Track 1

AI-Driven Innovations in Computer Science and Engineering Education

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AIHEITTLR101

AI-Driven Security Techniques in Social Media

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ABSTRACT

The use of social media has created a complex environment for communication and data sharing. However, these platforms are susceptible to security threats, including privacy breaches, misinformation, account hijacking, cyberbullying, and other harmful activities. Artificial Intelligence (AI) plays a crucial role in enhancing security on social media by detecting, preventing, and mitigating these threats. AI-driven security techniques use machine learning (ML), natural language processing (NLP), and deep learning algorithms to identify patterns, anomalies, and suspicious behaviors in real time. This enables the detection of fake accounts, automated bots, phishing attempts, and harmful content like hate speech and misinformation. With AI systems, inappropriate content can be identified and flagged, reducing the need for human moderation while improving response speed and accuracy. Additionally, AI models can detect changes in user interactions, signaling potential compromises or unauthorized access to accounts. Advanced AI tools also enhance user privacy by using encryption and anonymization techniques to protect personal data shared on social platforms. Despite these advancements, challenges persist in ensuring AI-driven security solutions' fairness, transparency, and accountability. Ongoing research and refinement of AI models are needed to address issues like algorithmic bias and privacy concerns. Nonetheless, AI revolutionizes social media security, providing scalable and adaptive defenses against evolving threats. This paper examines the critical role of AI-driven techniques in bolstering security on social media platforms, highlighting both the benefits and challenges of their deployment in today's digital environment.

Keywords: Artificial Intelligence, Social Media Security, Security, AI Tools for Social Media

AIHEITTLR102

AI-Enhanced Student Support Services: Academic Advising and Mental Health

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ABSTRACT

Artificial Intelligence (AI) is transforming how higher education institutions deliver student support services, particularly in academic advising and mental health care. AI-driven tools such as chatbots, virtual advisors, and predictive analytics offer personalized academic guidance by analyzing student data to recommend courses, monitor academic progress, and identify students at risk of underperformance. This allows institutions to provide timely, data-informed interventions that help students stay on track.

In mental health support, AI is revolutionizing access to care with virtual counseling platforms, mental health apps, and AI-powered systems that can detect early signs of emotional distress. By analyzing patterns in behavior, language, and interactions, AI tools can identify students who may be struggling and recommend appropriate mental health resources, often before a crisis occurs. These systems can supplement human counselors, offering 24/7 support and helping to address the growing demand for mental health services in higher education.

Despite these advantages, the implementation of AI in student services raises critical concerns around data privacy, algorithmic bias, and the limitations of AI in offering empathetic human interaction. Ensuring ethical and transparent use of AI is essential to its successful integration. When carefully designed and deployed, AI has the potential to enhance both academic success and student well-being by providing more efficient, accessible, and proactive support systems in higher education institutions.

Keywords: AI, Student Support, Academic Advising, Mental Health, Predictive Analytics, Virtual Counseling, Personalized Learning, Data Privacy, Higher Education.

AIHEITTLR103

Machine Learning for Traffic Classification in SDN-Based Networks for IoT Devices.

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ABSTRACT

Traffic Classification has become an important research area especially with the advancements of Machine Learning and Software Defined Networking. In this project, two machine learning models – Logistic Regression (supervised) and K-Means Clustering (unsupervised) were used to classify DNS, Telnet, Ping, and Voice traffic flows simulated by the Distributed Internet Traffic Generator (D-ITG) tool. Each host in the network was connected through an overlay network to an Open vSwitch (OVS). The OVS was connected to a Ryu controller which collected basic flow statistics between hosts. These statistics were then parsed by a Python traffic classification script which periodically outputted the learned traffic labels of each flow. Logistic Regression was found to work much better than K-Means Clustering. Further improvements in the project could be to add functionality to detect unique traffic flows between the same pair of source and destination.

Keywords: Openswitch, Traffic Generator, SDN, Traffic Sampling; Genetic Algorithm

AIHEITTLR104

Advancing Intelligent Transportation in Vehicular Ad Hoc Networks (VANETs)

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ABSTRACT

Vehicular Ad Hoc Networks (VANETs) allow cars to talk to roadside infrastructure and other vehicles, which is a significant development in intelligent transportation systems. In addition to improving traffic management and road safety, this communication infrastructure serves as a foundation for a variety of applications, such as entertainment services, traffic light control, and accident avoidance. To enable real-time data sharing, VANETs make use of a variety of wireless communication technologies, including 5G, LTE, and Dedicated Short-Range Communication (DSRC). Due to their rapid mobility and frequent topology changes, vehicle environments are dynamic and present substantial problems for network scalability, security, and stability. Innovative routing protocols, strong security measures, and effective data distribution plans are being created to meet these issues. The potential of VANETs is further enhanced by their integration with cutting-edge technologies like autonomous driving systems and the Internet of Things (IoT), opening the door to safer and more intelligent transportation ecosystems. An overview of the state of VANETs today is given in this abstract, which also highlights important technologies, problems, and potential paths forward. Vehicle-to-Vehicle (V2V) and vehicle-to-infrastructure (V2I) networks are specialized networks that allow automobiles to interact with each other and with roadside equipment. Real-time data exchange is improved via this communication, which is essential for intelligent transportation systems. explains the several wireless technologies used in VANETs, including Long-Term Evolution (LTE), Dedicated Short Range Communication (DSRC), and the upcoming 5G networks, which serve as the foundation for dependable and fast communication.

Keywords: Vehicle-to-Infrastructure, Dedicated Short Range Communication, Internet of Things, Vehicle-to-Vehicle.

AIHEITTLR105

Implementation of License Plate Recognition System

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ABSTRACT

India, being one of the most densely populated countries globally, faces a significant proliferation of vehicles. Consequently, there arises a crucial necessity for accurately detecting vehicles through a robust traffic management system. This research proposes a system designed to identify vehicle number plates from video footage using Raspberry Pi-based video processing techniques. Diverse techniques and algorithms are utilized to efficiently extract information from number plates. The proposed system finds practical application at the entrances of college campuses and other highly restricted areas. Upon a vehicle's passage, the system captures video, which is subsequently processed into images utilizing OpenCV software.

Keywords: Raspberry, Optical Character Recognition (OCR), Block Matching Filter (BM3D), Region of Interest (ROI), Convolutional Neural Networks (CNNs).

AIHEITTLR106

Generative AI in Mental Health Support Systems: Rapid Transformation seen in a Wider Context

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ABSTRACT

Generating care for further possibilities of using generative AI represents a relatively new and untapped area within the field of mental health. Advanced algorithms can assist generative AI models in developing such support systems that can be embraced by patients with BPS on a more personal, practical and efficient level.
For instance, Chabot's or virtual therapists familiar with these patients' profiles and opinions would be able to suggest personalized advice on emotional in company, strategies or exercises in cognitive behavior therapy to practice, thus replacing a part of face-to-face help within 'automated' help.
In a similar way, Generative AI would be able to predict and detect mental health issues warning signs by sifting through data as well social media and text data, improving the timing of interruption and reducing symptom burden.
Relational stigmas can also be addressed through AI-based platforms that provide a safe, neutral space to help individuals reach out for help without stigma of mental illness.
The generative AI based solutions not only accelerate the healthcare but also reduce the costs of mental healthcare, making it widely available particularly in poorer countries with Access to mental health professionals.
While the potential benefits from generative AI to mental health are great, ethical considerations around privacy, bias, and overreliance on technology will be critical to resolve. Addressing these thoughtfully considered challenges, generative AI has great potential to create a key role in improving mental health outcomes and enhancing general well-being across populations worldwide.

Keywords: Mental Health, Virtual Assistants, Targeted Audiences, Social Stigmas

AIHEITTLR107

A Review of Recent Developments in Machine Learning Applications for the Detection of Chronic Liver Disease

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ABSTRACT

An important public health burden is chronic liver disease (CLD), for which early identification is essential to successful treatment. Improving CLD detection has showed potential in machine learning (ML). With an emphasis on prediction models, deep learning techniques, feature engineering and selection, data sources and preprocessing, comparison and assessment, and clinical applications, this study outlines recent developments in machine learning for CLD identification. We also talk about the difficulties, possible paths forward, and how machine learning could transform the identification of CLD.

Keywords: Chronic Liver Disease, Machine Learning, Deep Learning, Feature Selection, Data Preprocessing

AIHEITTLR108

Diabetic Retinopathy Detection Using Deep Learning

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ABSTRACT

One of the most dangerous complications of diabetes is diabetic retinopathy, which leads to permanent blindness if left untreated. Some stages of diabetic retinopathy have been diagnosed in one out of two people suffering from diabetes. Detecting the disease early, which is extremely necessary for the treatment, is one of the crucial challenges. Regrettably, it is extremely difficult to accurately recognize a stage of diabetes retinopathy, and expert human interpretation of fundus images is required. It is important to simplify the detection phase which can benefit millions of people. Deep learning has recently emerged as one of the most promising methods for improving efficiency in a variety of fields, including medical image recognition and classification. Deep convolutional neural networks (CNN) are effectively used in many diseases and to diagnose diabetic retinopathy. Comprehensive and automated tools and methods for the identification of diabetic retinopathy have been needed. Previous approaches have shown promise to be prevented with adequate and timely care and eye results using image classification, pattern recognition, and machine learning. The high cost of large, labeled datasets, however, as well as inconsistencies between various physicians, hinder the success of these techniques. An automated method based on deep learning is proposed here for the phase identification of diabetic retinopathy by human retina images.

Keywords: Diabetic Retinopathy, Image Classification, Deep Learning, Deep Convolutional Neural Network.

AIHEITTLR109

A Survey on Detecting Botnets in IoT: Techniques and Approaches

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ABSTRACT

The Internet of Things, or IoT, is a new paradigm that combines the Internet with physical things from several areas, including industrial processes, human health, home automation, and environmental monitoring. It increases the number of Internet-connected gadgets in our day-to-day lives, bringing with it numerous advantages and difficulties with security-related matters. The Internet of Things, or IoT, has rapidly evolved from a futuristic concept to a ubiquitous daily occurrence. Today, billions of smart gadgets are being linked to the Internet, forming a vast network of interconnected "things" that can sense their surroundings and communicate with one another to support monitoring and decision-making in real time. This paper provides an overview of IoT botnet detection research initiatives in this publication. Finding emerging patterns, unresolved problems, and potential areas for further research is the main goal. Based on the following characteristics—detection method, IDS installation plan, security threat, and validation approach—this paper categorized the botnet detection system that has been suggested in the literature.

Keywords: IoT, IDS, Botnet, DDoS.

AIHEITTLR110

Novel Machine Learning Techniques for Intrusion Detection and Anomaly Detection in Cyber-Physical System

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ABSTRACT

Industrial Control Systems (ICS) and Cyber-Physical Systems (CPS) are increasingly vulnerable to cyber attacks due to their growing connectivity and integration with broader networks. Ensuring the security of these systems is critical, especially in detecting intrusions and anomalies that could compromise their operations. This paper presents a novel machine learning-based approach for intrusion and anomaly detection in CPS, specifically designed for industrial control environments. The proposed model integrates supervised and unsupervised learning techniques to address the limitations of existing methods, including the high rate of false positives and the inability to detect novel threats. Our hybrid model combines deep learning techniques, such as autoencoders, for detecting unknown anomalies, with traditional classifiers like Random Forest and Support Vector Machines to detect known intrusions. To enhance performance and scalability, we incorporate feature selection and dimensionality reduction methods, which optimize the model's ability to process large-scale, high-dimensional CPS data efficiently. This approach allows the system to monitor network behavior in real-time, providing rapid and accurate detection of both intrusions and anomalies. Extensive evaluations on publicly available CPS datasets demonstrate that our method significantly improves detection rates and reduces response times compared to current state-of-the-art solutions. This approach offers a robust, scalable, and adaptive solution for securing CPS, ensuring the safety and reliability of industrial control systems against emerging cyber threats.

Keywords: Industrial Control Systems, Cyber-Physical Systems, Cyber Security, Intrusion Detection, Anomaly Detection, Machine Learning, Supervised Learning.

AIHEITTLR111

Early Brain Cancer Detection through Transfer Learning with Pre-Trained Imaging Models: A Comprehensive Review

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ABSTRACT

Early brain cancer detection plays a pivotal role in improving patient outcomes yet remains a challenging task due to the complexity of brain anatomy and the subtlety of early tumor growth. Traditional diagnostic methods, while effective, are resource-intensive and prone to human error. In recent years, transfer learning with pre-trained imaging models has gained momentum in medical imaging for brain cancer detection. This review provides an in-depth discussion of current approaches using transfer learning to detect early brain cancer, presenting a comparative analysis of 10 key research papers that have applied different pre-trained models and techniques.

