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Message from President

It is my profound pleasure to extend warm greetings to all participants, researchers, academicians, industry professionals, and delegates attending the International Conference on Artificial Intelligence in Engineering Systems (ICAIES2025). Organized by Rajeev Institute of Technology, Hassan, this conference reflects our strong commitment to academic excellence, innovation, and global research collaboration.

ICAIES2025 provides a dynamic platform for the exchange of ideas, presentation of original research, and discussion of emerging trends in artificial intelligence, engineering systems, and interdisciplinary technologies. In an era defined by rapid technological transformation, such scholarly gatherings play a vital role in bridging academia and industry while addressing real world challenges.

The conference fosters intellectual dialogue, collaborative research, and knowledge dissemination that contributes meaningfully to societal and technological advancement. I am confident that the deliberations and interactions during ICAIES2025 will inspire new research directions and enduring partnerships.

I wish all participants a stimulating and rewarding conference experience and every success in their academic endeavors.

- Dr. Rachana Rajeev
President

Message from Vice-President

It gives me immense pleasure to welcome all delegates, researchers, academicians, and industry professionals to the International Conference on Artificial Intelligence in Engineering Systems (ICAIES2025) at Rajeev Institute of Technology.

This conference serves as an important forum for discussing innovative research and emerging developments in artificial intelligence and engineering systems. ICAIES2025 brings together a distinguished community of scholars and practitioners, encouraging interdisciplinary dialogue and collaborative exploration of solutions to global technological challenges.

Rajeev Institute of Technology is dedicated to nurturing innovation, promoting research culture, and strengthening academia industry engagement. Conferences such as ICAIES2025 play a pivotal role in achieving these objectives by facilitating knowledge exchange and fostering meaningful partnerships.
I am confident that the conference will provide valuable insights, inspire innovation, and contribute to academic and professional growth. I wish all participants fruitful deliberations and a successful conference experience.

- Dr. Ranjith Rajeev
Vice President

Message from Secretary

On behalf of the organizing committee, I extend a warm welcome to all participants of the International Conference on Artificial Intelligence in Engineering Systems (ICAIES2025). It is a privilege for Rajeev Institute of Technology to host this prestigious international academic event.

ICAIES2025 has been carefully designed to provide a robust platform for researchers and professionals to present high quality work, exchange ideas, and explore advancements in engineering and intelligent systems. The conference emphasizes academic rigor, ethical research practices, and global collaboration.

Such scholarly engagements are instrumental in strengthening the research ecosystem and fostering innovation that benefits industry and society alike. I sincerely appreciate the efforts of authors, reviewers, committee members, and participants whose contributions ensure the success of this conference.

I wish all attendees an enriching and productive experience at ICAIES2025.

- Dr. B N Rathna
Secretary & Treasurer

Message from Principal

It is a great pleasure to welcome you to the International Conference on Artificial Intelligence in Engineering Systems (ICAIES2025) at Rajeev Institute of Technology, Hassan.

The conference highlights our institution's commitment to academic excellence, research innovation, and interdisciplinary collaboration. ICAIES2025 brings together academicians, researchers, and industry experts to deliberate on cutting edge developments and future directions in artificial intelligence and engineering technologies.

By fostering scholarly interaction and collaborative research, this conference aims to inspire impactful outcomes that address contemporary challenges. Rajeev Institute of Technology continually strives to empower faculty and students to engage in meaningful research and contribute to technological advancement.

I extend my best wishes to all participants for a successful and rewarding conference. May ICAIES2025 serve as a catalyst for innovation, knowledge sharing, and enduring academic partnerships.

- Dr. Mahesh P K
Principal

Message from General Chair

At the outset, it is my honour to convey gratitude to the *Rajeev Institute of Technology, Hassan, Karnataka, India* for support and encouragement to organise the **International Conference on Artificial Intelligence in Engineering Systems (ICAIES 2025)**, during 26th -27th December 2025.

It is my pleasure and privilege to present you the proceeding of the international conference in a bound volume, for the benefit of the participants and others. The main objective of the conference is to bring together researchers, scientists, engineers, academicians and research scholars under one place to discuss the challenges encountered and the solutions adopted in the field of Artificial Intelligence in Engineering Systems.

I thank to our beloved President, Dr. Rachana Rajeev, and Secretary, Dr. B N Rathna for his continuous encouragement from time to time in conducting this conference.

I thank to principal, Dr. Mahesh P K, for supporting to organise this conference

I thank to Dr. D Rammurthy, Technical Program Chair and Dean Academics for supporting to organise this conference

I whole heartedly acknowledge the keynote speakers, session chairs and reviewers for their salient contributions and thank them for making themselves available for the conference. I also thank eminent contributors from various institutions across the country for the submission of original research work for being presented in the conference.

I thank all the authors of the papers and participants in the conference for making the conference a grand success.

