule are oriented beside the supercoil's alignment. The molecular axis could exist seen as a pattern of anti-ferromagnetic spin systems since, as we have already said, spins in DNA particle are thought to be prearranged in an antiferromagnetic chain. A singlet is created when two neigh-boring spins with opposing orientations contain the same minimum spin-echo information. Since frustration breeds chirality, the spin system will be experiencing frustration, as a result of chirality brought on by caricature pull into the torsion-connected loop. With this approach, we may ex-press the thermodynamic free energy as entanglement energy, and spin entanglement is suitable for use as a hereditary information source. This suggests that genomic information transcript in sequence may exist measured in the context of the quantum in succession assumption.

166 Web-Based Real-Time Plant Leaf Disease Diagnosis System Using AI

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Early diagnosis and treatment of plant diseases are critical in the agricultural sector to ensure crop health and maximum yield. In this paper, we present a web-based application that uses deep learning and AI in natural language to diagnose plant leaf diseases and suggest intelligent treatment. The system utilizes three deep learning models-convolutional neural network (CNN), deep neural network (DCNN), and



DenseNet121 trained on a wide dataset of plant leaf images to perform multiclass disease classification. A comparative analysis was conducted to assess performance in terms of accuracy and generalization, with CNN exhibiting superior results. The CNN model achieved a high-test accuracy of 98.47%, demonstrating reliable disease classification across 38 plant leaf classes. Complemented by a minimalistic web interface built using Flask, the application offers two input modes: image upload and real-time web-cam capture. Upon classification, the predicted disease name is forwarded to Quasar AI, a large language model via OpenRouter API, which offers detailed, context-specific prevention and cure suggestions. This real-time, AI-based solution improves accessibility and decision making for farmers, researchers, and agronomists with the goal of bridging the gap between frontier technology and local agriculture.

169 Prediction of Stability in Smart Grids using Rough Set Based Machine Learning

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A smart grid is a conglomeration of electric power generation units, transmission media, distribution channels, and control stations to facilitate efficient power usage across large geographical areas. A stable operational smart grid is essential to meet the energy requirements of a wide range of consumers. Any fault in the grid can lead to wastage of energy which is a crucial commodity in todays energy hungry world. Therefore, it is important to predict the stability of a smart grid in order to optimize energy usage. Of late, machine learning techniques are being utilized to build predictive models for smart grids. In this work, a rough set-based machine learning approach has been put forth to predict the stability of smart grids. The model has been trained and tested on a standard dataset. Also, the efficacy of the proposed model has been compared with other similar models with respect to 16 performance metrics. Experimental results indicate that MODLEM classification model proves to be the best model irrespective of the dimension reduction and normalization process applied, yielding an accuracy of 99.98%, precision of 99.97%, recall of 99.97%, specificity of 99.98%, MCC of 99.96%, KC of 99.96%, GM of 99.98%, and YI of 99.96%.

170 Combining Machine Learning and Hybrid Feature Selection Techniques to enhance Medicare Fraud Prediction

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Health insurance plays a vital role in safeguarding individuals across various economic groups. However, the growing incidence of fraud poses a serious threat to its integrity. Fraudsters including healthcare



providers, patients, and even insurers often collaborate for illegal financial gain, complicating detection efforts. This study introduces a novel tripartite hybrid feature selection approach combining Mutual Information Feature Importance (MIFI), Correlation-Based Mutual Information (CBMI), and Correlation-Based Feature Importance (CBFI). By applying various supervised learning models like Decision Tree (DT), Logistic Regression (LR), Support Vector Machine (SVM), Random Forest (RF), Extreme Gradient Boosting (XGB), and Bernoulli Naive Bayes (BNB). The proposed model achieved an impressive 97.50% average accuracy in predicting fraudulent claims.

176 Artificial Neural Network Model for Developing a Cyber Security System for Autonomous Vehicle Communication

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Autonomous vehicular networks are highly vulnerable to cyber intrusions and malicious attacks due to their continuous data exchange and self-driving operations. This paper presents a novel Artificial Neural Network (ANN)-based intrusion detection framework designed to enhance cybersecurity in autonomous vehicle communication systems. Unlike conventional static models, the proposed ANN utilizes 14 input parameters derived from vehicular, communication, and environmental datasets collected via a centralized security manager. The system continuously monitors V2X traffic and classifies activities as normal or malicious. The ANN architecture, implemented in PyMoSim under a 28 GHz mmWave environment (50 MHz bandwidth), employs a sigmoid activation function with optimized weights trained using supervised learning. Simulation results across five rounds with 100–500 vehicles show an average detection accuracy of 96.2%, precision of 94.8%, recall of 95.3%, F1-score of 95.0%, and a false positive rate below 4.2%. Comparative analysis demonstrates that the proposed model outperforms baseline logistic regression and AODV-based classifiers by up to 7.6% in detection efficiency. These findings confirm the robustness, scalability, and real-time adaptability of the proposed ANN framework for mitigating cyber threats in autonomous vehicular environments.

181 Revolutionizing Synergy: Harnessing Hybrid Intelligent Algorithms for Corporate Sustainability and Environmental Human Rights Protection

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Mounting pressures of climate change and environmental degradation have led towards the enunciation of corporate sustainability and securing environmental human rights. This study discusses how Hybrid Intelligent Algorithms (HIAs) can be used to solve such complex problems since they use a combination



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of several artificial intelligence algorithms, including machine learning, optimization algorithms, and neural networks. Employing an extensive literature review, the study discusses the HIA applications in the fields of energy optimization, environmental monitoring, waste management, supply chain sustainability, and corporate governance. Findings show that there is a marked difference, with up to 30 percent reduction in the utilization of energy, 99 percent accuracy in pollution detection, and 36.8 percent increase in the effectiveness of waste management. HIAs enable preventive environmental management and increase corporate responsibility and environmental human rights protection by real-time monitoring and predictability. Although HIAs face some challenges, which include technical complexity and data quality, they provide a measurable solution to scaling the alignment of economic, environmental, and social goals.