Keywords: Machine Learning, Transfer Learning, Pre-Trained Models, ResNet-50, DenseNet

AIHEITTLR112

AI for Sustainability: Advancements, Applications, and Future Directions

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ABSTRACT

Artificial Intelligence (AI) is emerging as a key enabler of sustainability by transforming various sectors through improved resource management, enhanced operational efficiency, and contributions to environmental conservation. This paper examines the dynamic interplay between AI and sustainability, spotlighting the most recent innovations and applications of AI technologies across domains such as energy management, precision agriculture, smart urban planning, and wildlife conservation. By leveraging advanced AI techniques, including machine learning, computer vision, and natural language processing, these sectors are better equipped to address sustainability challenges, from reducing carbon emissions to optimizing water usage and protecting biodiversity.

Furthermore, the paper explores AI's role in enabling real-time decision-making and predictive analysis, which is essential for implementing sustainable practices at scale. AI-powered systems can analyze vast amounts of data, enabling more efficient use of natural resources and the development of solutions that are both adaptive and resilient. However, despite these advancements, several challenges persist. Issues such as data privacy, algorithmic bias, and the carbon footprint of AI systems present significant barriers to fully realizing the potential of AI in promoting sustainability.

Looking forward, the paper considers the future trajectory of AI in sustainability, focusing on its integration with other emerging technologies such as the Internet of Things (IoT), blockchain, and renewable energy systems. Additionally, it stresses the importance of developing comprehensive policies that address ethical concerns and regulatory frameworks to mitigate the unintended consequences of AI deployment. Global collaboration between governments, industries, and academic institutions is also identified as a critical factor in enhancing AI's contribution to sustainability. Ultimately, the insights shared aim to emphasize AI's significant potential to drive progress toward a sustainable future while navigating the challenges and opportunities that lie ahead.

Keywords: Artificial Intelligence, Sustainability, Resource Management, Ethical AI, Sustainable Practices, AI Applications, Environmental Impact of AI, Machine Learning

AIHEITTLR114

Feasible Study of A Generative Deep Learning Approach to Stochastic Downscaling of Precipitation in India

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ABSTRACT

Rainfall forecasting is one of the challenging and uncertain tasks that has a significant impact on human society. Timely and accurate predictions can help to proactively reduce human and financial loss. India is an agricultural country, and most of the economy of India depends upon agriculture. Rainfall plays an important role in agriculture, so early prediction of rainfall is necessary for the better economic growth of our country. Rainfall prediction has been one of the most challenging issues around the world in the last year. Rainfall prediction is important as heavy rainfall can lead to many disasters. The prediction helps people take preventive measures, and moreover, the prediction should be accurate. This paper introduces current supervised learning models that are based on machine learning algorithms for rainfall prediction in India. Rainfall is always a major issue across the world, as it affects all the major factors on which the human being is dependent. In current times, unpredictable and accurate rainfall prediction is a challenging task. We apply rainfall data from India to different machine learning algorithms and compare the accuracy of classifiers such as SVM, GAN, Navie Bayes, Logistic Regression, Random Forest, and Multilayer Perceptron (MLP). Our motive is to get the optimized result and a better rainfall prediction. The guess of precipitation utilizing machine intelligence techniques grants permission to employ regression. The intention concerning this project is to offer non-experts' smooth approach to the techniques and approaches promoted in the area of precipitation guess and determine a comparative study with the various machine intelligence methods.

Keywords: GAN, SVM, Machine Learning, MLP, Rain Fall Prediction, Stochastic Down Scaling.

AIHEITTLR115

A Software Defects Prediction Using Deep Learning Techniques

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ABSTRACT

In the context of software engineering, the ability to predict software defects is very important, since it affects the quality of the software and determines how easy or difficult future maintenance will be. As can be seen, existing approaches to defect prediction employ statistical methods and machine learning algorithms, which may not be the best solutions in today's complex software environment. This paper considers how the application of deep learning approaches can aid in prediction of software defects and improves the overall forecast reliability. We describe a number of ways to investigate software metrics and defect history using different deep learning architectures such as Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), and RNN-CNN Hybrid Models. In this way, part of the data includes code metrics, commit history, and issue tracking system, which can be used to build and test deep learning models. Experiments also showed that deep learning techniques exceed the accuracy and robustness of conventional prediction techniques. Some of the issues regarding software development and perspectives are addressed. This research study aims at providing new strategies that emerge possible with deep learning techniques in the future, and apply in enhancement of software defect prediction.

Keywords: Software Defect, Software Defect Prediction, CNN, RNN , RNN-CNN Hybrid Models

AIHEITTLR116

Real-time Detection and Prevention of Cyberstalking Using AI and Cloud Computing

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ABSTRACT

Cyberstalking, a dangerous and pervasive form of online harassment, has increasingly become a focus of academic and industry research. With the expansion of digital communication channels, the need for effective and timely detection and prevention mechanisms has never been more critical. This review paper explores the intersection of Artificial Intelligence (AI) and Cloud Computing in addressing the challenges of cyberstalking in real-time. The paper systematically examines existing literature on the detection and prevention of cyberstalking, identifying key trends, methodologies, and technologies that have emerged in recent years. It focuses on the role of AI, particularly in Natural Language Processing (NLP), machine learning, and sentiment analysis, which are leveraged to detect patterns indicative of cyberstalking behaviors across various online platforms. The review highlights how these AI techniques are employed to analyze vast amounts of unstructured data, enabling real-time monitoring and response. Furthermore, the paper explores the critical role of Cloud Computing in facilitating these AI-driven solutions. By providing scalable and flexible computing resources, cloud platforms enable the real-time processing of large datasets, ensuring that detection systems can operate efficiently across different geographical locations and platforms. The paper reviews various cloud-based architectures and services that support the deployment of AI models, discussing their benefits and limitations in the context of cyberstalking prevention.

The review also addresses the ethical and privacy concerns associated with using AI and cloud technologies for surveillance purposes. It discusses the importance of data protection, the challenges of balancing privacy with security, and the need for compliance with legal frameworks.

Keywords: Cyberstalking, Real-time Detection, Artificial Intelligence, Cloud Computing, Natural Language Processing, Machine Learning.

AIHEITTLR117

Guardian Bot: Autonomous Protection with Hybrid Intelligence

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ABSTRACT

Recently, many new avenues have opened up for developing autonomous systems that would help accomplish tasks of complexity with little human intervention, and this has come about in the wake of rapid development in AI and robotics. In this review paper, we would like to propose the framework of an autonomous protection system in what we can call a "Guardian Bot" that would be able to integrate hybrid intelligence toward ensuring more efficient decision-making. The Guardian Bot will function in various environments to allow monitoring in real-time, threat detection, and response. With its support of machine learning, sensor fusion, and cognitive computing, it will adapt to dynamic situations, learn through experience, and make informed decisions in uncertain scenarios. We introduce some of the core technologies at the base of hybrid intelligence within Guardian Bot: deep learning algorithms for object recognition and reinforcement learning for adaptive behavior, with an integration of human-in-the-loop strategies for critical decision-making. In this paper, we also make a review of some quite obvious applications of Guardian Bot in various domains, from security and defence to emergency response, pointing at the challenges and future directions for research in this area.

Keywords: Autonomous Protection, Hybrid Intelligence, Guardian Bot, Artificial Intelligence, Robotics, Deep Learning.

AIHEITTLR118

Enhancing Network Security: An Ensemble of Machine Learning Model for Distributed Denial of Service Attack Detection

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ABSTRACT

This research aims to address the pressing issue of detecting and mitigating distributed denial of service (DDoS) attacks on computer networks. A hybrid machine learning model is proposed that leverages unsupervised and supervised algorithms to classify network traffic as normal or malicious with high accuracy. The CICDDoS2019 dataset containing real and simulated attack traffic is used to train and evaluate various classification algorithms. Feature selection is applied to extract the most relevant attributes for detection. The proposed ensemble model combines K-Means clustering, random forest, extreme gradient boosting, adaptive boosting, support vector machine, and artificial neural network classifiers. Experimental results demonstrate the model achieves 99.65% overall accuracy in distinguishing DDoS attacks, outperforming individual algorithms. This research contributes towards developing more robust techniques for analyzing network behaviours and enhancing intrusion detection capabilities.

Keywords: DDoS, K-Means, Machine Learning, Ensemble Modeling, Cicddos2019 Dataset, Network Security.

AIHEITTLR119

Challenges in Cloud and Grid Computing Integration with Artificial Intelligence

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ABSTRACT

The integration of Artificial Intelligence (AI) with Cloud and Grid Computing has significantly transformed data processing, offering scalable, efficient, and cost-effective solutions for diverse computational tasks. This synergy promises advanced capabilities but also introduces several challenges that need to be addressed. Cloud computing provides on-demand access to resources such as storage and computational power, while grid computing utilizes distributed systems to manage complex tasks. The combination of AI, which demands extensive data and computational resources, with these infrastructures' highlights both opportunities and issues.

Interoperability between various cloud and grid platforms presents further difficulties. Diverse providers and architectures can lead to compatibility issues, complicating the deployment of AI models across different systems. Scalability remains another critical challenge; managing the significant bandwidth, computing power, and storage required by large-scale AI workloads, while maintaining performance and accuracy, is a complex task. Furthermore, the high energy consumption associated with training large AI models raises environmental and economic concerns, highlighting the need for energy-efficient algorithms and infrastructures.

The integration of AI with cloud and grid computing holds substantial promise but also presents technical, security, and logistical challenges. Addressing these issues requires collaborative efforts to develop new algorithms, optimize resource management, enhance data security, and ensure standardization across platforms to fully realize the potential of this integration.

Keywords: Cloud Computing, Grid Computing, Artificial Intelligence (AI), Resource Optimization, Data Privacy.

AIHEITTLR120

A Review of Multilayer Convolutional Neural Network Approaches for Computer Aided Analysis of Plants

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ABSTRACT

In agriculture, there is production and economic loss caused by plant diseases. The early plant disease detection is important to enhance the effectiveness of the crop production. Farmers faced many challenges like plant disease, and it is natural to have diseases in the plants. With the advancement in technology, plant disease identification becomes digitalized. The detection of plant disease can be automated and more beneficial for plant monitoring. The plant disease can be detected firstly by the symptoms shown in the plant leaves. This paper reviews many identification and classification techniques for plant disease detection. The recent techniques of image processing with machine learning show the effectiveness for plant leaves detection and classification.

Keywords: Plant Diseases, Disease Identification, Detection and Classification; Machine Learning, Automated Detection.

AIHEITTLR121

Classification using Bi-LSTM for Gender-Based Hate Speech Detection

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ABSTRACT

Social media moderation is a crucial component to establish healthy online communities and ensuring online safety from hate speech and offensive language. In many cases, hate speech may be targeted at specific gender which could be expressed in many different languages on social media platforms such as Indonesian Twitter. However, difficulties such as data scarcity and the imbalanced gender-based hate speech dataset in Indonesian tweets have slowed the development and implementation of automatic social media moderation. Obtaining more data to increase the number of samples may be costly in terms of resources required to gather and annotate the data. This study looks at the usage of data augmentation methods to increase the amount of textual dataset while keeping the quality of the augmented data. Three augmentation strategies are explored in this study: Random insertion, back translation, and a sequential combination of back translation and random insertion. Additionally, the study examines the preservation of the increased data labels. The performance result demonstrates that classification models trained with augmented data generated from random insertion strategy outperform the other approaches. In terms of label preservation, the three augmentation approaches have been shown to offer enough label preservation without compromising the meaning of the augmented data. The findings imply that by increasing the amount of the dataset while preserving the original label, data augmentation could be utilized to solve issues such as data scarcity and dataset imbalance.

Keywords: Dataset, Data Augmentation, Hate Speech Detection

AIHEITTLR122

Deep Learning Techniques for Hate Speech Identification: A Comprehensive Analysis

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ABSTRACT

Hate speech detection has become a crucial task in natural language processing due to the rise of online hate speech and its detrimental effects on individuals and communities. Deep learning systems can capture complex language patterns and semantics to detect and prohibit hate speech. This paper examines the latest deep learning hate speech detection methods. Several deep learning architectures for hate speech detection are studied. These models include RNNs, CNNs, BERT, and GPT transformers.

Each hate speech detection design's merits, shortcomings, and applicability are assessed. The report also examines publicly available corpora and domain-specific datasets annotated to identify hate speech. The study analyses how data preparation, feature engineering, and model evaluation ensure hate speech detection algorithm durability and application.

The article also examines hate speech detection industry concerns and future research topics. These include creating multilingual models, categorizing hate speech more precisely, and leveraging contextual information to improve model performance. The study covers deep learning hate speech detection in detail. It illuminates the main techniques, obstacles, and growth prospects in this subject.