All the accepted papers will be published in conference proceedings with ISBN Number, Springer LNCS series and high quality and selected papers will be published in the Scopus/SCI Indexed Journals.

-Dr. P. Chandra Babu Naidu
General Chair

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Real-Time Fault Diagnosis in EV Power trains Using Hybrid Quantum-Classical Models

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ABSTRACT. Strong fault diagnostic systems are therefore essential for electric vehicle (EV) powertrains to guarantee dependability, safety, and best performance. This work provides a new hybrid quantum-classical method for real-time defect identification and diagnostics in electric vehicle powertrays. Our approach uses the parallelism of quantum computing for sophisticated pattern recognition and employs classical methods for system integration and deployment. The proposed system blends classical machine learning methods for fault classification with quantum neural networks (QNNs) for feature extraction. Maintaining a latency of 15 milliseconds, experimental validation on a fleet of commercial electric vehicles shows that this hybrid technique achieves 97.3% accuracy in recognizing important powertrain problems including battery cell degradation, inverter anomalies, and motor bearing failures. Our hybrid model reduces false positives by 31% and demonstrates a 23% improvement in early defect detection timing when compared to just classical techniques. Comprising heat, vibration, electrical, and acoustic sources, the architecture effectively analyzes multimodal sensor data to enable complete powertrain health monitoring. This work provides a practical route for applying quantum-enhanced diagnostics in resource-limited automotive systems, thereby prolonging battery life and lowering maintenance costs and so increasing general EV dependability.

KEYWORDS: Quantum-classical computing, Electric vehicle powertrains, Fault diagnosis, Real-time monitoring, Hybrid modeling, Predictive maintenance

Wind and SOFC Based Hybrid Bidirectional EV Charging Infrastructure

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ABSTRACT. Production of electricity using Non- conventional sources along with the conventional sources and their transmission from one end to another involves power conversion at multiple stages in the power system. This power conversion somewhere leads into the deterioration of power quality and enhancement of losses in the power system.In order to reduce these losses and maintain power quality by reduction in the harmonic components to maintain the life of electrical components

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a simulation model has been made in the proposed system using two non-Conventional power sources in synchronization with the grid. In this simulation model performances of three DC-DC converters have been analyzed in terms of Harmonics, etc.

KEYWORDS: *Hybrid power system, EV*

Advances in Low Power Area Efficient SRAM Design for Computing in Memory Applications – A Comprehensive Review

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ABSTRACT. Compute-In-Memory (CIM) is a way to do calculations within memory arrays versus transferring data to a processor or large cache memory. This reduction in data transfers comes with a reduced latency and energy cost. CIM has been implemented using popular memory technologies like SRAM, DRAM, ReRAM, and Flash. However, each has significant shortcomings; refreshing information in DRAM, endurance and variability in ReRAM and Flash, and the complexity of large-scale integration. SRAM is viewed as the best fit due to access speeds, CMOS compatibility, reliable operation, and reasonable area in large-scale integration. SRAM-based CIM has its challenges, including stability relying on supply voltage, variation due to process, leakage power and long-term reliability. This review paper discusses the fundamental role of SRAM in CIM applications while illustrating progress overcoming these challenges. The review must conclude with the categorizations of enabling SRAM-based CIM technologies in ways that were previously never possible while improving energy efficiency, performance, and reliability.

KEYWORDS: Compute-in-Memory (CIM), SRAM, DRAM, ReRAM, Flash Memory, Low-Power Design, Memory Stability, Reliability.

Advanced Energy Management for Hybird (Pv-Wind-Battery) Microgrid

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ABSTRACT. In the context of growing energy demands and the global transition toward renewable energy sources, hybrid microgrids integrating wind, photovoltaic (PV), and battery systems present a promising solution for sustainable and reliable power generation. In order to maximize the performance of hybrid wind-photovoltaic-battery microgrid, this research presents an advanced energy management system (AMES). The proposed system leverages real time data processing and predictive algorithms to enhance energy efficiency, ensure load balance, and minimize reliance on conventional grid infrastructure. Key features include dynamic load forecasting, adaptive power dispatch strategies, and state-of-charge management for batteries. The AEMS also incorporates fault-tolerant mechanisms to ensure uninterrupted power supply during adverse environmental conditions or component failures. Simulation results demonstrate the system's effectiveness in improving energy utilization, reducing operational costs, and lowering greenhouse gas emissions. This research provides a robust framework for advancing hybrid microgrid technologies and contributes to achieving global sustainability goals.

KEYWORDS: Advanced energy management system, hybrid microgrid, wind energy, photovoltaic (PV), battery storage, renewable energy, power optimization, load forecasting, state-of-charge management, sustainability, energy efficiency, real time control, fault-tolerant system, greenhouse gas reduction, adaptive power dispatch.