186 Leveraging Predictive Analytics and Machine Learning to Support Student Achievement in Blended Learning

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Blended learning is a hybrid method to education that blends online and traditional classroom instruction. It offers a flexible and all-encompassing learning experience by fusing in-person encounters with digital materials and exercises. By enabling both solo and collaborative engagement with the subject, this method helps students retain more information and accommodates a variety of learning preferences. Using a blended learning approach, this study investigates how well machine learning models predict student success. Different Machine-learning algorithms like Random Forest, k-nearest Neighbors, and Logistic Regression were used to forecast student performance. With an accuracy of 86%, the k-nearest Neighbors model produced the best predictions. The dataset was taken from Kaggle.

189 Novel Score, Accuracy Functions for Polytopic Fuzzy Numbers and a Confidence-Level-Based Polytopic Fuzzy Aggregation Operators: Green Supplier Selection Problem

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Polytopic Fuzzy Set (POFS) is a mathematical framework for quantifying uncertainty, ensuring that the total of the qth power of positive, neutral, and negative membership grades does not exceed a maximum threshold of one. POFSs offer a broader overview of uncertain information, enhancing their



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effectiveness compared to Picture Fuzzy Sets (PFSs) and Spherical Fuzzy Sets (SFSs). The drawbacks of the current Score and Accuracy functions for Polytopic Fuzzy Numbers (POFNs) are established in this work. Better Score and Accuracy functions are introduced for more trustworthy comparisons to overcome these issues, and the paper also proposes a novel Confidence Level Polytopic Fuzzy Weighted Geometric (CPOFWG) aggregation operator (AO). Moreover, incorporating POFSs alongside decision-makers (DMs) confidence levels regarding a decision-making problem. Finally, a novel Multi-Criteria Group Decision-Making (MCGDM) approach is introduced, incorporating the proposed score, accuracy function, and aggregation operator. This approach is utilized to address the Green Supplier Selection (GSS). Its effectiveness is evaluated by comparing it with other established methods. Furthermore, a sensitivity analysis is conducted to ensure the robustness and credibility of the result.

190 Enhancing Urban Land Use Prediction: Integrating Traditional Machine Learning with Advanced Cellular Automata in Cloud Environments

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Urban land-use prediction plays a pivotal role in sustainable development, infrastructure planning, and environmental monitoring. However, the task remains challenging due to the intricate features in high-resolution satellite imagery and the high visual similarity among urban land-use categories. To address these challenges, we propose LightSE-ResCNN-21, a novel lightweight convolutional neural network that combines depth wise separable convolutions, squeeze-and-excitation (SE) blocks, and residual connections to optimize both computational efficiency and classification performance. The model is trained on a custom dataset of 10,500 satellite images spanning 21 urban land-use classes, each resized to 256Ã—256 pixels. To enhance generalization, we employ data augmentation, expanding the original 100 images per class to 500. LightSE-ResCNN-21 achieves a 96% classification accuracy, with an average precision of 90.5%, recall of 91.2%, and F1-score of 90.8%, while maintaining a compact size of ~5 MB and a fast inference time of ~11 ms per image. In comparative evaluations, our model significantly outperforms baseline architectures: VGG16 attains only 69% accuracy, while InceptionV3 reaches 90% under identical conditions. Detailed analysis of the confusion matrix and per-class metrics confirms the models robustness, particularly in discriminating visually similar categories such as golf courses, buildings, and storage tanks. Beyond standalone classification, we integrate CNN-based predictions with traditional machine learning algorithms and Cellular Automata (CA) to simulate spatial land-use transitions. This hybrid framework enables dynamic urban modeling with cloud-ready scalability, supporting real-time land-use forecasting. The system demonstrates strong potential for deployment in smart city planning and environmental monitoring, offering a balance of high accuracy, computational efficiency, and practical applicability.



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191 DDoS Attack Detection in Smart Agriculture using Machine Learning

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Smart agriculture incorporates cutting-edge technologies like cloud computing, artificial intelligence, and the Internet of Things (IoT). These networked systems are, nevertheless, more susceptible to cybersecurity risks, especially Distributed Denial of Service (DDoS) assaults, which have the potential to interfere with vital functions. A machine learning based method for identifying DDoS assaults in IoT-enabled agricultural networks is presented in this paper. XGBoost, Random Forest, Convolutional Neural Network (CNN), Long Short-Term Memory (LSTM), and a CNN-LSTM hybrid model were among the models created and assessed. With a 99.28% accuracy rate, the CNN-LSTM model outperformed the others by successfully identifying both temporal and spatial traffic patterns. Other models also showed strong performance, with Random Forest achieving 97.73%, XGBoost 97.28%, and LSTM 97.11%. The findings demonstrate how well ensemble and deep learning methods can recognize intricate attack patterns in agricultural systems. In order to improve resilience and protect data integrity in smart agricultural contexts, this study highlights the significance of intelligent, adaptive security systems.

194 Leveraging CRNN and EfficientNet-B0 for Deepfake Detection in the FakeAVCeleb Dataset

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The presence of deep learning technologies, in recent years, has triggered the emergence of deep fake's artificial media wherein the face of a human on an existing image, video, or audio is replaced with the face of the other person. The implications of such a phenomenon are devastating with regard to privacy, security, and regulation of misinformation. The study proposes a new multimodal deep fake detection model that integrates both visual and audio features to deliver competent and efficient results. Visual feature detection in the form of the EfficientNet-B0 model is applied to extract facial frames and a Convolutional Recurrent Neural Network (CRNN) is applied to put the audio features in the form of mel-spectrograms. A weighted late fusion method combines modality-specific predictions, which makes use of each of their strengths. The approach is tested on the FakeAVCeleb the dataset composed of labeled pairs of real and fake audio-visual examples-and beats the unimodal and state-of-the-art baselines over both accuracy and F1-scores by achieving 99.82% and 99.78% respectively in identifying fake classes. The



results establish directions of future research on lightweight and powerful architecture-based multimodal misinformation detection.