Keywords: Hate Speech, RNN, CNN, BERT, NLP, Feature Engineering, Deep Learning.

AIHEITTLR123

Handwritten Signature Verification System using Writer Independent Approach

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ABSTRACT

Signature is a fundamental trait for individual identification and the validation of official documents. This research investigates the use of geometric features to develop a robust offline signature verification system employing multiple classifiers, specifically with a writer-independent approach. A writer-independent offline handwritten signature verification model, referred to as the global model, is introduced in this study. The global model is built using a Support Vector Machine (SVM) with a polynomial kernel, a widely regarded machine learning method known for its ability to handle complex classification problems.
The performance of the model is tested on two different signature databases, with the effectiveness of the classifier being measured using the Average Error Rate (AER). The study emphasizes the importance of using geometric features—such as angles, curves, and stroke lengths—which are key characteristics that provide distinct information about a writer's unique signing style. These features help the system in distinguishing genuine signatures from forgeries.
Results demonstrate that the SVM-based model, combined with geometric feature extraction, is highly effective in identifying forged and genuine signatures, delivering a promising accuracy in a writer-independent context. This approach minimizes dependency on the specific characteristics of individual writers and focuses more on general geometric patterns that are typically present across different handwriting styles.

Keywords: Handwritten Signature, Writer Independent Approach, Writer Dependent Approach, Geometric Features, Support Vector Machine

AIHEITTLR124

Role of AI in research: Impact and Challenges of AI tools

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ABSTRACT

The integration of Artificial Intelligence (AI) in doctoral research is transforming the landscape of academia, offering innovative tools and methodologies that enhance every phase of the research process. AI tools are revolutionizing research design by enabling advanced data analysis, predictive modeling, and simulation. During the conduct phase, they facilitate automated data collection, enhance experimental precision, and enable real-time insights. The evaluation phase benefits from AI through improved data interpretation, pattern recognition, and peer review processes. Finally, the impact of AI tools on the research ecosystem is profound, reshaping how findings are disseminated, accessed, and utilized across disciplines. The integration of Artificial Intelligence into doctoral research presents several significant challenges that need addressing to maximize its benefits. One major issue is data privacy and security, as AI tools often require access to extensive datasets that may contain sensitive information. To mitigate this, robust encryption methods, secure access protocols, and comprehensive data governance policies are essential. Another challenge is the potential for bias in AI systems, which can exacerbate existing disparities in research outcomes. Addressing this requires the use of diversified datasets and regular auditing of algorithms for fairness. Integration with traditional research methods also poses a challenge, as AI tools may disrupt established methodologies. Collaborative efforts between AI experts and traditional researchers, along with the development of hybrid research approaches, can facilitate smoother integration. The skill gap among researchers in using AI tools is another significant hurdle. Providing targeted training and educational resources can help bridge this gap and enhance AI literacy. Ethical considerations are crucial, as the use of AI raises questions about the implications and potential misuse of automated systems. Establishing ethical guidelines and review boards can ensure responsible use of AI in research. Finally, ensuring the reliability and validation of AI tools is essential for producing valid and reproducible results. Rigorous validation studies and standardized benchmarks can help address concerns about the performance and accuracy of AI in research. Addressing these challenges collaboratively can enhance the effective and ethical use of AI in doctoral research.

Keywords: AI in Research, Doctoral Research Tools, Research Design, Data Analysis, AI Impact, Research Evaluation, Academic Innovation, AI Applications

AIHEITTLR125

A Comprehensive Review of Sentiment Analysis Techniques

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ABSTRACT

The fast evolution of Internet-based applications like websites, social networks, and blogs, leads people to generate enormous heaps of opinions and reviews about products, services, and day-to-day activities. Sentiment analysis poses as a powerful tool for businesses, governments, and researchers to extract and analyze public mood and views, gain business insight , and make better decisions.
Sentiment analysis is the computational examination of end user's opinion, attitudes and emotions towards a particular topic or product. Sentiment analysis (SA), also called Opinion Mining (OM) is the task of extracting and analyzing people's opinions, sentiments, attitudes, perceptions, etc., toward different entities such as topics, products, and services. Sentiment analysis classifies the message according to their polarity whether it is positive, negative, or neutral. Recently researchers focused on lexical and machine-learning based method for sentiment analysis of social media post.
This paper presents a comparative study of sentiment analysis approaches to give researchers a global survey on sentiment analysis and its related fields. This paper present comprehensive overview of sentiment analysis technique based on recent research and subsequently explores machine learning and feature extraction techniques in context of Sentiment analysis over social media data set. Then, it evaluates, compares, and investigates the approaches used to gain a comprehensive understanding of their advantages and disadvantages. This paper also examine utilizing different ML and Lexicon investigation methodologies.

Keywords: Sentiment Analysis, Deep Learning, Machine Learning, Lexicon-Based Sentiment Classification, Feature Extraction, Polarity, Pre-Processing, Classification, Accuracy.

AIHEITTLR126

Strategies for Optimizing Quantum Circuit Parameters in Quantum Neural Network Training: A Comprehensive Review

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ABSTRACT

Quantum Neural Networks (QNNs) are becoming an exciting way to harness quantum computing for machine learning. However, training QNNs is not straightforward, particularly when it comes to adjusting quantum circuit parameters. Unlike classical neural networks, traditional optimization techniques like backpropagation don't work as easily in quantum systems due to problems like barren plateaus (where gradients vanish) and sensitivity to noise. This paper takes a closer look at the various strategies being used to fine-tune quantum circuit parameters during QNN training. It examines methods such as Variational Quantum Algorithms (VQAs), quantum natural gradients, evolutionary algorithms, and hybrid techniques that combine classical and quantum optimization. The paper also delves into the unique hurdles in quantum computing, such as dealing with noise, decoherence (loss of quantum information), and the limits of quantum measurements, and how these factors impact the success of these optimization strategies. Additionally, this review explores new trends and potential future improvements in making these optimization techniques more effective and reliable, which are essential for pushing the boundaries of quantum machine learning. The goal is to provide a useful resource for researchers and practitioners interested in improving quantum circuit optimization in QNNs and to point out areas where more research is needed.

Keywords: Quantum Computing, Quantum Neural Networks, Quantum Machine Learning Algorithm.

AIHEITTLR128

Image Recognition Algorithms in Digital Media in Content Editing and Production

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ABSTRACT

In the digital age, image processing and image recognition algorithms are critical to content creation and editing. They offer original methods for enhancing visual quality, expediting procedures, and personalizing user interfaces. This study covers in-depth techniques for integrating state-of-the-art image processing and image recognition algorithms into digital media content production and editing workflows.

The research first focuses on pre-processing and enhancing digital photos using the median filtering technique in order to maximize visual quality. In order to discover and identify objects in photos and enable personalized and interactive content change, the Histogram of Oriented Gradients (HOG) technique is utilized. The photos are then segmented using the watershed approach, and the Mayfly Optimized Spatial Graph Recurrent Neural Network (MOSGRNN), which enhances content organization and retrieval, is used to precisely classify the images.

The experiment findings show that the proposed technique achieves good performance in terms of accuracy (94.91%), recall (92.70%), recognition speed (44 FPS), and f1-score (93.7%) in all image processing domains. Image processing and image recognition algorithms in digital media could have a profound impact on content development, editing, and delivery across a range of platforms.

Keywords: Image Processing, Image Recognition, Median Filtering, Histogram of Oriented Gradients (HOG), Watershed Approach, Mayfly Optimized Spatial Graph Recurrent Neural Network.

AIHEITTLR131

Forgery Detection using PSO Optimization with SIFT feature Algorithm

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ABSTRACT

In the modern forensics research world, picture forgery detection of multimodal digital images is one of the fastest-growing fields. We think that our suggested approach demonstrates that research on false identification and analysis is still in its infancy and has a lot of promise for use in the future. We proposed PH-SIFT using PSO method to improve the overall forgery analysis because the current deep learning method forgery detection and analysis is insufficient. This algorithm is the result of PH-SIFT's excellent accuracy, robustness, and other factors being increased with the application of the PSO Algorithm technique. This method can get beyond many of the challenges and complexities associated with forgery analysis and identification. The performance assessment criteria and widely used datasets for evaluating the efficacy of the PH-SIFT utilizing PSO Algorithm method, which also aims to improve its accuracy and other metrics, are employed to carry out this investigation. This method can avoid the challenges and complexities caused by numerous problems with forgery analysis and detection.

Keywords: Image Forgery, PSO-Particle Swarm Optimization, Forensics, Watermarking

AIHEITTLR134

Advanced Blowfish Algorithm and Multi-Phase Verification for Secure Cloud Data Restoration

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ABSTRACT

Due to its higher productivity, widespread accessibility, low cost, and other benefits, distributed computing is currently playing a big role in the data innovation sector. In order to provide computer resources as services through the internet, one method is known as cloud computing. Data storage and evaluation of the apps and services offered by cloud servers are both made possible by cloud computing. At the cloud storage server, there is a wealth of data. However, due of worries about safety and security, many customers are reluctant to use the cloud. This implementation discussed safe file exchange via the cloud utilizing improved blowfish computation (OBA) and multi-stage confirmation (MSA) to produce productive secure information recovery. The three elements that make up the suggested structure are MSA, information security, and information recovery. To improve the security of the cloud data, the solution we suggested made use of the hash function concept as well as several cryptographic tools. Third-party auditor (TPA) checks the accuracy of the data kept in the cloud on the part of the data owner. To ensure the accuracy of the data, TPA examines the message's hash. The TPA offers the Integrity Verification, which significantly lessens the data owner's workload. The Blowfish and RSA cryptographic algorithms are employed in our suggested system to merge the characteristics from both and improve upon the existing system.

Keywords: Cloud Storage Server, Blowfish, RSA, Recovery, Cloud Computing, Cryptography.

AIHEITTLR135

Machine Learning Applications in Medical Imaging: A Review

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ABSTRACT

The rapid advancement of machine learning (ML) technologies has profoundly impacted the field of medical imaging, offering innovative solutions for diagnostic, prognostic, and therapeutic challenges. This review explores the diverse applications of ML in medical imaging, covering a wide range of imaging modalities such as MRI, CT, ultrasound, and X-ray. Machine learning techniques, particularly deep learning models like Convolutional Neural Networks (CNNs), have shown remarkable proficiency in tasks such as image segmentation, disease classification, and anomaly detection.

The review delves into key applications including automated detection of tumors, segmentation of organs and tissues, and enhancement of image quality. ML has also enabled the development of radiomics and radiogenomics, which are pivotal in extracting complex patterns from imaging data to predict disease progression and treatment response. Furthermore, the integration of ML models into imaging workflows has the potential to reduce diagnostic errors, optimize clinician workloads, and facilitate personalized medicine.

Despite its transformative potential, the implementation of ML in medical imaging faces significant challenges. Issues such as data scarcity, model interpretability, generalization across populations, and the ethical considerations surrounding patient privacy and algorithmic bias are critical hurdles that must be addressed. This review highlights recent breakthroughs while emphasizing the need for continuous research to fully harness the capabilities of ML in clinical settings.

Keywords: Machine Learning, Medical Imaging, Deep Learning, Image Segmentation, Diagnostic Accuracy, Radiomics, Ethical Considerations.

AIHEITTLR136

A Framework for Integrating Automated Fact-Checking Systems into News Platforms

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ABSTRACT

The proliferation of misinformation poses significant challenges to the integrity of news media and public trust. This paper presents a comprehensive framework for integrating automated fact-checking systems into news platforms, aimed at providing real-time verification of news articles. By leveraging advanced machine learning and natural language processing techniques, the proposed framework facilitates the automatic assessment of news content against verified data sources. The system is designed to evaluate claims made within articles, check them against a database of facts, and provide contextual feedback to users, thus enhancing their ability to discern credible information.

We discuss the architecture of the framework, including data collection, claim extraction, verification processes, and user interface design. Additionally, we explore the scalability of the system and its adaptability to various news platforms, ensuring it meets the diverse needs of journalists, editors, and consumers. The integration of automated fact-checking not only improves the accuracy of news reporting but also fosters a more informed public discourse. This research underscores the critical role of technology in combating misinformation and supports ongoing efforts to uphold journalistic standards.

Keywords: Automated Fact-Checking, Misinformation, News Verification, Machine Learning, Natural Language Processing, News Platforms, User Interface, Public Discourse.

AIHEITTLR141

Cognitive Modeling in Artificial Intelligence

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ABSTRACT

Cognitive modeling in artificial intelligence (AI) provides a framework for simulating human cognitive processes, thereby deepening our understanding of human intelligence. This approach leverages computational models to replicate various aspects of cognition, such as perception, memory, reasoning, and decision-making. By systematically analyzing these cognitive functions, researchers can identify the underlying mechanisms that govern human thought and behavior. This paper discusses the development and application of cognitive models, highlighting their contributions to advancements in AI, particularly in areas such as natural language processing, problem-solving, and human-computer interaction.