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Advance Road Navigation System For Autonomous Vehicle In Adverse Weather Condition Using Deep Learning

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ABSTRACT. Self-driving under adverse weather conditions continues to be a significant challenge because of compromised sensor input and low visibility. This paper introduces a self-supervised deep learning system for object-based scene classification in self-driving scenarios. The goal of this work is to classify whole driving scenes according to their prevailing object or ambient condition (e.g., car, rain, clear, other), without requiring explicit object detection or bounding box annotation. Here, Contrastive Predictive Coding (CPC) is employed to learn concise

latent features from unlabeled road scene images in a self-supervised fashion. The features are employed to form similarity-based graphs, where scenes are nodes and edges are generated based on cosine similarity. An ST GNN is then trained on the graphs to capture structural and contextual relationships between different scenes. Measured on the DAWN dataset (1,310 images in COCO format), the CPC-STGNN pipeline proposed here attains training accuracy of 90.18 percent and testing accuracy of 89.8 percent for multi-class classification. The system accurately classifies weather-affected scenes without using hand-crafted labels or object localization. By integrating CPC and ST-GNN, this paper presents a scalable, label-efficient approach for perception in weather-degraded autonomous driving scenarios.

KEYWORDS: Autonomous Driving, Contrastive Predictive Coding, Spatio Temporal Graph Neural Networks, Adverse Weather, DAWN Dataset, Deep Learning, Scene Understanding.

Design and Analysis of Two stage Cascaded Super-Lift Converter

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ABSTRACT. This work demonstrates the design, analysis, and simulation of a Modified Two-Stage Cascaded Super-Lift Converter (TSCSLC) for high-gain DC-DC power conversion. The novel converter topology enhances the voltage-boosting capability of the conventional super-lift method by utilizing two cascaded energy-storing stages with alternate switching through two MOSFETs. Step-by-step mathematical derivations are presented to determine the output voltage, inductor ripple currents, capacitor voltage ripples, and current ripple ratios. The converter is simulated through MATLAB/Simulink for a source voltage of 10 V. The simulated results validate the converter's potential to provide a high output voltage of 90 V, confirming a voltage gain of 9. Voltage ripple across each capacitor is less than 1%, and switching loss in MOSFETs are negligible, confirming efficient operation. Diode conduction profiles and capacitor voltage waveforms validate mode-wise energy transfer predicted analytically. The transient response validates excellent dynamic performance with stable settling. The proposed TSCSLC is highly suit-able for renewable energy applications, electric vehicle powertrains, and high-voltage DC loads.

KEYWORDS: Advanced DC-DC Converter, Luo Converter, Ripple Analysis, Switching Losses, MATLAB Simulation.

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Enhanced Dynamic Performance of STATCOM Using Fractional Order Notch Filter with Evolutionary Optimization Technique

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ABSTRACT. Recent research in the growing demand for improved power quality in long transmission line applications is driven by customers' increasing need for reliable load demand and power generation. The previous work has drawbacks, such as irregular flow in regulating power supply, high harmonics in grid output, and power stability in both grid and alternative power load outputs. To overcome the problem, a novel fractional order notch filter (FONF) with Evolutionary Optimization algorithm, combined with a bidirectional Photovoltaic module and interconnected with a static synchronous compensator (STATCOM) in a Long Transmission architecture. The STATCOM circuit effectively manages reactive power movement, applying a DC link capacitor in a shunt to generate and absorb responsive energy. Also, a photovoltaic DC source is linked with STATCOM and the FONF optimization controller algorithm is actively pulse generation the notch filter parameters utilizing evolutionary optimization to remove harmonic distortion and stabilize the power signal. The STATCOM causes real-time reactive power absorption and injection to regulate voltage fluctuations, compensating for either a sag or swell condition. The output simulation calculated Low 1.15 % THD outcome in received improve voltage stability.

KEYWORDS: STATCOM (Static Synchronous Compensator), Power Quality, Fractional Order Notch Filter (FONF), DC-DC Cuk Converter.

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Energy-Aware and SLA-Compliant Task Scheduling in Cloud Environments Using Hybrid DRL–PSO

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ABSTRACT: - Task scheduling in cloud computing remains an NP-hard problem that directly affects system performance, energy efficiency, and cost optimization. Traditional heuristics are lightweight but fail under dynamic workloads, while metaheuristics and reinforcement learning approaches offer adaptability but suffer from convergence and training limitations. To address these challenges, this study proposes a hybrid scheduling framework combining Deep Reinforcement Learning (DRL) with Particle Swarm Optimization (PSO). The DRL component learns adaptive scheduling policies, while PSO refines task–VM mappings for global optimization. The mathematical model minimizes make-span, energy, and execution cost under SLA constraints. Simulation results demonstrate that the proposed method outperforms Min-Min, Genetic Algorithm, and standalone DRL schedulers, achieving reductions of 18% in make-span, 22% in energy consumption, 15% in cost, and 45% fewer SLA violations. These findings establish the proposed Hybrid DRL–PSO framework as a scalable, efficient, and adaptive solution for next-generation cloud computing platforms.