196 Crude Oil Price forecasting using Hybrid Model

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Crude oil plays a vital role in the global economy, making accurate price predictions essential for companies and investors in the oil industry. However, traditional methods of forecasting crude oil prices have limitations, prompting the exploration of machine learning algorithms as a potential solution. Machine Learning algorithms have shown great promise in predicting crude oil prices by effectively for large datasets and uncover complex. In the paper, historical data is use to train and test a neural network model, consisting of different features such as crude oil production levels, geopolitical events, and economic indicators to predict the daily closing price of crude oil. The paper primarily focuses on crude oil price forecasting using different machine and deep learning algorithms, including Linear Regression, XGBoost, Support Vector Regression (SVR), and CNN-LSTM. Overall, it highlights the potential benefits of employing machine-learning algorithms in crude oil price forecasting. These algorithms possess the ability to uncover intricate relationships and patterns and can prove to be a gain to decision makers in the oil industry with more accurate predictions, which will help to do strategies and investment more wisely.

198 Rice Grain Classification Using Transfer Learning for Agricultural Automation

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Rice remains a staple food crop to nearly half of global population, and it's grading into various grain categories remains vital to achieve quality control, productivity enhancement, and food safety. However, manual grading processes are generally time-consuming, error-prone, and ineffective, particularly due to minute appearance variations between rice grain categories. To address this, we propose a deep learning-based approach leveraging transfer learning with convolutional neural networks (CNNs) for automated rice grain classification. The study utilizes GrainSpace dataset, which contains 79,200 images of rice grains divided into eight distinct subtypes. The GrainSpace dataset was evaluated with five pre-trained models of CNNs, including ResNet50, EfficientNet-B0, DenseNet121, MobileNetV2, and VGG16,



to identify their classification precision. Among these, EfficientNet-B0 outperformed other models, achieving an impressive accuracy of 99.51%, followed by MobileNetV2 with a 99.06% and ResNet50 with a 99.04%. To further enhance understandability of models, Gradient-weighted Class Activation Mapping (Grad-CAM) was applied to identify regions-of-interest impacting prediction from the model. The research reveals potential applications of transfer learning as a scalable and efficient tool to attain fine-grained rice grain grading, promising significant impacts to automate agronomic applications analysis.

208 Real-Time Emergency Vehicle Detection and Route Assistance Using YOLOv8

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Urban traffic congestion critically delays emergency service response times, leading to severe consequences. To address this, we propose a real-time intelligent system that enhances emergency vehicle transit through automated detection and dynamic route guidance. The system utilizes a YOLOv8 deep learning model to accurately identify ambulances, police cars, and fire trucks from live CCTV footage, demonstrating robust performance under challenging conditions such as varying lighting, visual noise, and dense traffic. Upon detection, the system dynamically computes the shortest viable route to the nearest relevant facility (e.g., a hospital) using the OpenRouteService (ORS) and Overpass API. To ensure rapid public cooperation, the suggested route is communicated through two primary channels: it is displayed on traffic signal LED screens and encoded into a QR code for direct mobile navigation.

Our model achieves a high detection accuracy of mAP@0.5 = 0.984 and mAP@0.5:0.95 = 0.82. By integrating a state-of-the-art detection model with user-friendly routing interfaces, this framework significantly reduces emergency response delays, improves transit efficiency, and has the potential to save lives. Future work will focus on integrating live GPS data from emergency vehicles and expanding the systems operational scope.



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230 A Hybrid Approach for Classifying Averaged EEG signal into Ictal and Non-ictal States using SVM and Random Forest Guided by K-Means Labelling

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Accurate detection of epileptic seizure activity from Electroencephalogram (EEG) data is crucial for timely intervention and treatment. Studies reveal that various methodologies have been used for this purpose. However, this work proposes a machine learning-based approach for the classification of averaged EEG signal into ictal(seizure) and non-ictal(non-seizure) stages using a Random Forest(RF) and Support Vector Machine(SVM) classifiers. This work aims at creating a framework to automate the process of monitoring EEG signals acquired from patients suffering from epilepsy disorders. The process involves filtration of signal using a Band Pass filter for noise removal, averaging, spike detection using adaptive thresholding, clustering, and classification of EEG signal into ictal and non-ictal stages of the signal. The EEG dataset is bench-marked dataset with record varies from patient to patient, making it essential to develop an algorithm that can automatically label the signal into its corresponding stages. We propose a method that makes use of K-Means Clustering for pre-labelling the records along with an SVM / RF classifier to identify ictal and non-ictal stages. The study demonstrates the use of averaged signal and classical ML methods together serve as a computationally efficient and interpretable method for classifying ictal and non-ictal states. Results indicate both SVM (76.74\% accuracy) and RF(83.72\% accuracy) effectively determine the seizure and non-seizure states with RF showing marginal superiority compared to SVM.