Cognitive modeling not only enhances AI's capability to mimic human-like responses but also serves as a valuable tool for investigating cognitive theories in psychology and neuroscience. By bridging the gap between human cognition and artificial systems, these models facilitate the design of more intuitive AI interfaces and improve collaborative human-AI interactions. This research underscores the importance of cognitive modeling in enriching our understanding of human intelligence and guiding the development of intelligent systems that better align with human cognitive capabilities.

Keywords: Cognitive Modeling, Artificial Intelligence, Human Cognition, Natural Language Processing, Decision-Making, Human-Computer Interaction, Computational Models, Cognitive Theories.

AIHEITTLR143

Transformative Potential of AI in Ophthalmic Healthcare

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ABSTRACT

Diabetic Retinopathy (DR) is a leading cause of blindness globally, underscoring the critical need for early detection and timely intervention. Traditional screening methods are often resource-intensive, relying heavily on trained specialists and advanced equipment, which can limit accessibility, particularly in underserved regions. This case study investigates the application of advanced artificial intelligence (AI) techniques for the automated detection of DR, addressing significant research gaps in existing methodologies, particularly in the areas of diagnostic efficiency, scalability, and integration into routine clinical practice.

The healthcare organization in focus aims to implement an AI-based system that analyzes retinal images to accurately detect signs of diabetic retinopathy. Current AI solutions often lack robustness across diverse patient demographics and imaging conditions, which this research seeks to improve. By utilizing deep learning algorithms and enhanced image processing techniques, the proposed system aims not only to increase diagnostic accuracy but also to minimize false positives and negatives, thereby reducing unnecessary referrals and anxiety for patients.

This study addresses the need for scalable solutions that can be seamlessly integrated into existing healthcare workflows, ensuring that the benefits of AI are accessible to a broader population. Ultimately, this exploration highlights the transformative potential of AI in ophthalmic care and its critical role in facilitating timely interventions, thereby improving patient outcomes and reducing the burden of diabetic retinopathy on healthcare systems.

Keywords: Diabetic Retinopathy, Artificial Intelligence, Deep Learning Algorithms, Image Processing

AIHEITTLR145

The Fusion of AI and VR: Redefining E-Learning for the Future

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ABSTRACT

Virtual Reality (VR) and Artificial Intelligence (AI) are increasingly revolutionizing the domain of distance education, particularly within higher education frameworks. VR facilitates the creation of immersive, interactive simulations and virtual classroom environments, enabling experiential learning that transcends physical and geographical constraints. AI enhances this paradigm by providing adaptive learning algorithms, intelligent tutoring systems, and real-time analytical feedback, thereby personalizing the educational process to accommodate diverse learner profiles and cognitive needs. The convergence of VR and AI addresses the inherent limitations of traditional distance education, such as limited student engagement and reduced interactivity, by establishing a more dynamic and responsive virtual learning infrastructure. This research paper delves into the integration of VR and AI technologies to enhance learning experiences. Additionally, it examines the challenges associated with the deployment of these technologies in higher education, including technical scalability, financial investment, and ethical implications. The paper further outlines prospective research directions and technological advancements necessary for harnessing the full potential of VR and AI in transforming distance education into a more effective, inclusive, and accessible learning model.

Keywords: Artificial Intelligence, Virtual Reality, Interactive Simulations, E-Learning, Higher Education

AIHEITTLR147

Plant Image Super-Resolution using Attention-based Deep Learning Network

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ABSTRACT

Image Super-resolution is a technology that enhances the resolution of captured input images. This technology may assist in visualizing crop and soil conditions, which may overcome the limitations of traditional imaging methods. Existing methods adopted deep learning methodology to generate high-resolution plant and soil images with high-quality features corresponding to the input images. However, these methods give equal weight to all the features that may cause the inclusion of artifacts and noise in the output images. Therefore, the attention-based deep learning method proposed in this paper assigns higher weights to critical features and generates high-resolution images. These images help to identify plant disease, soil type, and plant health. This facilitates early disease diagnosis, efficient water usage, and optimized fertilization, ultimately contributing to increased crop yields and sustainability. Extensive experiments are carried out on different datasets, indicating the proposed method's superiority over the existing methods.

Keywords: Attention, Plant Images, Super-Resolution, Deep Learning, High-Resolution, Low-resolution, Features

AIHEITTLR151

Integrating AI in Education: Elevating Teaching, Learning, Measurement and Assessment

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ABSTRACT

The future of education hinges on the integration of information technologies, with a strong focus on promoting equity and inclusiveness to ensure quality learning for all. Teacher education programs play a critical role in preparing qualified educators for this future. Incorporating AI into education is key to fostering inclusivity and providing comprehensive services that address diverse learning needs. For AI to be effective, it must be thoughtfully integrated into lesson plans to enhance personalized learning experiences. Student teachers have observed that AI positively supports and motivates learning, significantly transforming how students' needs are met. However, they have also raised concerns about potential drawbacks, such as AI limiting the teaching profession, potentially replacing teachers, and generating biased outcomes.

The rapid advancement of AI technology has become essential for educators in enhancing teaching and learning experiences. Integrating AI assessment tools offer many good points, like enhancing the efficiency and accuracy of evaluations, creating personalized feedback, and helping teachers tailor their strategies to meet individual student needs. AI has capable to transform how education is both delivered and assessed, with significant implications for educational measurement and evaluation. This explores various applications of AI in these domains, particularly focusing in classroom assessments. Key areas of impact include test purpose determination, test specification, blueprint development, item generation, test instructions preparation, item selection, test administration, scoring, result interpretation, analysis, and reporting.

It also examines the evolving importance of teachers in AI based assessments and the challenges associated with using AI tools in educational settings. Additionally, strategies to address these challenges, along with the benefits and limitations of AI in assessment, are discussed. To fully harness the potential of AI in education, collaboration among educators, policymakers, and stakeholders is essential in order to maximize benefits while mitigating risks.

Keywords: Artificial Intelligence in Education, Student Teachers, Sustainable Education, Teacher Education Programs, Chatgpt, Educational Assessment, Reliability, Skills, Technology

AIHEITTLR153

Artificial Intelligence based optimization model for Pruning in Game Playing System

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ABSTRACT

Artificial intelligence (AI) has grown considerably in the present era and acts as a domain that still possess substantial space for development, making most of its noteworthy advancements in the field of computer games. The computer games are the computer programs based on AI that involve in sensing the environment of game like chess with the aim to defeat the human opponent. This paper proposes the hybrid ANN optimized model for attaining the maximum possible legal moves in the chess game rectifying the drawbacks of conventional position evaluation strategies. The Portable Game Notation (PGN) file acts as the input database comprising the details and the games played by the human players. The legal possible moves corresponding to a single move of the opponent is evaluated through the proposed model, out of which the one best optimal move is evaluated using the conventional minimax algorithm. The significance of the research relies on the proposed AI based optimization algorithm that involve in tuning the weights of the ANN classifier optimally, leading to enhanced performance of the game playing system. The effectiveness of the proposed method is analyzed in terms of the evaluation metrics such as accuracy, sensitivity and specificity which is found to be above 98% which shows the effectiveness of the proposed model in pruning.

Keywords: Artificial Intelligence, Game Playing System, Artificial Neural Network, Portable Game Notation, Pruning and Optimization.

AIHEITTLR155

A Study of Various Security Threats in Wireless Sensor Network

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ABSTRACT

WSN security approaches such as improve spectrum, the use of cryptography and key management may not detect violations efficiently and may require complex software and hardware modifications, rendering these approaches inadequate to address WSN safety issues, as WSN devices reduce the network's strength, storage, computational, and ability to communicate.The Internet of Things (IoT) is based on wireless sensor networks, which are lightweight and inexpensive. Wireless Sensor Networks raise significant security risks. It includes the use of low-energy devices, wireless broadcasting channels, multi-hop relays, dynamic network architecture, parameter medium-to-large network dimensions, different sensor node creation, and, most significantly, the different protocols for routing used. Because IoT comprises any number of WSNs, securing WSNs is crucial to safeguarding IoT systems. These networks have been studied for a range of applications, including the military, environmental, healthcare, and civilian sectors, despite their susceptibility to cyber threats. The development of effective attack prevention and detection systems is hampered by the unique qualities and limitations of WSNs. This paper aims to give a comprehensive understanding of the basic ideas underlying cyber security in WSNs. The biggest global threat to communication networks is security threats. Any network's connectivity, availability, stability, and secrecy are all impacted by security assaults, which limit the network's capacity for effective use. It is imperative to mitigate this threat, particularly given the recent sharp increases in assault frequency and severity.

Keywords: Wireless Sensor Networks Machine Learning, Internet of Things, Security Threats, Detection, Prevention, Security.

AIHEITTLR161

Efficient Intrusion Detection Systems for IOT Networks Using Machine Learning

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ABSTRACT

The rapid growth of Internet of Things (IoT) networks has introduced important challenges in securing these environments from a large number of cyber-attacks. Existing Intrusion Detection Systems (IDS) are not up to mark as per today requirements, heterogeneous, and resource-constrained nature of IoT devices. This paper presents an efficient IDS framework specifically designed for IoT networks, including the power of machine learning (ML) techniques. The proposed system utilizes misdeed detection and classification algorithms to identify and mitigate malicious activities in real-time. By using supervised and unsupervised learning models, the IDS system can adapt to evolving threats, ensuring improved detection accuracy while minimizing false positives. Extensive experimentation on IoT-specific datasets presents the system's ability to outperform existing IDS solutions in terms of scalability, efficiency, and error free environment. This paper contributes to the ongoing effort to utilize IoT ecosystems against emerging cyber threats through intelligent, adaptive security solutions.

Keywords: Iot Security, Intrusion Detection System, Machine Learning, Anomaly Detection, Cyber-Attacks, Real-Time Monitoring, Network Security.

AIHEITTLR162

Ethical Consideration of AI in Education

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ABSTRACT

The integration of Artificial Intelligence (AI) in education offers transformative potential but raises ethical concerns that must be addressed to ensure fairness and responsibility. This paper explores issues such as data privacy, algorithmic bias, and transparency, particularly in areas like admissions, grading, and personalized learning. As AI becomes more central to educational decision-making, concerns about equity and the risk of reinforcing social inequalities grow. The research emphasizes the ethical responsibilities of educators, developers, and policymakers in deploying AI tools that prioritize student well-being and academic integrity, while proposing strategies to mitigate these challenges for a more inclusive and transparent education system.

Keywords: Artificial Intelligence in Education; Ethical Concerns; Data Privacy; Educational Decision-Making

AIHEITTLR167

An Efficient Approach for Business Intelligence using Deep Learning

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ABSTRACT

To obtain a competitive advantage and make data-driven choices, businesses now depend heavily on business intelligence (BI). But complicated patterns and vast amounts of unstructured data are frequently too much for conventional BI techniques to handle. This paper offers an effective BI strategy that gets over these restrictions by utilizing deep learning techniques. Deep learning models may be integrated into BI systems to increase the accuracy of data analysis, especially for unstructured data like text, photos, and audio. By improving predictive analytics, the method helps companies anticipate trends, streamline processes, and extract more meaningful information from large, complicated datasets.
The system is scalable for a variety of industries, including banking, healthcare, and retail, as it automates feature extraction, minimizes user involvement, and offers real-time analysis. This paper demonstrates how deep learning has the potential to revolutionize business intelligence by providing more flexible and effective tools that enable contemporary organizations to make well-informed, data-driven choices.

Keywords: Business Intelligence, Deep Learning, Predictive Analytics, Convolutional Neural Networks, Recurrent Neural Networks, Unstructured Data, Data-Driven Decision-Making, Operational Efficiency.

Metaheuristic Optimization Algorithms for Solving Multidimensional Search Space Problem

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ABSTRACT

The rapid growth of data in modern applications poses significant challenges for machine learning techniques, particularly in terms of feature selection. This process is vital for enhancing classification results and improving learning accuracy by removing redundant and irrelevant data. As metaheuristic optimisation strategies gain prominence, they offer effective solutions for complex optimisation problems, allowing for efficient identification of high-quality solutions within constrained resources. This paper reviews various nature-inspired metaheuristic algorithms utilised for feature selection, emphasising their strengths, weaknesses, and applications in image forensic analysis. We highlight advancements such as the Improved Crow Search Algorithm (ICSA), Grey Wolf Optimiser (GWO), and Whale Optimisation Algorithm (WOA), while noting the importance of balancing exploration and exploitation in achieving global optimality. Additionally, we discuss the integration of deep learning with metaheuristic approaches, demonstrating their potential to address real-world challenges in data-driven domains. The findings underscore the need for ongoing research in refining these algorithms and exploring new combinations to enhance their performance in feature selection tasks.