KEYWORDS: Cloud Task Scheduling, Deep Reinforcement Learning (DRL), Particle Swarm Optimization (PSO), Energy Efficiency, SLA Compliance.

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Drivers and Barriers of E-Commerce Adoption among SMEs in India: An Extended TOE Framework Perspective

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ABSTRACT. Small- and medium-sized enterprises (SMEs) are central to India's economy, generating numerous jobs, industrial outputs, and innovations. This

study investigates the drivers and barriers to e-commerce adoption among Indian SMEs using an extended Technology-Organization-Environment (TOE) framework that also includes individual-level attributes. Through systematic analysis of academic literature, policy documents, and industry reports, combined with a comparative analysis across Pakistan, Indonesia, and Ghana, we identify key factors influencing adoption. The study reveals that while India benefits from advanced digital payment infrastructure (UPI) and government initiatives (Digital India), SMEs face significant barriers including gaps in technological infrastructure (particularly in rural areas), limited financial resources, insufficient digital literacy, and persistent consumer trust issues. Organizationally, SMEs struggle with resource constraints and lack of ICT skills, while individual factors such as managerial innovativeness and risk perception play decisive roles. Environmental factors include supportive government policies but weakly implemented, and market pressures from dominant platforms. The findings highlight the need for targeted interventions including improved ICT infrastructure, enhanced digital literacy programs, strengthened institutional support, and trust-building mechanisms. The paper concludes with specific policy recommendations for accelerating e-commerce adoption among Indian SMEs and identifies areas for future empirical research.

KEYWORDS: SMEs, E-commerce adoption, TOE framework, India, digital transformation, technology adoption.

Automatic Power Outlet Lock for Overload Prevention in Portable Disaster Relief Power Units

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ABSTRACT. In disaster relief situations mostly portable power units are used for providing temporary electricity in medical camps, shelters and communication equipment. These setups are prone to overload, which leads to power outages or damage of equipment. To solve this problem, we propose a system that integrates a current sensor, a microcontroller and an electromechanical lock which prevents overloading automatically in a power socket when the current flow exceeds the safe limit. It also uses LED and buzzer to indicate users about the overload condition. This system ensures safety and reliability in temporary electrical networks thus allowing uninterrupted power supply aiding in critical situations.

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KEYWORDS: Portable power unit, overload prevention, disaster relief, automatic outlet lock, current Sensing**,** electromechanical lock, temporary power distribution.

Enhancing traffic using IOT

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ABSTRACT. The rapid rise in urban traffic density has created a demand for intelligent transportation systems (ITS) that enhance road safety and reduce congestion. This work proposes an IoT-based framework where in-vehicle devices equipped with ESP32, GPS, and GSM modules transmit real-time data such as location, speed, and vehicle size to a cloud server. Using lightweight protocols like MQTT or DSRC, the system ensures low-latency communication between vehicles, infrastructure, and traffic management units. By integrating vehicle dimensions with dynamic data, the system provides context-aware decisions, such as estimating clearance times and identifying alternate routes for smaller vehicles in congested conditions. Analytics further support congestion prediction, adaptive signalling, and efficient urban planning. The proposed ecosystem improves commuter experience, lowers fuel use and emissions, and aids authorities in traffic control. Over time, this framework can enable seamless integration with autonomous vehicles, contributing to sustainable smart city mobility. .

KEYWORDS: Internet of things, intelligent transportation systems, traffic management, vehicular communication, GPS tracking, congestion prediction, MQTT, VANET, smart mobility, urban computing.

Design and Implementation of a Natural Language Command-Based Portable Testing Device For Embedded Applications

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ABSTRACT. The rapid expansion of IoT and embedded systems has intensified the

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demand for compact, low-cost tools that can test and validate devices outside traditional laboratory settings. Existing instruments are often bulky, expensive, and lack AI-driven adaptability. To address these limitations, an AI-powered waveform and fault simulator is introduced, built on an STM32 microcontroller. An embedded TinyBERT NLP model interprets natural-language commands with 96% accuracy and sub-150 ms response times, eliminating cloud dependence. The system delivers 1.5% waveform accuracy for both analog and digital signals and incorporates a fault-injection module that simulates noise, distortion, and electrical anomalies for realistic stress testing. Supporting multiple waveform types—including arbitrary signals—the simulator combines portability, real-time AI intelligence, and cost efficiency, offering a practical alternative to conventional laboratory instruments for both field and lab validation.

KEYWORDS: Artificial Intelligence, Waveform, Fault Simulation, IoT, Natural Language Processing (NLP).