231 Novel optimal business competition in mobile device and telecommunication network market – based algorithm for loss diminution in electrical power transmission system

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This paper proposes optimal business competition in mobile device and telecommunication network market – based algorithm for loss diminution in electrical power system. Projected algorithm is grounded on the business competition in mobile device and telecommunication network market. The mobile device and network market is vibrant and gigantic, incorporating the hardware, infrastructure of mobile device and network connectivity services which support them. Optimizing how the products are reaching customers is important for market share. E-commerce platforms are important and developing channel, particularly for mid-level and economical phones. Partnerships with network providers for shoved



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covenants and extensive physical marketing incidence re-main vital for reaching and customer attainment. Sustainability and regulations is important factor while dealing the e-waste and data privacy and it is necessary to prioritize the sustainable practices and vigorous security structures, to become competitive differentiators. Prime factor is network quality and coverage and this feature act as essential differentiator. Signal forte and degree of network coverage, particularly in rural regions. Data speeds during downlink and uplink throughput rates determine the quality of the service. Consistency and permanence of the service influence the consumer to choose particular network. Low call drop rates, nominal latency, delay, packet loss, influence the user to make crucial decision. Optimal business competition in mobile device and telecommunication network market – based algorithm (OBMN) is validated in 7 Benchmark functions and IEEE 30, 57 bus systems.

235 Intrusion Detection System Optimization through Conditional GAN backed by Knowledge Distillation

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Network security intrusion detection is becoming exponentially important with the acceleration of cyber-attacks due to expanding internet. In this work, we introduce a new framework integrating Conditional Generative Adversarial Networks (CGANs) and Knowledge Distillation to enhance detection efficiency while keeping the model efficient on the UNSW-NB15 dataset. The CGAN is utilized to create realistic synthetic samples that strengthen the diversity and balance of the training data, in order to counter the class imbalance problems inherent in intrusion detection datasets. A complex and large-scale Teacher model is initially trained to acquire complex data patterns before being utilized to transfer knowledge to a compact Student model through Knowledge Distillation. Experimental results demonstrate that although the Teacher model has high accuracy (90. 12\%) and an F1 score (0.9227), the much smaller Student model (79.13\% size reduction) has competitive performance with 89.03\% accuracy and an F1 score of 0.9131. Moreover, the Student model has a lower false positive rate (1.70\%) than the Teacher model (2.61\%), which indicates its suitability for real-time and resource-limited environments. Our method optimally trades detection performance and deployment efficiency and is therefore well suited for real-world cybersecurity applications.



251 Blood Cell Cancer Prediction using Lightning CNN with XAI Interpretability (LIME & SHAP)

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Acute Lymphocytic Leukemia (ALL) must be diagnosed promptly and accurately to be treated. This paper introduces a Lightning CNN-based deep learning model for blood cell classification into basophil, erythroblast, monocyte, myeloblast, and segmented neutrophil. Here, a 750 blood smear image-based model attained an accuracy rate of 98.87% and macro F1-score of 97.88%, with high reliability. To enhance interpretability, we employ Explainable AI (XAI) techniques LIME identifies salient image regions affecting predictions, and SHAP offers feature importance scores. These techniques make transparent and trustworthy AI-based leukemia detection possible to aid clinicians in medical decision-making. Our findings show that deep learning combined with XAI enhances diagnostic accuracy and model inter-pretability, making AI-based blood cell classification a powerful medical tool.

258 An Explainable Multi-Agent Pipeline for Thyroid Ultra-sound Analysis

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This paper presents a compact, clinically oriented pipeline for thyroid ultra-sound decision support that couples a fine-tuned ResNet50 classifier with BLIP captioning and a LangChain-based multi-agent analysis layer. A curated dataset of â‰ˆ2,549 thyroid ultrasound images (normal/abnormal) is processed through a lightweight Streamlit interface that handles upload, preprocessing (resize/normalize), and dynamic model loading. The classifier is trained with Adam and progressive layer unfreezing, and evaluated using K-fold validation with ROC analysis. A BLIP captioner, adapted to the medical domain, generates concise image descriptions that feed a medical analysis agent (for TI-RADSâ€“style reasoning) and a data analytics agent (trend/risk context). Real-time explainability is delivered via Grad-CAM, SHAP, LIME, and edge overlays, and the system exports structured PDF reports summarizing predictions,



confidence, captions, and rationale. On the held-out test set, the model attains 99.56% accuracy, 99.20% sensitivity, 99.80% specificity, and AUC = 0.998, demonstrating high discriminative performance while remaining interpretable at the point of care. The contribution lies in unifying robust classification, clinically useful captions, agentic reasoning, and multi-modal explanations within a single deployable workflow, supporting trans-parent decision making and streamlined documentation for radiology clinics.

259 Deep Learning Based Multi Class Identification of Tomato Leaf Diseases

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Tomato leaf diseases often show overlapping symptoms at early stages, making timely identification challenging for farmers. In this study, we make use of a DenseNet121 model using transfer learning for multi-class tomato leaf disease classification. The model was trained on the PlantVillage dataset using a Google Colab T4 GPU environment, and image augmentation was applied to improve robustness against lighting and background variations. The proposed system achieved a validation accuracy of 97.5% with balanced precision and recall across 13 disease categories, including visually similar ones such as Early Blight and Target Spot. To support expert validation, principal component analysis (PCA) was used to visualize the latent feature distribution and assess class separability. Since many real-world agricultural settings rely on smartphones or low-power devices, the model was further optimized for near real-time inference on edge hardware. This work demonstrates a useful study in precision agriculture, helping reduce crop losses through timely decision-making.

260 An Enhanced DV-Hop Localization Algorithm for Wireless Sensor Networks using Chaotic Human Conception Optimization with Nonlinear Dynamic Acceleration Coefficients

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Wireless Sensor Networks (WSNs) are capable of sensing, collecting data, processing it, and transmitting it to other devices. Many applications of WSNs face challenges associated with localization. This article introduces an enhanced DV-Hop localization method that employs chaotic human conception optimization alongside nonlinear dynamic acceleration coefficients to address localization challenges. The results have been validated through simulations. The effectiveness of this enhanced method was



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evaluated against earlier findings, showing improved localization accuracy and a decrease in both localization error and variance.