Keywords: Metaheuristic Optimization, Machine Learning, Classification Accuracy, Algorithm Performance Enhancement

Exploring Model Compression in Deep Neural Networks: A Comprehensive Survey

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ABSTRACT

In recent years, deep learning has advanced rapidly, leading to the widespread use of deep neural networks (DNNs) in various computer vision applications. However, as DNNs become more sophisticated to achieve higher performance, their complexity increases, resulting in more extensive memory usage and significant computational requirements. This makes real-time applications challenging. Model compression has emerged as a critical area of research for overcoming these limitations. Additionally, compression techniques are essential for deploying models on edge devices with limited resources. This paper reviews various model compression techniques, which help reduce storage needs, accelerate inference, lower model complexity and training costs, and improve model deployment. The review covers state-of-the-art approaches such as pruning, quantization, low-rank approximation, knowledge distillation, and designing lightweight models. Furthermore, the paper highlights current challenges and suggests directions for future research.

Keywords: Deep Neural Networks; Model Compression; Pruning; Quantization; Low-Rank Approximation; Knowledge Distillation; Lightweight Model Design.

AIHEITTLR172

Role of Machine Learning Techniques in Big Data Analysis

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ABSTRACT

This research introduces a novel approach that has been introduced, integrating Big Data Analytics with supply chain management. It involves the capacity to predict how changes will affect the labour force, stock levels, and the SC as a whole. The approach covers problem identification, machine learning model training, hyperparameter tuning, data sources, exploratory data analysis, performance evaluation, and optimization. First, the necessity of gathering data in accordance with the SC plan has been addressed, as have the methods for doing so. The essay addresses the necessity of using various forecasting techniques based on the time frame or SC objective. It has been suggested that the best performing model be optimized by utilizing the SC KPIs and the error-measurement system. It has been demonstrated that phantom inventory negatively impacts forecasting, and that SC KPIs are important for managerial decision-making as they provide model performance benchmarks and enhance operations management, transparency, and planning effectiveness. workforce determination, cost, Inventory management, production & capacity planning, and pre- processing optimization are transformed into the full control process through the framework's cyclic link, which is predicated on the post-process KPIs. The suggested standard supply chain (SC) process structure, suggested forecasting data analysis, forecasting impacts on supply chain performance, machine learning algorithm optimization, and future research directions are the main contributions of this study.

Keywords: Supply Chain, Data Analysis, Inventory Management, Production & Capacity Planning.

AIHEITTLR173

Novel Framework of Artificial Intelligence to Improve Personalized Learning in Higher Education

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ABSTRACT

Personalized learning is a promising approach to education that aims to meet the individual needs and preferences of each learner. Artificial Intelligence (AI) has emerged as a powerful tool for delivering personalized learning experiences(PL) in higher education(HE). However, existing AI-based personalized learning systems face several challenges, including the lack of a comprehensive framework for integrating AI into the learning process. In this paper, we propose a novel framework for AI-based personalized learning that addresses these challenges. The framework combines machine learning algorithms, natural language processing techniques(NLP), and personalized recommendations to provide a holistic learning experience. The proposed framework also incorporates real-time feedback and adaptive learning strategies to enhance student engagement and improve learning outcomes. We discuss the potential benefits of the framework and its implications for the future of personalized learning in higher education. Finally, we provide recommendations for the implementation of the framework and highlight areas for future research.

Keywords: Personalized Learning, Artificial Intelligence, Higher Education, Machine Learning, NLP, Recommendation Systems

AIHEITTLR174

Risk Identification and Mitigation as tangent for Data Governance Strategy Using Data Science

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ABSTRACT

For any organization, Data is the Most Valuable Asset and today all organization has a plethora of Data. Data often moves from one point to another in various forms and shapes throughout the data lifecycle. In an organization, we have associated with this Data in some or the other form formal or informal way, and it impacts us in some or the other form. To manage this Data, we need some Data Governance mechanisms to control collaboration and bring value for us at the organizational or societal level.
On the Other hand, due to the rise in technology like Artificial intelligence(AI), IOT, Big Data, Cloud computing, Edge Computing, and so on around 90% of Data has been generated in the last 2 years, and to manage this Data Strong Data Governance is needed which is static in nature today.
The Success and Failure of an Organization depends on Data Maturity and to calculate this Data Maturity. To Conclude there are many Data Governance Software to support the business but when it comes to Data Governance there is On One Size Fits which is Big Risk, All Framework and these are currently customized or Tailored Framework which are also not that efficient in to cater new technology trends like Edge Computing or Cloud Computing so there is need to rethink redefine and redevelop improved framework considering Data science AI and ML Capabilities as a baseline to Mitigate this Risk.

Keywords: Data Governance Data Governance framework, Datam management Big Data Data analytic, Big Data, Data Model, Strategic Solution, Framework for Data Governance, Risk management, Risk Mitigation, Risk Plan

AIHEITTLR176

Quantum Machine Learning: A New Approach to Image Classification

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ABSTRACT

The rapid growth of data and the increasing complexity of tasks such as image classification necessitate the development of more efficient computational models. Quantum Machine Learning (QML) offers a promising new approach to these challenges by leveraging the principles of quantum computing to enhance traditional machine learning techniques. This paper explores the application of QML in image classification, discussing the underlying quantum algorithms, different quantum-based models for image classification, and the potential advantages over classical models. We present experimental results demonstrating the efficacy of QML models in optimizing image classification tasks and highlight future directions for this emerging field.

Keywords: Quantum Computing, Quantum Machine Learning, Image Classification, Artificial Intelligence

AIHEITTLR178

Cyber-attacks Detection and Prevention using Empowering AI Tools

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ABSTRACT

With more organizations entering the digital transformation sphere, the opportunities and risks in cyberspace have increased and gone up in levels of sophistication and occurrence. Many of these developments are attributed to the limits of existing cyber security solutions where addressing new threats require advanced detection technologies and its techniques. Cyber threats gained a new meaning and dimension with Artificial Intelligence coming into play in ways that supplement security systems in real time and even provide exceptive analysis. This research paper reviews various ways in which include but are not limited to the use of machine learning, deep learning and natural language processing techniques to analyze the effect and mitigation of cyber-attacks with a focus on AI systems. As a result, new threats go undetected because human behavior is ignored in the area of information security through AI systems and behaviors of the systems are to be undetected because machine speed behavior objectives are joined in a slim gap. For example, algorithms in regard to the machine learning mechanisms can also adapt instantaneously as and when new attack patterns arise improving the performance of the system over time, whereas system patterns that involve deep learning mechanisms allow efficiency in exploring and identifying complicated attacks through the use of complex data focused structures. In addition, natural language processing allows these intelligent systems to monitor communication channels, aviates phishing attempts, even recognize insider threats by scrutinizing communication patterns through text.

Keywords: Artificial Intelligence (AI), Cyber security, Machine Learning, Deep Learning, Cyber Attack Detection, Threat Prevention.

AIHEITTLR179

Evaluating Soybean Root Health Using Residual Neural Network (ReNN) Based Image Analysis

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ABSTRACT

ReNN's layer-wise image segmentation and robust data processing address the complexities of soybean root analysis, providing valuable insights for improved crop management. Accurate assessment of soybean root health is crucial for optimal crop production and growth. This study utilizes Residual Neural Network (ReNN) image evaluation to analyze soybean root development. By deploying sensor-based devices (IoT Devices), field data is collected and integrated to evaluate soybean crop stages. ReNN facilitates data preprocessing, layer-wise image segmentation, and effective data processing, enabling accurate assessment of root health, plant vigor, flower fragmentation, and fruit formation. This approach predicts soybean crop yield and provides valuable insights into degradation detection and decision-making for optimal soybean cultivation practices. ReNN utilizes layer-based image formation, collecting data from farm fields through sensor-based devices. The dataset encompasses various environmental and weather conditions, ensuring comprehensive coverage. Key considerations for data preprocessing include the Weather conditions (temperature, humidity, precipitation), Environmental factors (soil type, moisture, sunlight), Spatial variability (field location, soil heterogeneity), and Temporal variability (growth stage, seasonality) By integrating these factors, ReNN enables accurate evaluation of soybean root conditions, facilitating to root health assessment, Plant growth monitoring, Yield prediction, and Optimized cultivation practices

Keywords: Residual Neural Network, Internet of Things, Data Preprocessing, Neural Network.

AIHEITTLR180

Machine Learning-Based Framework for Efficient Detection and Mitigation of Low-Rate DDoS Attacks in Software-Defined Networking (SDN) Environments

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ABSTRACT

Software-Defined Networking (SDN) is a substantial shift in network architecture that decouples the control and data planes, resulting in more flexibility and programmability. However, this centralized paradigm exposes weaknesses, notably from low-rate Distributed Denial-of-Service (DDoS) assaults that consume resources such as flow tables and processing capacity in discrete steps. Low-rate DDoS assaults are difficult to detect because they might imitate legitimate traffic patterns. Current detection technologies, such as machine learning (ML) and intrusion detection systems (IDS), confront issues in computational efficiency, scalability, and adaptation to changing threats. This study tackles these issues by introducing a comprehensive methodology for detecting and mitigating low-rate DDoS assaults in SDN systems.

The framework uses a three-tiered approach: rule number prediction, attack detection, and mitigation. It combines advanced machine learning algorithms for real-time analysis of flow table characteristics with dynamic eviction mechanisms to reduce assaults while maintaining network speed. This study yielded enhanced detection accuracy, fewer false positives, and a resource-efficient architecture designed for large-scale SDN deployments. These contributions seek to improve the security and resilience of SDN networks to sophisticated low-rate DDoS attacks.

Keywords: Software-Defined Networking, Low-rate DDoS attacks, Flow Table Overflow, Machine Learning, Intrusion Detection System, Network Security, Attack Mitigation, Recurrent Neural Networks, Resource Efficiency, Network Scalability.

Track 2

AI Applications in Electrical and Electronics Engineering Education

Volume Editor: Professor Vikas Thada, vthada@gwa.amity.edu

AIHEITTLR133

Black Spots of Artificial Intelligence in Pedagogy of Higher Education Teaching Learning Process

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ABSTRACT

The integration of artificial intelligence in the pedagogy of higher education brings both promise and challenges. Among its notable drawbacks, several "black spots" emerge, raising concerns about its impact on the teaching and learning process. Firstly, AI can lead to a depersonalized educational experience. Over-reliance on automated tools may diminish essential human interaction, which is crucial for nurturing critical thinking, empathy, and collaborative skills. When students engage primarily with AI systems rather than instructors, the richness of human mentorship and discussion is lost. Second, AI algorithms can perpetuate biases, affecting student assessments and learning outcomes. If AI systems are trained on skewed data, they may unfairly disadvantage certain student groups, reinforcing existing inequalities within the educational system. Additionally, the misuse of AI can encourage academic dishonesty. Students might exploit AI to generate essays or complete assignments without fully grasping the subject matter, undermining genuine learning and intellectual engagement. Finally, there is the risk of over-standardization in teaching methods. While AI can optimize processes, it may inadvertently stifle creativity and diverse pedagogical approaches, leading to a one-size-fits-all model that fails to accommodate varied learning styles. To harness AI effectively, higher education must address these black spots while prioritizing a balanced, inclusive, and human-centred approach.

Keywords: Artificial Intelligence, Higher Education, Pedagogy, Teaching Learning, Skewed Data.

AIHEITTLR137

Design and Implementation of a Compact Bandpass Filter with Microstrip to Coplanar Waveguide Transition for UWB Applications

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ABSTRACT

This paper presents the design and implementation of an ultra-wideband (UWB) bandpass filter (BPF) with a wide passband ranging from 3.1 GHz to 10.6 GHz. The filter employs a combination of microstrip and coplanar waveguide (CPW) structures to achieve broadside coupling, ensuring a compact design suitable for integration into printed circuit boards (PCBs). Stepped-impedance resonators (SIRs) are utilized to enhance selectivity and suppress unwanted harmonics. The ground aperture was added to improve the filter's effectiveness. The ground aperture has been changed by a ring for the microstrip to CPW transition, and the conducting plane has been converted into CPW utilising parallel lines in the same plane. This filter provides the benefits of CPW. Compare and contrast the results of these two. The proposed filter demonstrates low insertion loss, high selectivity, and minimal group delay variation across the passband, making it ideal for UWB communication systems. Additionally, the design includes notch bands to reject specific frequencies, such as those used by WLAN, to prevent interference.