PLC-Based Automatic Car Wash System with Water and Energy Optimization

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ABSTRACT: Automatic car washing systems have changed with automation to improve efficiency by reducing manual effort and cutting down on the time and resources needed for vehicle cleaning. The project aims to develop a PLC-based automatic car wash system with smart water and energy management using Allen-Bradley. This system will offer a fully automated cleaning process that includes pre-wash, detergent application, scrubbing, rinsing and drying. Programmable Logic Controllers (PLCs) will control the sequence of operations using sensors and timers. This setup ensures a consistent, high-quality wash with minimal human intervention. The project also focuses on including adjustable water and energy control mechanisms in the automatic car wash system for better efficiency. Features like dirt-level detection and water recycling make this solution more sustainable and cost-effective compared to traditional car wash systems. The smart water management system includes real-time water quality monitoring, filtration, and recycling, which significantly cuts down on overall water usage during the car wash process. Combining PLC-based automation with energy-efficient components makes this car wash system a smarter, eco-friendly, and cost-effective option compared to traditional car washing methods. The project highlights how Industry

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4.0 technologies can transform automated car washing to promote sustainability and improve operational efficiency.

FPGA based emulator for power converter control verification

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ABSTRACT. The growing use of DC-DC converters in modern applications like renewable energy systems, electric vehicles, and power electronics highlights the need for reliable and efficient control validation methods. Traditional hardware prototyping can be costly, time-consuming, and prone to component damage, making safer and quicker alternatives essential. This study presents an FPGA-based real-time emulation framework designed to verify and analyse control strategies for DC-DC power converters before hardware implementation. The platform includes models of buck, boost, and buck-boost converters using synthesizable hardware description language (HDL) with detailed device-level behavioural modelling, which ensures smooth deployment on an FPGA. Closed-loop control methods, such as pulse-width modulation (PWM) and feedback regulation, are included to assess stability and performance under different operating conditions. The emulation results are compared with MATLAB/Simulink simulations, showing strong accuracy, computational efficiency, and practical use. Overall, this work provides a cost-effective and dependable solution that connects simulation and hardware realisation, speeding up prototyping and enhancing the reliability of power converter control in real-world applications.

KEYWORDS: FPGA, real-time emulation, DC-DC converter, buck converter, boost converter, buck-boost converter, MOSFET, PWM, HDL, Control verification.

Retrofitting of a Conventional Vehicle into an Electric Vehicle

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ABSTRACT. The growing imperative to alleviate fossil fuel shortages and mitigate environmental destruction has motivated the transition from internal combustion engine (ICE) vehicles to electric vehicles (EVs). Nevertheless, replacing ICE vehicles with new EVs requires large financial and infrastructural outlays. Retrofitting presents an environmentally friendly and cost-effective solution to meet this demand. The present work describes the design and development of a retrofitting system for a two-wheeler ICE vehicle. The system proposed involves disassembling the ICE units and replacing them with an electric drivetrain system consisting of the hub motor, controller, and portable battery pack. A comprehensive description is given of the mechanical interfacing, electrical integration and safety aspects. The experimental validation of this propulsion system has demonstrated promising performance in terms of speed and efficiency for short-distance city commutes. The results verify that retrofitting is an effective concept for mitigating emissions and improving the longevity of conventional vehicles.

KEYWORDS: Retrofit, Electric vehicle, Two-wheeler vehicle, lithium iron phosphate battery, BLDC Hub motor, controller.

ATC calculation and identification of critically loaded lines in a deregulated power system

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ABSTRACT. The rising power demand stresses the transmission network to deliver the power over and above its existing transfer commitment, especially in the competitively driven deregulated power system markets. To ascertain the highest power that can be sent between the sending and receiving ends without going above overload and stability restrictions, the available transfer capability must be calculated. This paper demonstrates the use of the ACPTDF method for ATC computation on the IEEE 24 reliability bus test system. It also identifies transmission lines that are critically loaded for different transactions.

KEYWORDS: Available transfer capability (ATC), Deregulated power system, Critically loaded lines, AC Power Transfer Distribution Factor (ACPTDF) method.

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Modelling and Analysis of Dual-Battery Energy Management Strategies for Agricultural Electric Vehicles

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ABSTRACT. The rising penetration of electric vehicles (EVs) needs innovative and efficient energy schemes for managing the longevity of the batteries, ensuring safety, and smooth operational running. For agricultural applications, however, power demand is highly unpredictable and difficult to estimate upfront due to variations in soil quality, tool depth, and load regimes. A dual-battery energy management system (DBEMS) is utilised, affording flexible demand sharing between two packs and guaranteeing balance and reliability.