265 Federated Learning-based XGBoost Framework for Privacy-Preserving Sepsis Prediction using EHRs

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Early detection of sepsis is crucial in intensive care units, where timely intervention can greatly improve survival outcomes. This study proposes a federated learning-based framework for privacy-preserving sepsis prediction using three large-scale, publicly available EHR datasets: MIMIC-IV, PhysioNet Sepsis Challenge 2019 and eICU. The diverse datasets enhance model robustness and generalizability. In the federated setup, patient data remains within each institution, while encrypted model parameters are centrally aggregated to form a global model without sharing raw data. Feature selection combines mutual information and recursive feature elimination to retain clinically significant variables such as heart rate, blood pressure, respiratory rate, white blood cell count, and lactate levels. XGBoost is chosen for its efficiency with heterogeneous, high-dimensional data. Cross-dataset validation confirms strong generalization to unseen hospital systems. The model achieved 96% accuracy, surpassing random forest, logistic regression, and SVM baselines. This framework provides a scalable, secure, and high-performance solution for sepsis prediction, suitable for real-time clinical decision support integration.

267 Melanoma Detection Using Transfer Learning: A Comparative Study of Pretrained CNN Models

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Skin cancer diagnosis is a critical task where the accuracy of automated tools can directly impact patient outcomes. This study proposes the comparison of five popular pre-trained convolutional neural network (CNN) architectures including VGG19, ResNet50, Efficient-NetB0, MobileNetV2, and DenseNet121 to determine the best performing model in classifying skin lesions as benign or malignant. We curated a well-balanced dataset by merging and down sampling the ISIC 2018, 2019, and 2020 datasets and used a standard preprocessing and augmentation pipeline to provide an unbiased comparison and enhance



model generalization. All models were trained on resized and normalized images, with extensive augmentations to simulate a more heterogeneous dataset. The extensive experimental results demonstrated among the models DenseNet121 was the most effective, with the highest accuracy 90.3% and F1-score for malignant cases and possessing high generalization capability. In addition, MobileNetV2 performed well in terms of speed and efficiency, although with a lower recall.

283 Hybrid BWM-TOPSIS Framework for Evolutionary Computing Algorithm Selection in a Probabilistic Hesitant Fuzzy Setting

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Evolutionary computing algorithms have proven to be effective in handling challenging optimization issues in dynamic and uncertain situations. However, due to subjective opinions and contradictory evaluation criteria, selecting the best algorithm from several options is never easy. This study suggests a novel approach for choosing the optimal evolutionary computing algorithm by using the Probabilistic Hesitant Fuzzy Sets (PHFSs). To improve discriminatory power in the context of PHFS, a novel distance measure is developed. The Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) approach is used to rank alternatives based on how close they are to an ideal solution, and the Best-Worst approach (BWM) is incorporated into the model to determine criterion weights. Ultimately, the proposed methodology is implemented on an issue concerning the selection of evolutionary computing techniques. This case study evaluates the alternatives A_1 (``Differential Evolution''), A_2 (``Genetic Algorithm''), and A_3 (``Particle Swarm Optimization'') based on the criteria C_1 (``Convergence speed''), C_2 (``Computational cost''), and C_3 (``Accuracy''). The findings indicate that A_3 is the superior alternative. In the last, a comprehensive comparative analysis is conducted with the existing theories, illustrating the efficacy and application of the proposed method.



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293 AI-Powered E-Waste Sorting with Spectral Analysis and Anomaly Detection Techniques

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The speedy proliferation of electronic devices has given birth to an explosion of digital dumping resulting in serious ecological, technological, as well as regulatory trials. This paper introduces a multidisciplinary approach that combines machine learning (ML) algorithms with hardware-based anomaly detection systems for improving the lifecycle assessment and predictive maintenance of E-waste. Through the use of high-end spectral analysis techniques like Pulsed laser ablation spectroscopy, in combination with supervised ML classifiers, the present method facilitates real-time detection and categorization of toxic constituents in digital dump. Moreover, the proposed framework also overcomes the issues related to the unavailability of high-quality datasets using synthetic generation of data for model training and testing. Additionally, the research discusses the role of extended producer responsibility (EPR) and other regulatory policies in encouraging sustainable E-waste management. Experimental outcomes prove that combined application of ML and hardware options effectively enhances the precision and efficacy of digital electronic waste cataloguing, risk evaluation, and environmental impact forecasting. This work adds value to the development of smart automated systems to sustainably manage E-waste.

301 Depth Analysis of Different Techniques for Migraine Classification, Detection, and Diagnosis

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Migraine place a significant burden on health and economies, and is typically diagnosed using symptom-based clinical histories, which suffers delays or is incorrectly diagnosed in difficult cases. Recent advances in artificial intelligence (AI), machine learning (ML) and deep learning (DL), allow automated analysis of neuroimaging and multi-modal clinical data to find early markers and sub-types. This paper describes a review of 25 contributions to the literature applying DL to neuroimaging and ML to multimodal integration, of the last decade, comparing modalities, architectures, and performance. CNNs on rs-fMRI and 3D deep achieve accuracies as high as 99.25% but multimodal models perform better across populations. The review pointed out the latest advanced techniques, main obstacles (small data, absence of standardization), and indicated future research trends concerning explainable AI frameworks to be used in clinical practice.



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304 Machine Learning-Based Classification and Repetition Counting of Barbell Exercises Using Wearable Sensor Data

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This study presents a machine learning-based framework for the classification and repetition counting of barbell exercises using wearable sensor data. MetaMotion devices equipped with accelerometers and gyroscopes were used to capture movement signals across multiple strength training sessions. The dataset underwent systematic preprocessing, feature extraction, and predictive modeling to ensure reliable analysis. Several machine learning algorithms including Random Forest, Support Vector Machines, Decision Trees, and k-Nearest Neighbors were evaluated for their ability to accurately classify exercise types and count repetitions. The proposed framework achieved classification accuracies exceeding 90%, with certain models reaching up to 98%. In addition, the repetition-counting module demonstrated error margins below 2%. These results highlight the potential of sensor-driven machine learning systems for precise workout monitoring, offering practical applications in personalized fitness tracking, rehabilitation programs, and performance optimization. This research contributes to the field of human activity recognition by establishing a reliable and scalable approach for automated exercise detection and quantification.