Keywords: Band pass filter, CPW, UWB, PCB, Stepped Impedance Resonator (SIR), Aperture

AIHEITTLR140

Expansion of Education's Horizon by the Implementation of Artificial Intelligent Techniques in Higher Education

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ABSTRACT

The integration of Artificial Intelligence (AI) in higher education is not only transforming traditional educational models but also expanding the horizons of how education is delivered and experienced. This paper explores the revolutionary impact of AI technologies in reshaping the landscape of higher education. By implementing intelligent algorithms, data analytics, and machine learning, institutions can create more personalized and adaptive learning environments that cater to the diverse needs of students. The study delves into key areas where AI is pushing the boundaries of educational possibilities: automated content delivery, predictive analytics for student performance, and AI-powered virtual assistants that provide on-demand support. Additionally, AI is enabling more dynamic forms of assessment, offering instant feedback and deeper insights into student progress, thus fostering continuous improvement in learning outcomes. This expansion is also enhancing the accessibility of education, making learning more inclusive for students with varied abilities and learning styles. While the potential benefits of AI are vast, the paper also examines the challenges that come with its implementation, including issues of equity, ethical use, and data security. The findings contribute to a broader understanding of how AI can drive the future of higher education, ultimately leading to more innovative, scalable, and efficient educational models.

Keywords: Artificial Intelligence, Higher Education, Personalized Learning, Adaptive Systems, AI in Education, Automated Assessment, Predictive Analytics, Education Innovation.

AIHEITTLR142

The Role of Artificial Intelligence in Shaping the Future: Innovations, Challenges, and Ethical Considerations

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ABSTRACT

Artificial Intelligence (AI) is rapidly becoming a central force in the development of various industries, reshaping everything from healthcare to finance, education, and beyond. This paper explores the latest innovations in AI, focusing on its transformative impact across diverse fields. From machine learning algorithms and natural language processing to computer vision and robotics, AI is revolutionizing processes, enhancing efficiency, and driving unprecedented growth. However, with this advancement come significant challenges, including ethical dilemmas related to privacy, data security, and algorithmic bias. The increasing reliance on AI also raises questions about its potential to displace jobs and fundamentally alter societal structures. This paper provides a comprehensive overview of AI's current capabilities, examines the ethical and societal challenges, and discusses the future directions of AI development, offering insights into how these technologies can be harnessed responsibly to benefit humanity. Furthermore, AI fosters innovative research methodologies by facilitating data analysis, predictive modelling, and fostering interdisciplinary collaboration. However, the widespread adoption of AI also raises ethical concerns, particularly around data privacy, algorithmic bias, and the evolving role of educators. This paper explores the transformative potential of AI in higher education institutions while addressing the challenges and opportunities it presents for stakeholders. The goal is to examine how AI can support a more inclusive, effective, and forward-thinking education system.

Keywords: Artificial Intelligence (AI), Machine Learning, Natural Language Processing (NLP), Robotics, Ethical AI, Data Privacy, Algorithmic Bias.

AIHEITTLR146

Energy Challenges in IoT-based Networks

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ABSTRACT

The Internet of Things and wireless sensor networks (WSNs) are widely employed for a variety of purposes. One of the several difficulties in implementing Internet of Things (IoT)-based WSNs is energy usage. Mobile wireless sensor networks (MWSNs) are now growing field, and researchers are working this field for various reasons. In comparison to static WSNs and MWSNs have longer lifetime of the network. The mobile nodes consume more power but dynamically they can collect data from various locations and so consumes less power and have more channel capacity due to its dynamic nature. The present work theoretically presented and analysers two unique MAC methods for efficient medium access control. These methods aim to maximize energy efficiency while maintaining the network connectivity without compromising with important parameters such energy consumption, detection range, and network stability. The proposed research work contributes to the efforts in the direction development of energy-efficient methods for the deployment of IoT-based networks.

Keywords: Internet of Things, Wireless Sensor Networks, Energy Consumption, and Network Lifetime.

AIHEITTLR158

Harnessing Artificial Intelligence in Higher Education: Revolutionizing Teaching, Learning, and Research

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ABSTRACT

The rapid integration of Artificial Intelligence (AI) in higher education is transforming traditional approaches to teaching, learning, and research. AI-powered tools are revolutionizing the way educators design curricula, assess student performance, and engage learners in personalized learning experiences. From adaptive learning systems to intelligent tutoring and automated grading, AI enhances student outcomes by catering to individual learning styles and needs. Furthermore, AI fosters innovative research methodologies by facilitating data analysis, predictive modelling, and fostering interdisciplinary collaboration. However, the widespread adoption of AI also raises ethical concerns, particularly around data privacy, algorithmic bias, and the evolving role of educators. This paper explores the transformative potential of AI in higher education institutions while addressing the challenges and opportunities it presents for stakeholders. The goal is to examine how AI can support a more inclusive, effective, and forward-thinking education system.

Keywords: Artificial Intelligence (AI), Higher Education, Personalized Learning, Adaptive Learning Systems, Intelligent Tutoring, Ethical Concerns in AI, Data Privacy.

Track 3

AI Integration in Applied Sciences Education

Volume Editor: Professor Vikas Thada, vthada@gwa.amity.edu

AIHEITTLR113

Post-Quantum Authentication for Energy Internet-Based Vehicle-to-Grid Communication with Federated Learning

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ABSTRACT

The rapid expansion of the Energy Internet and the integration of electric vehicles (EVs) through Vehicle-to-Grid (V2G) communication necessitate secure and efficient authentication mechanisms to protect against emerging cyber threats. As quantum computing advances, traditional cryptographic algorithms are at risk of being compromised, highlighting the need for post-quantum cryptography (PQC). This paper explores a post-quantum authentication framework for V2G communication within the Energy Internet, leveraging federated learning to enhance security and scalability. The proposed scheme utilizes lattice-based cryptography, a promising candidate for PQC, to ensure secure communication between EVs and the grid. Federated learning is integrated to train models across distributed devices without transferring sensitive data, thus preserving user privacy while improving authentication accuracy. We evaluate the framework's resilience against quantum attacks, its efficiency in real-time V2G scenarios, and its adaptability to large-scale energy systems. The results demonstrate that the proposed post-quantum authentication scheme provides robust security, scalable performance, and effective privacy preservation, making it a viable solution for future energy networks.

Keywords: Post-Quantum Cryptography, Vehicle-to-Grid Communication, Energy Internet, Federated Learning, Lattice-based Cryptography, Quantum Computing

AIHEITTLR144

Exponential-Based Similarity Measure for Pythagorean Fuzzy Sets: A Comparative Numerical Study

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ABSTRACT

In this research article, we address the challenge of uncertainty by applying Pythagorean fuzzy sets (PFSs), aiming to enhance the accuracy of similarity assessments in environments with uncertainty and imprecision. Pythagorean fuzzy sets, an extension of intuitionistic fuzzy sets, allow for greater flexibility in representing uncertainty by incorporating membership and nonmembership degrees with a squared sum constraint. The study introduces the use of three-sided standards and co-norms to summarize the basic connections between fuzzy sets (FSs), interval fuzzy sets, and Pythagorean fuzzy sets. By examining S-norms that maintain invariance across different standards, the research seeks to provide a deeper understanding of these relationships. In addition, an alternative method is proposed for determining the similarity between two Pythagorean Fuzzy Sets. The proposed similarity measure leverages an exponential function to capture subtle differences between PFSs more effectively. This approach contributes to the broader field of fuzzy logic by offering more precise tools for managing uncertainty and improving the analysis of complex systems involving imprecise or vague information. This study provides valuable insights into the practical applications of PFS in decision-making, pattern recognition, and data analysis, offering a more refined tool for handling fuzzy data.

Keywords: Similarity Measures, Pythagorean Fuzzy Sets, Exponential Functions, S-Norm

AIHEITTLR156

Convergence and Computational Approximate Solution of Non-Linear PDE's

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ABSTRACT

This research article proposed a computational technique to approximate the solution of Non-linear pdes. we used a collocation scheme of order 4th degree to approximate the solution of the Non-linear partial differential equation. To linearize the Non-Linear term of PDEs, we used the Rubin graves technique to discretize them. The crank-Nickolson scheme is used to discretize the system in space and time variants. Weather the time derivative terms in partial differential equation terms discretized by finite difference scheme. Von-Neumann stability condition established that the computational system is unconditionally stable for the given boundary condition and also stable for the compact considerable region. To check the authenticity of the scheme, convergence analysis is shown in this article, which is purely based on the L-p space norm. The outcome of the present scheme is very finer than the existing computational scheme.

Keywords: Finite Difference Scheme, Rubin Graves, Crank-Nickolson, Von-Neumann, Convergence Analysis.

AIHEITTLR157

Fixed Point Approximation of Asymptotically Nonexpansive Mapping Using Generalized Viscosity Implicit Scheme in Banach Spaces and Application in Optimization Problem

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ABSTRACT

Our focus in the present work is on introducing an iterative scheme based on the generalized implicit method and viscosity approximation method with Meir-Keeler contraction for solving a fixed point problem of an asymptotically nonexpansive mapping in the framework of Banach spaces. The strong convergence results of the proposed iterative scheme are established. An application based on convex minimization problem is derived from our main result. The numerical applicability and efficiency of our results are demonstrated using some examples. Our results extend, generalize and unify the previously known results given in the literature.

Keywords: Asymptotically Nonexpansive Mapping; Meir-Keeler Contraction; Implicit Iteration; Viscosity Approximation Method; Banach Space; Convex Minimization Problem

AIHEITTLR159

Dynamical exploration of a nutrient-plankton diffusive system incorporating nutrient recycling and toxicity

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ABSTRACT

This paper proposes a nutrient-plankton system with toxin-determined functional response (TDFR) and nutrient recycling. System dynamics is studied in both cases, i.e., the system with and without diffusion. In the absence of diffusion, we have derived boundedness and local stability of all the possible equilibrium points of the model system. Forward and backward bifurcation diagrams are obtained for the temporal system in order to understand the behavior of different parameters that control the system dynamics. We have performed the numerical computation for the diffusive nutrient-plankton system, and diffusion-induced Turing instability conditions are derived. The obtained spatial patterns show that the diffusion coefficients and time can change the spatial distributions, and the stationary wave appears in the whole domain.

Keywords: TDFR; Nutrient Recycling; Stability; Diffusion

AIHEITTLR160

Special Values of Hypergeometric Functions over Finite Fields

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ABSTRACT

Let p be a prime number, and let $\mathbb{F}_q$ be a finite field with $q = p^n$ elements. In this paper, we find finite field analogues of the classical complex-valued hypergeometric series ${}_4F_3$ and ${}_5F_4$ in the form of finite character sums, referred to as hypergeometric functions. Using this, we derive important identities and transformation formulas for hypergeometric functions. Furthermore, we discuss some special values of ${}_4F_3$ hypergeometric functions over the finite field $\mathbb{F}_q$. These special values are found by using properties of binomial coefficients and multiplicative characters.

Keywords: Character Sums; Hypergeometric Functions; Binomial Coefficient.

AIHEITTLR163

Asteroid Capture near about Earth and Lunar Gravity effect

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ABSTRACT

The study of asteroids is increasingly vital for understanding the solar system and accessing rare elements. This paper explores methods to capture asteroids, specifically Apollo and Aten types, into Earth's orbit while considering the gravitational influence of the Moon. Utilizing the two-body problem framework, we analyse two control methods: the slow-push technique with Hohmann transfer and the impulsive method for velocity adjustments. We detail the time of flight for rendezvous with Earth and examine the sensitivity of these methods.

Keywords: Fly-by, Slow-push, Impulsive, Lunar Gravity

AIHEITTLR164

Design and Development of Novel Nanocomoposite based Toxic Gas Sensor

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ABSTRACT

In the last few decades, serious environmental issues have been aroused due to massive industrialization, which poses continuing risks to human health and environment. Humans are exposed to various air toxins in the indoor and outdoor environment. Poor air quality is a well-known trigger for various health problems which can often result in life threatening and expensive emergency care. The latest WHO reports of 2016 and 2018 includes the poor air quality index of few Indian cities, including Gwalior and Delhi. Therefore, precise toxic gas sensing will not only bring a major benefit to industries but also to day-to-day life for all people. Toxic gases, such as NOx, SOx, H_2S and other S-containing gases, cause numerous harmful effects on human health even at very low gas concentrations. Reliable detection of various gases in low concentration is mandatory in the fields such as industrial plants, environmental monitoring, air quality assurance, automotive technologies and so on. Hydrogen sulphide (H_2S) gas is one of the major air pollutants that is produced in large quantity from petroleum/naturalgas drilling and refining, sewage treatment, paper milling, and land-fills. Sulphur dioxide (SO_2) is another most common air pollutant, mostly found as a mixture of sulphur oxides (SOx). In the last one decade, various efforts have been made on the sensor development, specifically for S-containing gases, by using variety of material like oxides, nanocomposites, polymers and 1D and 2D nanomaterials. However, the optimum solution is still awaited as the industry faces the challenges of early detection, detection limit, response and recovery time, sensitivity and selectivity. In few recent efforts the Zinc Ferrite Nanoparticles with few polymers have been attempted for H_2S and other toxic gases and hence the present attempt is to use other Transition metal (Ni, Co, Mn) ferrites' nanoparticles (NPs) in organic polymer (PANI), for their possible exploitation as adsorbent for few S-containing gas sensing. The present proposal has been designed by looking at the expertise of each individual in terms of computational and real-time designing and development of nanomaterials as sensors.