Heuristic and fuzzy controllers have been extensively used and tested due to their interpretability and simplicity; however, they often lack dynamic adaptability to changing conditions. Reinforcement learning (RL) achieves data-driven dynamism through interactive policy improvements in the environment. This paper designs and implements a comparative study of three DBEMS controllers, Heuristic, Fuzzy, and RL, under realisable conditions of loads in MATLAB. The framework compares controllers based on energy delivery, switching frequency, and SoC balancing criterion. We find that while the heuristic method minimises switching, it leads to imbalance; fuzzy logic achieves good balancing, though at the cost of over-switching; RL achieves the best trade-off, ensuring balance and efficient delivery at moderate rates of switching. These findings indicate the potential of DBEMS in optimising the use of EVs for farm equipment and farm vehicles.

Dual Band RF Enegy Harvesting System

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ABSTRACT: Wireless communication growth has increased the availability of ambient radio frequency (RF) energy, making RF energy harvesting a promising solution for self-powered electronic systems. This work presents a dual-band RF

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energy harvesting system operating at 2.1–2.45 GHz and 5.8 GHz to enhance energy availability compared to single-band harvesters. A dual-band antenna and Schottky diode–based rectifier are employed for efficient RF-to-DC conversion, while a buck–boost DC–DC converter with Zener regulation ensures stable low-power output. The harvested energy is monitored and managed using an ESP32 microcontroller with voltage sensing, relay-based load control, and LCD display for real-time visualization. The proposed system demonstrates the feasibility of sustainable IoT and embedded applications powered by ambient RF energy.

KEYWORDS: Rectenna, RF-DC conversion, Energy storage

LINEAR AND NON-LINEAR SVM BASED HIGH IMPEDANCE FAULT DETECTION FOR RADIAL FEEDER

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ABSTRACT. High impedance faults occurring in radial distribution networks can pose severe threat to the people and living organisms at the location of fault. In order to isolate the section at which fault has been occurred and the severity may depend on the resistance offered by the particular surface. In this work, standard IEEE 37 node test feeder has been utilized for analysis of short circuit studies with assumptions of the presence of ground resistance for the first four multiples of 5 ohms and their respective behavior for performing its metrics values for multilayer perceptron and the linear and non-linear Support Vector Machines (SVM) based methods. Here, Radial Basis Function Based Neural Network (RBFNN) has been used as a Non-Linear SVM and their comparison for predicting the exact fault bus node will be analyzed.

KEYWORDS: Support Vector Machines, Radial Basis Function, Neural Network, Multilayer Perceptron, Short Circuit, Ground Impedance.

SAND BATTERY

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ABSTRACT. This paper provides an in-depth examination of the sand battery which is an innovation and greener energy source. With a thermoelectric generator (TEG) module, SP1848SA27145, this system collects and traps solar and heats this sand and finally turns the heat into electrical energy. A DC-DC boost chopper is then used to condition the generated current, followed by a power bank module so that it can be used to power mobile devices. The use of sand as a thermal store is explained by its outstanding availability and the capacity to store the heat. The sand is stored in a steel load and to achieve minimum heat loss, rock wool insulation is employed. The solar heat collectors make detailed a work of heating sand to the optimum levels by focusing the sun rays onto the container. Combining the novel approach to mobile power delivery with thermoelectric conversion, and a solar thermal storage, this system demonstrates potential to produce power on a very decentralized basis, particularly during an emergency, or in the rural setting.

KEYWORDS: Sand Battery, Thermoelectric Generator (TEG), SP1848SA27145, Thermal Energy Storage (TEG), Rock Wool Insulation, DC-DC Boost Converter, Renewable Energy, Portable Energy System, Energy Harvesting, various other keywords are available to use.

A Transfer Function Approach to RLC Circuit Damping Analysis in EV Regenerative Braking System

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ABSTRACT. This paper explains the theoretical analysis of the damping characteristics of a series RLC circuit formulated through a transfer function approach. The study establishes an analytical analogy with the regenerative braking process in electric vehicles (EV). In EV equivalent RLC network represents the converter, motor, and battery interaction. The characteristic equation derived from the second-order circuit model is solved by the transfer function and the Durand–Kernal numerical method to evaluate the system poles and transient behavior. The pole location analysis gives understanding into the stability, damping regime and energy recovery efficiency of the regenerative braking system. The results highlight that appropriate pole placement minimizes current spikes and torque oscillations. It enhancing braking smoothness and energy recuperation. This theoretical framework extends design guidelines for automotive engineers in developing next-generation EV braking systems.
KEYWORDS: RLC circuit, Electrical vehicle (EV), Regenerative braking system, Transfer function, Durand-Kernal method, Differential Equation (DE).

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Advanced Voltage Profile Correction in Power Systems Using Intelligent DVR Architecture

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ABSTRACT. Ensuring the quality of electrical power has become increasingly critical due to the growing dependence of modern technologies on a stable and efficient energy supply. Electronic devices such as computers, variable speed drives, and household appliances demand high power quality for optimal performance and longevity. However, power system disturbances—particularly voltage fluctuations, frequency variations, and harmonic distortions—can significantly impair equipment functionality and reduce system reliability.