306 Hybrid Probability Fusion with Temporal Smoothing for HRV-Based Recognition of Rest, Fatigue, and Stress in Athletes

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Heart rate variability is a well-established noninvasive marker of autonomic regulation, yet robust automatic recognition of rest, fatigue, and stress in field conditions remains challenging. We present a hybrid pipeline that combines generative and discriminative evidence with temporal smoothing. First, HRV windows (meanRR, SDNN, RMSSD, pNN50, SampEn, DFA Î±1) are standardized and modeled by a Gaussian Mixture Model to obtain soft memberships. In parallel, an SVM (RBF) trained with weak labels (per condition) produces calibrated posteriors. The two probability streams are fused by a weighted sum, and a Hidden Markov Model with physiologically plausible transitions (favoring Res vs. Fatigu vs. Stress



over direct Res vs. Stress) yields the final Viterbi sequence. Evaluation follows a leave-one-file-out protocol, where the proposed hybrid method achieves Accuracy 0.94, Macro-F1 0.92, ARI 0.85, and NMI 0.88, clearly outperforming K-Means (Accuracy 0.86, Macro-F1 0.87) and standalone GMM (Accuracy 0.83, Macro-F1 0.84). Per-class results show balanced performance with F1 0.93 for Rest, 0.91 for Fatigue, and 0.93 for Stress, substantially reducing Rest vs. Stress misclassifications and improving Fatigue recognition. PCA visualizations support geometric separability, while DBSCAN on PC1â€“PC2 acts as an outlier detector for artifact-prone windows. Across experiments, the hybrid consistently improves Macro-F1 by 5â€“15 percentage points over the best single baseline (K-Means, standalone GMM/HMM), providing more stable temporal trajectories without sacrificing interpretability. The method is lightweight and amenable to near real-time deployment on wearable ECG/PPG devices, enabling practical monitoring and prevention of accumulated fatigue and acute stress in athletes.

320 Autonomous Firefighting Robot with Catapult-based Suppression in ROS-Gazebo Environment

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Fires in indoor environments present significant threats to both life and property. This research focuses on the design, simulation, and analysis of an autonomous firefighting robot that integrates SLAM-based navigation, YOLOv8 fire detection, thermal imaging, and a projectile suppression mechanism. The robot identifies fires through a combination of vision and thermal data, navigates autonomously using LiDAR, and deploys a 1.3 kg fire extinguisher ball via a torque-driven catapult arm. The system was evaluated in a Gazebo simulation and visualized in RViz. The results demonstrated the robot's ability to effectively suppress fires at distances ranging from 14.78, 12.8, 7.39, and 0 musing different angles such as 45°, 60°, 75°, and 90° respectively.

324 Stock Price Prediction Using Regression and ARIMA Models: A Comparative Analysis

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This quantitative study examines predicted stock price forecasts by two intuitive paradigms (Linear Regression and ARIMA) alongside a chosen technical indicator. The data used for this analysis was obtained from Yahoo Finance and the analysis was driven towards formalizing the statistical and



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regression paradigms in one experiment. To add to the comparison of models presented, the Russell price index (RSI), moving average convergence divergence (MACD), moving average 20 (MA20), and moving average 50 (MA50) were added to models to analyze the models predictability. The proposed design is captured in an interactive design and dashboards to allow interactive analyses in real-time online, where the research also considered the exchange conversion of USD-INR both on the regional usability side but also in application to user accessibility. For purposes of this research a seven-day forecast time horizon was chosen, which highlights short- term predictability, and in which the promises measuring the predictability of each model and their strength or weaknesses in both correctness, repeatability and usability. The research design also offered the research a platform to grade models on a graded model comparing a models across a Trimester on placements based on parameters, to offer a reflexive eye on comparative models based not only on models, but on usability for both investors/practitioners. The research strives for a user-friendly research design decision-making.

328 Object detection for Autonomous vehicles using YOLO based models: A performance Evaluation

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Accurately detecting objects is vital to success in both safety and the reliability of autonomous driving systems. To explore this need, YOLOv8, YOLOv11, and YOLOv12 were compared using the KITTI dataset, which captures a range of driving scenarios and multiple object classes. All models were trained and tested under the same experimental conditions for comparison. Standard performance metrics, including precision, recall, and mean Average Precision (mAP) at different intersection over Union IoU levels, were analyzed, while also controlling for mAP@0.5.The benchmarking covered the process of pre-processing the KITTI dataset into a structure for the YOLO model training process, while ensuring that the models were trained with the same hyperparameters, and the results were evaluated with the validation dataset by measuring all detections made by the models in the vehicles. The comparative analysis highlighted the trade-offs between accuracy and reliability for each detector. Overall, the results indicated that YOLOv12 had demonstrated overall accuracy detection with an mAP@0.5 score of 90.70%, YOLOv11 had the highest recall of the three models at 84.02%, and YOLOv8 produced the highest precision score of the 3 classes at 92.58%. Generally, these results indicated that none of the models had produced any dominant measure for the assessment in the metrics discussed, and the choice of model will come down to those key measures that are suited for each application, and whichever model is assessed for precision.