The analysis will be focused on meeting the current challenges of the sensor industry, like cost effective, low-concentration detection, operation at room temperature, and reusability for field deployment. Specifically, the sensitivity, selectivity, detection limit and response time, will be measured in terms of various electronic properties.

Keywords: TSDC, Activation Energy, PVK, FTIR, PMMA

AIHEITTLR165

Time fraction Non-linear PDE's approximate by using a Computational scheme

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ABSTRACT

In this article, we propose a computational scheme purely based on the collocation in a Shishkin mesh-based method. To discretize the non-linear term of the PDEs, Rubin-Graves techniques were adopted. The time derivative term is discretized by the finite difference scheme, while the remaining terms of the partial differential equation are discretized using Taylor expansion. To check the stability of the system, Von Neumann stability analysis was proposed. Convergence analysis states that the system is unconditionally stable for larger numbers of space and time nodes. A comparison of three examples is provided in this article, which shows that the present scheme is highly efficient and accurate in dealing with such types of problems.

Keywords: Convergence Scheme, Partial Differential Equation, Shishkin Mesh and Crank-Nickolson

AIHEITTLR166

Transformative Applications of Artificial Intelligence in Modern Chemistry

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ABSTRACT

Artificial Intelligence (AI) is revolutionizing the field of chemistry, enabling breakthroughs in research and industrial applications through data-driven insights and computational power. One of the most impactful areas is drug discovery, where AI accelerates the identification of potential drug candidates by predicting molecular interactions, reducing the time and cost of traditional trial-and-error methods. In material design, AI aids in the development of novel materials, including catalysts and polymers, by predicting their properties and guiding synthesis.

AI also plays a crucial role in molecular property prediction, where algorithms forecast attributes like solubility and reactivity based on molecular structures, streamlining the experimental process. Additionally, AI is utilized in chemical reaction prediction, allowing chemists to anticipate reaction outcomes and side products with high accuracy, which enhances synthesis efficiency. Automated synthesis planning is another key application, where AI suggests the most effective and economical reaction pathways for chemical production.

In quantum chemistry, AI accelerates the calculation of molecular electronic structures, offering deeper insights into chemical behavior. The technology is also applied to environmental chemistry, where AI models predict pollutant behavior and optimize remediation efforts. Furthermore, AI facilitates spectroscopic data analysis by automating the interpretation of complex data, such as NMR and IR spectra, improving structural identification.

In terms of safety, AI contributes to toxicology and safety assessments by predicting the toxicity of chemicals, minimizing the need for animal testing. Finally, AI enables the creation of personalized chemical solutions, tailoring products like pharmaceuticals and cosmetics to individual needs. These applications highlight AI's transformative potential in advancing both academic research and industrial chemistry.

Keywords: Artificial Intelligence, Drug Discovery, Material Design, Molecular Property Prediction, Chemical Reaction Prediction, Automated Synthesis, Quantum Chemistry

AIHEITTLR169

Emerging trends of Artificial intelligence in material Prediction for Energy Storage Application

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ABSTRACT

The integration of Artificial Intelligence (AI) into material synthesis and storage prediction represents a paradigm shift in materials science, enabling unprecedented advancements in efficiency and innovation. AI-driven approaches, including machine learning and deep learning algorithms, facilitate the rapid discovery and optimization of novel materials by analyzing complex datasets to predict properties and performance. In the context of material synthesis, AI enhances high-throughput experimentation and automates the identification of promising candidates tailored for specific applications, such as catalysis and advanced electronics. Simultaneously, AI contributes to energy storage technologies by predicting the behavior of materials in batteries and supercapacitors, optimizing their design for enhanced energy density, cycle life, and durability. Moreover, the incorporation of AI in real-time data analysis, particularly within IoT frameworks, enables adaptive management of storage systems, improving efficiency and reliability. Despite existing challenges, such as data standardization and interdisciplinary collaboration, the potential of AI to revolutionize material synthesis and storage prediction is vast, promising significant strides toward sustainable technological solutions and advanced materials for the future. This review explores current methodologies and future prospects for harnessing AI in these critical areas.

Keywords: Iot Frameworks, Durability, Energy Density, Power Density, Batteries, Supercapacitors.

AIHEITTLR175

Unveiling the potential of AI in designing advanced materials

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ABSTRACT

The use of Artificial Intelligence (AI) in materials science in coherence with advancements in Machine Learning techniques (ML) has been rigorously used for development of new materials. Designing of Advanced materials with desired properties is a key challenge in field of Radiation dosimetry, notably the traditional trial-and-error approach to materials design is time-consuming. Subsequently AI can be employed to predict required properties, optimize desired design by incorporating requisite constraints such as band gap, temperature, dose, cost and environmental impact. With the use of ML algorithms it is possible to identify (i) promising material candidates for specific applications from available databases of known materials, (ii) optimal material compositions and structures for specific applications (iii) predict their potential properties. Thus, AI/ML contributes to more efficient and cost-effective materials design and discovery. Presented paper will highlight transformative Impact of AI on development of advanced materials.

Keywords: Advanced Materials, AI, ML

AIHEITTLR181

The Role of Artificial Intelligence (AI) in Shaping the Future of Higher Education: Opportunities and Challenges

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ABSTRACT

The emergence of Artificial Intelligence (AI) in modern developed society (MDS) has become a transformative force across various sectors, including marketing, design, entertainment, science, modelling and higher education. AI technologies, such as ChatGPT, which is based on Large Language Models (LLMs) and Natural Language Processing (NLP), represent a significant leap in AI advancements. Tools like DALL-E and Google's BARD open up new opportunities and pose challenges for higher education institutions (HEIs).

In education, AI-powered tools have the potential to revolutionize teaching, learning and research by automating processes, enhancing creativity and providing innovative methods for academic assessment. Technologies such as Adaptive Learning Platforms (ALP), Intelligent Tutoring Systems (ITS) and Virtual Assistants (VA) enable personalized instruction, addressing the unique needs of each student and improving engagement and learning outcomes.

However, the increasing integration of AI in higher education also raises important ethical concerns. Issues related to data privacy, potential biases in AI systems and the evolving role of human educators in AI-driven environments are critical areas for consideration. Research into the current applications of AI in academia aims to assess its benefits, address challenges and provide insights into how AI can reshape higher education systems (HES) in the future. By embracing AI, HEIs can enhance efficiency and foster innovation, preparing students for a technology-driven future while ensuring a balance between automation and human guidance.

Keywords: Artificial Intelligence, Higher Education Institutions, Large Language Models, Natural Language Processing, Adaptive Learning Platforms, Intelligent Tutoring Systems, Virtual Assistants, Academic Innovation, Data Privacy, AI Ethics, Personalized Learning, Technology-Driven Education, Educational Automation.

Track 4

AI-Enhanced Mechanical Engineering and Civil Engineering Education

Volume Editor: Professor Vikas Thada, vthada@gwa.amity.edu

AIHEITTLR127

Fiber Reinforced Polymer Composite materials and Their Damage Detection Using AI Techniques for Aerospace Application

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ABSTRACT

Composite materials, particularly Carbon Fiber Reinforced Polymers (CFRP) and Glass Fiber Reinforced Polymers (GFRP), have gained prominence in aerospace applications due to their high strength-to-weight ratio, corrosion resistance, and design flexibility. However, the detection and evaluation of damage in these materials remain challenging due to their heterogeneous structure and complex failure modes. Traditional non-destructive testing (NDT) methods often require extensive labor and can fail to detect subsurface or micro-level damage.

Recent advances in Artificial Intelligence (AI) and machine learning have revolutionized damage detection techniques by automating and enhancing the accuracy of damage prediction in composite materials. AI-driven models, coupled with real-time data from sensors such as acoustic emission, ultrasonic waves, and infrared thermography, provide a powerful framework for early damage detection and prognosis. These techniques allow for the identification of minute defects and stress points that traditional methods might overlook, thus improving the overall safety and reliability of aerospace structures.

This paper reviews the latest AI techniques for damage detection in composite materials. It highlights their application in aerospace and discusses how integrating AI with traditional NDT methods can lead to more effective, real-time monitoring systems. The implications of these advancements in improving the durability, safety, and efficiency of aerospace components are explored, with suggestions for future research directions.

Keywords: Composite Materials, Damage Detection, Artificial Intelligence (AI), Machine Learning, Aerospace Applications, Non-Destructive Testing.

AIHEITTLR129

Investigation of Fiber-Reinforced PLA Composites in Fused Filament Fabrication for Improved Mechanical Properties

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ABSTRACT

Fused Filament Fabrication (FFF) offers great versatility in producing complex geometries; however, the mechanical properties of printed parts often limit their broader adoption in functional applications. This paper explores the reinforcement of Polylactic Acid (PLA) with short carbon fibres to enhance its mechanical properties, such as tensile strength, stiffness, and impact resistance. The study involves the development of PLA-carbon fiber composite filaments, optimized for FFF processes. Mechanical testing, microscopic analysis, and thermal characterization are conducted to understand the impact of fiber content and distribution on printed part performance. Results show a significant improvement in mechanical properties without compromising the print quality or process stability. These findings provide valuable insights into the use of fiber-reinforced PLA in structural and load-bearing applications, opening up new avenues for high-performance FFF components.

Keywords: Fused Filament Fabrication, PLA Composites, Carbon Fiber Reinforcement, Mechanical Properties, Tensile Strength, Impact Resistance,3D Printing, Additive Manufacturing, Fiber-Reinforced Materials, Structural Applications

AIHEITTLR130

Optimization of Print Parameters in Fused Filament Fabrication for Enhanced Mechanical Properties of PLA Components

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ABSTRACT

Fused Filament Fabrication (FFF) has become a widely used additive manufacturing technique due to its accessibility and cost-effectiveness. However, optimizing print parameters such as layer height, infill density, and nozzle temperature is critical to achieving superior mechanical properties in printed parts. This study investigates the influence of these parameters on the tensile strength, surface finish, and dimensional accuracy of Polylactic Acid (PLA) components. Using Design of Experiments (DOE) and statistical analysis, optimal settings are identified, leading to significant improvements in material performance. Furthermore, the paper examines the relationship between print settings and post-processing techniques to enhance part quality. The findings contribute to the development of robust FFF workflows for both prototyping and end-use applications.

Keywords: Fused Filament Fabrication, PLA, Print Parameters, Mechanical Properties, Tensile Strength, Surface Finish, Dimensional Accuracy, Optimization, Design Of Experiments (DOE), Additive Manufacturing.

AIHEITTLR132

AI Progressions in Composite Materials: Revolutionizing Design, Manufacturing, and Performance

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ABSTRACT

Integrating Artificial Intelligence (AI) in composite materials research has rapidly transformed the field, driving significant advancements in materials design, optimization, and manufacturing processes. AI-driven methodologies, such as machine learning (ML) and deep learning, enable predictive modeling, data-driven material discovery, and enhanced performance analysis. These technologies help optimize the selection of constituent materials and predict the properties of composites with high accuracy, reducing experimental time and costs. In manufacturing, AI enables automated control systems that improve production efficiency and quality by predicting defects and optimizing process parameters. AI's ability to analyze vast datasets accelerates the development of new composite materials with tailored mechanical, thermal, and chemical properties, opening avenues for innovations in industries like aerospace, automotive, and renewable energy. As AI continues to evolve, its role in the composite materials sector is expected to expand, offering more intelligent systems for real-time monitoring, adaptive manufacturing, and sustainability-driven material design. This paper explores the state-of-the-art AI applications in composite materials, addressing current challenges and future prospects.