Among these disturbances, voltage sags and swells are especially prevalent in distribution networks and can lead to equipment malfunctions, insulation damage, and reduced operational lifespan. To address these challenges, advanced power conditioning solutions have been developed. One of the most effective and cost-efficient among them is the Dynamic Voltage Restorer (DVR), which compensates for voltage deviations in real time.

This paper presents a comprehensive analysis of the DVR, focusing on its working principles and the control strategies used for effective mitigation of voltage-related issues. Simulation results based on the implemented control technique are provided to validate the performance of the proposed system.

KEYWORDS: Dynamic Voltage Restorer (DVR), Power Quality, Voltage Sag, Voltage Swell, Harmonic Distortion, Control Strategies, MATLAB/Simulink.

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Machine Learning-Enhanced FOPID Control Strategy for Adaptive Quadruple Tank Process Regulation

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ABSTRACT. This research paper offers an integrated control scheme with Fractional Order PID (FOPID) controllers and Machine Learning (ML) models for robust regulation of a Quadruple Tank Process (QTP). Machine Learning algorithm such as Decision Tree algorithm (Fine Tree type) is utilized for proper QTP system modeling. Centralized and multiloop FOPID controllers are tuned using Covariance Matrix Adaptation Evolution Strategy (CMAES). Simulation outcomes under different setpoints and disturbances indicate ML-based models perform superior to conventional ones, with the CMAES-optimized centralized FOPID controller with a Decision Tree model of best performance according to IAE, ISE, and ITAE measures. Real-time viability is addressed through computationally efficient models and hardware tools. The new methodology illustrates better adaptability, sturdiness, and control accuracy, which can be applied to intricate, nonlinear, and coupled systems such as the QTP.

KEYWORDS: Fractional Order PID (FOPID) Controller, Quadruple Tank Process (QTP), Machine Learning Modeling, Covariance Matrix Adaptation Evolution Strategy (CMAES), Multivariable Process Control.

Hybrid Electric Car System Design Using Dual-Battery Energy Storage: A Dual-Port DC/DC Converter

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ABSTRACT. In this research, a hybrid energy system-based modern multi-input dc–dc converters with fuzzy control is proposed. Because a fuzzy controller has several advantages over other controllers, we use it in this paper. Fuzzy controllers integrate expert judgment with automated device functionality, making them ideal for human decision-making. It is possible to transfer energy into different energy sources using the suggested converter. There are two modes of functioning for the suggested converter: charging mode and discharging mode. The output receives power from all of the input sources. The suggested converter regulates the power of ESSs by permitting active power sharing. Both the output voltage and the voltage levels of the employed ESSs may be greater or lower. For a nonlinear system, using a fuzzy controller improves performance while lowering unpredictable effects in system management. With the help of the simulation results, we will investigate the new bilateral non-isolated multi-input converter (or MIC) topology for hybrid systems intended for usage in electric vehicles.

KEYWORDS: fuel-cells hybrid electric vehicles (FCV/HEV), plug-in hybrid electric vehicles (PHEVs), bidirectional dc to dc converter (BDC), voltage split sources (VES1, VES2), Third Keyword.

DESIGN & IMPLEMENTATION OF MULTILEVEL INVERTERS FOR ENHANCED PERFORMANCE & EFFICIENCY IN ELECTRIC VEHICLES

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ABSTRACT. Advanced power electronics research for electric vehicles (EVs) has intensified due to the growing need for environmentally friendly and energy-efficient transportation. Multilevel inverters (MLIs) have become a viable option for EV powertrains due to their ability to produce high-quality output voltage with lower total harmonic distortion (THD). The design and actual deployment of a multilevel inverter system with the goal of enhancing the effectiveness and performance of electric vehicle drive systems are the main topics of this article. In this study, a cascaded H-bridge multilevel inverter topology—selected for its modularity and scalability—is simulated and implemented on hardware. We model and validate inverter performance under varied load situations in detail using MATLAB/Simulink. The simulation results show higher voltage consumption, better power factor,

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and less THD, all of which increase motor efficiency and decrease switching losses. An intelligent PWM control method that is suited for the dynamic load circumstances commonly found in EVs is integrated into the design. The practical difficulties of incorporating MLIs into small EV systems are also covered in this research, including control complexity, space restrictions, and thermal management. To simulate actual vehicle operation, a prototype system was created and tested with an induction motor load. The modelling findings were confirmed by experimental results, which highlighted the benefits of MLIs in lowering energy losses and enhancing torque responsiveness. For next-generation EVs, the suggested MLI system exhibits encouraging promise. The results are meant to help academics and engineers optimize inverter designs for more effective and clean electric mobility.