330 Comparative Analysis of Custom CNN and Transfer Learning Models for Alzheimer's disease Stage Classification

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Alzheimer's disease (AD) is a progressive neurodegenerative disorder, which needs early diagnosis for successful intervention. This paper describes a comparative study of deep learning frameworks for multi-class classification of Alzheimer's disease stages using MRI scans. Four methods were considered: a custom CNN (Convolutional Neural Network), and three transfer learning architectures (VGG16, ResNet50, and DenseNet121). The data set was comprised of 6,400 MRI images which were divided into four groups: Mild Demented, Moderate Demented, Non-Demented, and Very Mild Demented. Models were trained for five epochs and assessed with accuracy, precision, recall, F1-score, and confusion matrices. Experimental results show that the VGG16 has the highest validation accuracy (61.3CNN (57.2class imbalance and small sample size caused all models to have poor performance in the Moderate Demented class. The results demonstrate the efficiency of the transfer learning, especially VGG16, in classifying Alzheimer's stages and emphasize the importance of better management of minority classes. This work is part of the research to build automated computer-assisted diagnostic systems that can assist clinicians in early diagnosis of Alzheimer's disease.

33 NFT and Blockchain-Based Provenance Verification for Counterfeit Prevention in Pharmaceutical Supply Chains

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Counterfeit drugs are still a grave threat to global health, particularly for low- and middle-income nations, where it's estimated one of ten of their medical products are substandard or falsified. Traditional supply chain structures are heavily dependent on centralized databases and trust relationships between manufacturers, distributors, regulators, and end-consumers. However, they are prone to information silos, desynchronized latency, and insider manipulation, which make them ineffective for sophisticated counterfeiting methodologies. To exceed these limitations, here we propose a blockchain-based provenance verification mechanism based on Non-Fungible Tokens (NFTs) as tamper-proof digital tokens of aeries of pharmaceutical products. Manufacturing and distributions metadata are stored on each NFT, which are deposited onto a blockchain (Polygon) via intelligent contracts. Authorized parties, at each supply chain step, insert updates, forming a tamper-evident, timestamped, and open audit log. A QR codes framework links a real-world product item to its on-chain



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NFT record, enabling end-consumers to authenticate via a decentralized, intermediary less mechanism, taking a fraction of a second, and requiring a tiny fraction of a penny for each authentication request processing fee. The solution is scalable, economical, and interoperable, rendering it real-world deployable at mass scale. Analysis highlights advantages of a decentralized, trustless architecture for increasing transparency, pre-venting counterfeiting, and recovering consumer trust for global Pharma distribution.

334 DeepLightBoost Framework: A Deep Neural and LightGBM Hybrid Model for Comprehensive Alzheimer's disease Prediction

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Alzheimer's disease (AD) is a progressive neurological syndrome which requires early and precise diagnosis in order to be effectively treated. Using multidimensional non-imaging clinical data that includes demographic, cognitive, lifestyle, and medical history aspects, a combined Deep learning and Machine learning framework is represented in this study to predict Alzheimer's disease. Correlation matrix was used to find inter-feature relationships and eliminate redundancy after important features such as Functional Assessment, ADL, Memory Complaints, MMSE, Behavioral Problems had been identified using Extra tree classifier. Various machine learning and deep learning models, like Random Forest (RF), Support Vector Machine (SVM), Convolutional Neural Networks (CNN) and XGBoost, were used and analyzed. A DeepLightBoost, a novel hybrid model, was also constructed through integrating the speeding up-based LightGBM with the learning-based Multi-Layer Perceptron (MLP). The model DeepLightBoost performed better with an accuracy of 95.58% in precision, recall, F1-score, and MCC. The findings underlie a great promise of hybrid paradigms for the reduction of false positive AD diagnosis, aid in early diagnoses, and delivery of personal based medicine plans.



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337 Conformity in Digital Review Systems: A PLS-SEM Analysis of Consumer Behaviour on Review Accuracy and Reliability

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Online reviews continue to play a central role in the modern e-commerce systems, but that is viewed as untrustworthy, which is fueled by the bias mechanisms that cause conformity. This paper focuses on the factors that influence the perceptions of consumers in regards to the accuracy and reliability of reviews on the digital platforms using Amazon as the main context. Partial least squares structural equation modelling (PLS-SEM) was used to examine the effects the latent variables which include Social Influence, Rating Distribution and Platform Design have on the Conformity Behavior, therefore, contributing to evaluative judgments of review accuracy and reliability. The empirical research is based on the data gathered with the help of 66 participants who have completed the online questionnaire. PLS-SEM estimates were made in SmartPLS 4, and standard errors and significance tests of 5,000 bootstrap resamples were obtained. The predictive utility of the model was high for both, Review Reliability ($R2 = 0.745$) as well as the Review Accuracy ($R2 = 0.546$). The path coefficient between Conformity Behavior and Review Accuracy was $\beta = 0.503$ ($p<0.001$) and to Review Reliability was $\beta = 0.301$ ($p= 0.007$), which shows that CB had significant effect on both the constructs. Review Reliability had a major direct effect on Rating Distribution ($\beta = 0.546$, $p<0.001$) and Platform Design ($\beta = 0.336$, $p= 0.011$). On the other hand, the proposed direct impact of Social Influence, Rating Distribution, and Platform Design on Conformity Behavior was not statistically significant, which can be interpreted as the indication that the dynamics behind the previously mentioned factors are more complex and context-specific, which was not initially hypothesized. These findings add significant value to online consumer behavior and can be applied to the development of an online review system that enhances the credibility.