Keywords: Artificial Intelligence (AI), Composite Materials, Machine Learning (ML) Materials Optimization

AIHEITTLR138

Elasto-Plastic Finite Element Analysis of Stresses in the Pillar Zone of Deep Interacting Tunnels – A Comparative Study

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ABSTRACT

The purpose of the present study is to carry out a parametric study and compare the stresses developed in the pillar zone of twin interacting horse shoe tunnels and twin interacting circular tunnels with different W/D and Ko conditions in the rock mass. The plain strain elastic and elasto-plastic finite element analysis with Hoek-Brown yield criterion have been performed. Three pillar width (W) to diameter (D) ratios (W/D) as 0.3, 0.6 and 1.2 have been introduced for each of three considered insitu stress ratio (Ko) as 0.5, 1.0 and 1.5 in the rock mass. The tunnels have been considered to be excavated simultaneously. Variation of principal stresses in the pillar zone and at the tunnel boundary have been studied in the analysis. The results have also been compared with the results of that of excavation of a single tunnel. It has been concluded that for lower W/D ratio of 0.3 and for all in-situ stress ratios, the maximum principal stresses developed in case of twin circular tunnels are significantly larger than that of twin horse shoe tunnels at both the boundary of tunnels and centre of pillar zone. But as the W/D ratio increases to 0.6 or higher the pattern reverses at the centre of pillar zone only for insitu stress ratio of 1.0 or more. From the study of elastic and elasto-plastic analysis as well as single and interacting tunnel analysis, it is concluded that at the tunnel boundary the difference in maximum principal stresses are higher for circular tunnels than that of horse shoe tunnels for all W/D and Ko ratios. But at the centre of pillar zone the differences are higher for horse shoe tunnels for W/D ratio of 0.6 or more and insitu stress ratio of 1.0 or more.

Keywords: Drucker-Prager criterion, finite element analysis, horse shoe tunnel, in-situ stress ratio, Mohr-Coulomb criterion, pillar width.

AIHEITTLR139

Using explainable AI to improve photovoltaic material prediction modeling of solar power conversion efficiency

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ABSTRACT

The rapid advancement of photovoltaic (PV) technologies has heightened the need for accurate prediction and optimization of solar power conversion efficiency (PCE). Traditional modeling approaches often struggle to capture the complexity of material interactions, limiting the potential for breakthroughs in PV material design. In this context, Explainable Artificial Intelligence (XAI) emerges as a powerful tool to enhance predictive modeling by providing deeper insights into the underlying mechanisms driving PCE in photovoltaic materials. This paper presents a novel approach that integrates XAI techniques into predictive models, enabling more accurate and interpretable predictions of PCE. By leveraging XAI methods such as SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-agnostic Explanations), the proposed model offers not only high prediction accuracy but also transparency in the decision-making process. This transparency fosters better understanding and trust among researchers and material scientists, facilitating the discovery of new PV materials with improved efficiency. The results demonstrate significant improvements in PCE predictions and highlight key material properties that contribute to performance optimization. This research underscores the potential of XAI to drive innovation in the field of renewable energy by bridging the gap between complex machine learning models and human interpretability.

Keywords: Photovoltaic Materials, Solar Power Conversion Efficiency, Predictive Modeling, Explainable AI, SHAP, LIME, Renewable energy.

AIHEITTLR148

Comparative Studies on Structures with a Tuned Mass Damper and a Particle Damper

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ABSTRACT

In recent years, much attention has been paid to the research and development of a new kind of passive control device named a particle damper, which has a very similar configuration and application method to the tuned mass damper; however, the damping mechanisms are different. Hence, systematic comparative studies on these dampers are very important for future applications. In this paper, three cases including single-degree-of-freedom structure, 5-story linear-elastic steel frame and 25-story nonlinear benchmark building, are used as primary structures to compare the structural performance with optimal tuned mass damper and optimal particle damper. The optimal parameters of the particle damper are designed by a differential evolution algorithm and the optimal parameters of the tuned mass damper are designed by the classical Den Hartog theory, providing the same additional mass. The numerical simulation shows that the properly designed particle damper certainly has better vibration control effect than that of the optimal tuned mass damper, not only for elastic performance indexes, but also for nonlinear performance indexes, such as the number and maximum rotation of plastic hinges, and energy dissipation of components. Moreover, the more obvious advantages are that, compared with the optimal tuned mass damper system, the optimal particle damper can significantly reduce the relative displacement between primary structure and the damper itself, as well as its better robustness

Keywords: Tuned Mass Damper; Particle Damper; Optimization; Passive Control; Vibration Control; Numerical Simulation.

AIHEITTLR149

Smart Concrete structures with Sensors And Software

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ABSTRACT

Energy saving and maximum occupant's comfort can be achieved by smart buildings. Buildings and roads made with i nert materials cement and concrete are now associated with software and sensors for optimizing the facilities and now associated with AI also. This review paper analyses how new technologies of Electronics and computer Engineering, AI are incorporated in modern construction works. Now your houses can not be separate entity from other structures of the surroundings. Smart Grid is new concept in which all buildings of the city are connected in such a way that all energy-need can be fulfilled by all connected energy sources Electricity, Gas etc. Network of sensors and software and AI will be in dominating role in every energy operation in a building. Automation and Robotics is becoming important part of construction work in dangerous situations. In high-rise buildings outer surface plastering painting, repairing is being done by tiny robots.

Keywords: Smart Buildings, Sensors, Network, Robotics, AI.

AIHEITTLR150

Quantitative evaluation of the concentration of heavy metals and the associated risk analysis in the urban soil of Gwalior and Dabra, MP, India

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ABSTRACT

The prevalence of heavy metal pollution in soil has increased globally as a result of increased geological and anthropogenic activity. The current investigation of soil pollution has been conducted in the region of Dabra a town near to Gwalior, which is city of Madhya Pradesh, India. This study's goals are to measure the levels of heavy metals in specific areas of Dabra and Gwalior locales, evaluate the risks connected to these areas, determine the cancer risk, and do statistical association analysis for employees who visit or work there.

This study investigates the concentration of heavy metals in urban soils of Gwalior and Dabra, Madhya Pradesh, India, and evaluates the associated ecological and health risks. Soil samples were collected from various sites, including residential, industrial, and agricultural areas. Using inductively coupled plasma mass spectrometry (ICP-MS), the concentrations of heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), nickel (Ni), and arsenic (As) were quantified. The results revealed significant variations in metal concentrations, with industrial sites showing the highest levels of contamination. Risk assessment was conducted using the United States Environmental Protection Agency (USEPA) guidelines, calculating hazard quotients (HQ) and potential ecological risk indices (PERI). Findings indicated that certain heavy metals pose a considerable risk to human health and the environment, particularly in areas adjacent to industrial activities. This study underscores the need for targeted remediation strategies and policy interventions to mitigate heavy metal pollution in urban soils, thereby protecting public health and promoting sustainable urban development.

Keywords: Heavy Metals, Sustainable Development, Risk Assessment, Quantitative Evolution

AIHEITTLR152

Utilization of Construction Demolition Wastes in Paver Blocks

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ABSTRACT

The increasing volume of construction and demolition waste (CDW) presents significant environmental challenges, necessitating innovative approaches to waste management. This study investigates the utilization of CDW as a sustainable alternative in the production of paver blocks, aiming to reduce landfill disposal and minimize the depletion of natural resources. Various forms of CDW, including concrete, bricks, ceramics, and asphalt, were collected and processed for incorporation into paver block formulations. The research involved a series of experiments to evaluate the mechanical properties, durability, and workability of the paver blocks produced with varying proportions of CDW. Standard tests, such as compressive strength, water absorption, and abrasion resistance, were conducted to assess performance against conventional paver blocks. Results indicated that paver blocks containing up to 30% CDW could achieve compressive strengths comparable to those made from traditional aggregates, while also demonstrating improved resistance to environmental degradation. Moreover, the environmental impact assessment revealed a significant reduction in carbon footprint and resource consumption associated with CDW-based paver blocks. By repurposing waste materials, the production process not only alleviates the burden on landfills but also fosters a circular economy within the construction industry. The study further emphasizes the importance of developing standards and guidelines for the safe and effective use of CDW in construction applications. In conclusion, the integration of construction demolition waste into paver block production is not only feasible but also beneficial for sustainable urban development. This research advocates for policy changes and industry adoption of CDW utilization practices, contributing to more resilient and environmentally friendly infrastructure solutions. Future work will explore optimization techniques and broader applications of CDW in various construction materials.

Keywords: Block Production, CDW, Infrastructure, Environmental Impact.

AIHEITTLR154

A Critique on Unbridled Application of Artificial Intelligence in Mechanical Engineering Practices and Research

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ABSTRACT

Integrating Artificial Intelligence (AI) into mechanical engineering research has revolutionized various processes, enhancing efficiency and precision in design, simulation, and manufacturing. However, the negative implications of AI adoption in this field warrant critical examination. This paper explores the adverse effects of AI on mechanical engineering research, highlighting concerns related to over-reliance on automated systems, ethical dilemmas, data security, and workforce displacement.

One significant concern is the over-reliance on AI systems, which may lead to a decline in fundamental engineering skills. As AI algorithms become increasingly sophisticated, there is a tendency for researchers to depend heavily on these tools, potentially diminishing their problem-solving abilities and critical thinking skills. This dependence can result in a lack of understanding of underlying principles, making engineers vulnerable to errors when confronted with unexpected challenges not adequately addressed by AI.

Ethical dilemmas also emerge with the use of AI in mechanical engineering research. The implementation of AI can inadvertently perpetuate biases present in training data, leading to flawed conclusions and designs. This raises questions about accountability when AI systems produce erroneous results, complicating the ethical landscape of engineering research. The challenge lies in ensuring that AI systems are designed with fairness and transparency in mind, yet the rapid pace of AI development often outstrips the establishment of comprehensive ethical guidelines.

Data security is another critical concern, as AI systems rely on vast amounts of data for training and operation. The collection and storage of sensitive data pose significant risks, particularly in industries such as aerospace and automotive engineering, where proprietary information can be targeted by cyber attacks. Breaches can lead to the loss of intellectual property and compromise the integrity of research findings, thereby undermining the trustworthiness of the engineering profession.

Furthermore, the rise of AI in mechanical engineering raises concerns about workforce displacement. As automated systems take over tasks traditionally performed by human engineers, there is a growing fear of job losses and skill obsolescence. While AI can enhance productivity and innovation, it also poses challenges for workforce development and training. The transition to AI-driven processes necessitates a re-evaluation of educational curricula and training programs to equip engineers with the skills needed to coexist with AI technologies, rather than be replaced by them.

Keywords: Artificial Intelligence, Mechanical Engineering, Automation, Data Security, Innovation, Workforce Development, Research Ethics.

AIHEITTLR168

Experimental Investigations for Reduction of Defects in MIG Welding Process

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ABSTRACT

An experimental analysis has been tested to understand the roll of process parameter of MIG welding on under frame assembly components. Three important process parameter like a current, voltage and rate of gas flow MIG Welding process were used to reduce the welding defects in under frame assembly components. Taguchi method approach has been adopted to identify the process parameter level to have reduced welding defects in under frame assembly components. The experimental results coupled with ANOVA results to identify the factors having the significant for reduction of welding defects in under frame assembly components. The experiments conformation predicted conducted with level of factors proved to be worthy.

Keywords: Metal Inert Gas Welding (MIG), Gas Metal Arc Welding (GMAW), Metal Active Gas (MAG), Post weld heat treatment (PWHT), Inter metallic compound (IMC)

AIHEITTLR177

Vulnerability Assessment and Consequence Analysis in Oil & Gas Refineries – An Approach toward Accident Prevention Using FLACS Software

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ABSTRACT

In India, the country that consumes the third most oil globally, oil and gas refineries play a crucial role in the energy industry and the country's economy. India's economy, which is expanding quickly, is mostly dependent on petroleum products to supply its energy needs for transportation, industry, and households. Thus, refineries are essential to maintaining the security and stability of the energy supply. But the handling of hazardous and combustible materials in harsh environments makes these facilities also extremely dangerous. These refineries are prone to catastrophic events like fires, explosions, and hazardous discharges because they process combustible gases and liquids under extreme pressure and heat, have disastrous effects on both human lives and financial losses. These hazards are significant for an emerging country like India, where safety rules and infrastructure are still developing. To effectively mitigate these risks, consequence analysis and vulnerability assessment are essential. FLACS (Flame Acceleration Simulator), advanced Computational Fluid Dynamics (CFD)-based modeling software, is widely used for simulating accidental release scenarios and assessing their impacts. This paper outlines the importance of vulnerability assessment in oil and gas refineries and demonstrates how FLACS software can be applied for detailed consequence analysis. The paper outlines the pressing need for advanced risk management in Indian refineries, highlighting the dual goals of improving safety and minimizing economic disruption. FLACS software, as a sophisticated tool for consequence analysis, is positioned as a vital asset in achieving these objectives and supporting India's broader ambitions of energy security and sustainable economic growth.

Keywords: Vulnerability Assessment, Consequence Analysis, Accident Prevention, FLACS Software, Explosion Modeling.