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338 IntelliHire: A Smart Resume Screening System

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Obtaining the right resume for screening becomes a very crucial point in recruitment. The process must weigh in facing massive volume, fairness, and deliver results in due time. Weighing each resume manually takes time and might be biased and inconsistent across recruiters. The paper presents IntelliHire, an intelligent resume screening system that uses a hybrid approach combining GNNs and Transformer-based language models for better accuracy, interpretability, and fairness. A novel dataset, Graph Res-HR, containing 3,000 resumes and 600 job descriptions in five domains--Software Engineering, Data Science, Marketing, Finance, and UX Design--with structured annotation of skills, education, and experience, and human-rated relevance scores is created. The core of IntelliHire encodes textual information extracted from resumes and job descriptions using a fine-tuned transformer model, builds a relational graph linking candidates, skills, education, and job requirements, and applies GNNs to capture cross-entity interactions. A ranking module then computes relevance scores by aggregating the textual and graph embedding's. To finish, experimental results show that IntelliHire outperforms traditional machine learning and transformer-only models with regard to accuracy, Mean Average Precision (MAP), nDCG, and AUC-ROC and also offers interpretability for the recruiters. The system proposed is, therefore, a strong, transparent, and fair method of resume screening that can take care of some of the problems faced by present recruiting avenues.

339 IPO ForeSight: Intelligent Draft Prospectus Analysis System

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Over the past few years, the increasing complexity of financial disclosures and the increased sophistication of fraud tied to the market, have created difficult challenges for regulators and investors. Draft Red Herring Prospectuses (DRHPs), the source of IPO regulatory review, commonly contain large quantities of financial, structural, and narrative-based information that is difficult to review manually and may contain inconsistencies, similar information, or misleading information. These concerns have



prompted more global interest in using Artificial Intelligence (AI) to enhance transparency and oversight in markets. This paper introduces IPO Foresight, an exploratory frame-work to examine the potential of Natural Language Processing (NLP) and anomaly-detection techniques for analysis of DRHPs at early stages. The purpose here is not to supplant human review, but to illustrate how AI-based insights, from semantic similarity verification to structural irregularities and summarizing relevant news in context, can support, supplement, or enhance the assessment processes in the traditional forms. The objective of establishing an interpretable and transparent automated system is to explore how AI can enhance the reliability, efficiency and accountability of prospectus analysis.The work contributes to SEBI's vision for responsible AI governance in finance and contributes to the ongoing conversation regarding the assistive capabilities of explainable machine learning to uphold financial disclosure integrity. The prototype achieved F1-score of 74.1%.

351 Integrating Adaptive Focus Fusion and Micro-Anchor Optimization in Tiny-YOLOv8 for Robust Small-Object Detection

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Detecting small objects is still a difficult problem in computer vision because of the use of a few features, the change in scale and the clutter problem that is dense in real-world images. Traditional YOLO-like detectors cannot easily be used to recognise small objects with high precision due to the fact that multi-scale features are combined by fixed, non-adaptive operations, which do not recognize cross-scale context dependencies. To improve the detection of small objects, we introduce in this paper an Adaptive Focus Fusion (AFF) improved Tiny-YOLOv8 architecture that learns to adaptively weight and fuse multi-scale features to enhance the detection of small objects. The proposed AFF module incorporates three hierarchies of feature maps (P3, P4, P5) of the backbone and learns dynamically the contribution of each scale by pooling context globally and attention per channel. The spatial and semantic information is optimised through this adaptive fusion and then delivered to the neck and detection head, making the network more representative of small and partially covered objects. Moreover, there is a micro-anchor optimisation approach that is used to match the anchor sizes to the pixel properties of small targets. Further optimisation to generalisation comes by using an AdamW optimiser, cosine learning rate, and the state-of-the-art data augmentation strategies such as mosaic, mix-up, and copy-paste. Experiments



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carried out on the TinyPerson dataset prove that the suggested AFF-YOLOv8 can significantly increase the detection accuracy and efficacy. The optimised version of the initial Tiny-YOLOv8 model has an improvement in the F1-score of +0.320, with higher precision and recall, with no change in the underlying YOLOv8 library structure. The findings affirm that the combination of adaptive multi-scale fusion and anchor refinement is quite effective in improving the sensitivity of the network to small objects without compromising the real-time performance. In general, the proposed YOLOv8 with AFF additions is a lightweight but powerful solution to the tasks of detecting small objects in surveillance, aerial imagery, and autonomous systems.



The **STEM-Research Society**, a foundation is registered in the year 2020 to support and promote the research in the multidisciplinary domain under the able guidance of renowned academicians and researchers from India and abroad.

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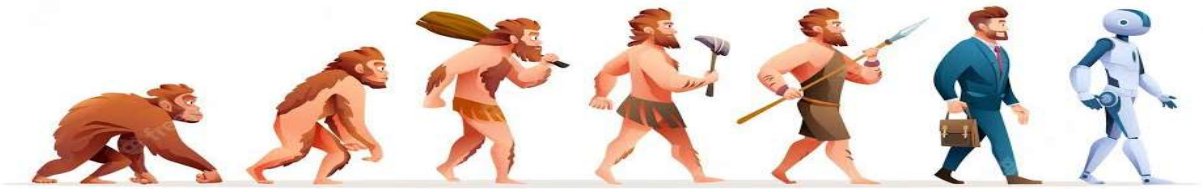

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3	Branch Name	AXIS BANK LIMITED, Ambala Road Saharanpur
4	Branch Code	004186
5	IFS Code	UTIB0004186
6	Swift Code	AXISINBB420
7	MICR Code	247211003
8	Account No	**920020065907453**
9	Bank Branch	Ground Floor No. 14/25/25/1/2, Ambala Road, Saharanpur, U.P., PIN: 247001
10	Type of Account	Current

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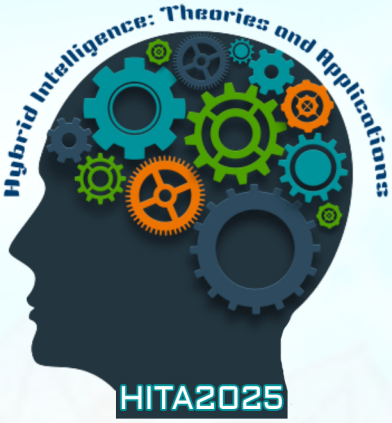

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