KEYWORDS: Inverter with multiple levels (MLI), EVs (electric vehicles), H-Bridge cascade, Total Distortion of Harmony (THD), PWM (pulse width modulation), Simulink/MATLAB, Efficiency of Power, Changing Losses, Drive for Traction Motors, Transportation Based on Renewable Resources.

IMPLEMENTATION AND PERFORMANCE EVALUATIONS OF IOT BASED FOOT STEP POWERED ENERGY HARVESTER (FSPEH)

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ABSTRACT. This paper outlines the architecture, design, implementation, and testing of the proposed system, including the selection of energy harvesting technology, IoT integration, microgrid compatibility, and data management. Performance metrics such as energy output, communication efficiency, and system durability are evaluated through experimental setups in controlled and real-world environments. The prototype achieved a peak voltage output of 17.4 V and an overall efficiency of about 80%, demonstrating a significant improvement over conventional footstep energy harvester. The proposed solution not only contributes to sustainable urban development but also sets the foundation for smarter, more adaptive energy systems powered by everyday human activity. This modular approach ensures ease of maintenance, efficient fault detection, and flexible deployment strategies based on foot traffic density and energy demand. Additionally, real-time data visualization enables facility managers and urban planners to make informed decisions about energy utilization, crowd flow, and infrastructure development.

KEYWORDS: Footstep Energy Harvesting, Piezoelectric Energy Conversion, IoT Integration, Hybrid Power Generation, Smart Energy Monitoring.

Power Electronics-Driven PV-Wind Hybrid Energy System with Bidirectional and POSLL Converters for Sustainable Power-to-X Applications

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ABSTRACT. This paper proposes a power electronics-based solar photovoltaic (PV) and wind hybrid integrated energy system with an advanced bidirectional DC-DC converter for optimal battery charging, energy management, and superior power flexibility. The system consists of a Positive Output Super-Lift Luo (POSLL) converter on the PV side to realize higher voltage gain, enhanced efficiency, and better power output than traditional converters. A MATLAB/Simulink simulation was performed to analyze the dynamic and steady-state behavior of the system under different solar irradiance and wind speed conditions. Experimental verification of the designed system was achieved using an experimental prototype, the performance of which was measured using a Yokogawa WT1806E power analyzer. The experimental results were consistent with the simulated performance, validating that the system can effectively harvest and regulate renewable energy. The hybrid configuration allows greater energy storage, power flow, and bidirectional energy transfer between the PV, wind, and battery subsystems. In addition, the proposed system offers a scalable platform for power-to-X applications, including integration with energy storage, electric vehicle charging, and future sector-specific energy solution coupling. This research presents a promising solution for sustainable and flexible energy generation and management in off-grid and grid-connected systems.

KEYWORDS: Bidirectional DC-DC Converter, Energy Storage, Maximum Power Point Tracking (MPPT), Photovoltaic-Wind Hybrid System, Positive Output Super-Lift Luo (POSLL) Converter, Power Electronics, Power-to-X (PtX) Applications, Renewable Energy Integration.

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Comparative Analysis of Analytical Methods for Transient Response in RLC Circuit

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ABSTRACT. This paper explains, the transient response of a series in RLC circuit under DC excitation method validation and specific focus on the damping characteristics. In this study utilizes the three analytical approaches there are classical method, Laplace transform, and Elzaki transform. The model analyzing the circuit behavior across overdamped, critically damped, and underdamped regimes. A comparison is conducted to evaluated the accuracy and computational efficiency of each method. The analytical formulations are implementing tool using in Python. In this analytical method used to simulate transient and steady-state responses. They providing graphical visualization of voltage behavior time is over. In the results are demonstrate the mathematical equivalence among all the three methods. In the errors below 1.42×10^{-7}%, ensuring accuracy in the Elzaki transform as a reliable alternative to the established techniques. The Laplace transform maintains higher computational efficiency. The Elzaki transform offered the systematic approach with comparable accuracy. In this research provides the valuable insights for researchers in selecting appropriate modeling techniques for transient analysis in electrical systems, especially in applications involving in instrumentations, damping control and energy storage system.

KEYWORDS: DC Excitation, Damping Characteristics, Elzaki transform, RLC in Laplace transform method, Analytical method.

Smart Control of Traffic Light Using AI and IOT

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ABSTRACT: The rapid growth of vehicles in cities has led to serious traffic congestion problems, causing delays, fuel wastage, and pollution. To overcome this, a Smart Traffic Control System using Artificial Intelligence (AI) and the Internet of

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Things (IoT) is proposed. This system automatically controls traffic lights based on the number of vehicles present on each road. Sensors and cameras are used to detect traffic density, and the collected data is processed using an AI algorithm to determine which lane requires a longer green signal. A NodeMCU microcontroller manages the signal operations, while the Blynk IoT platform helps monitor and receive message. The system also gives priority to emergency vehicles by automatically clearing their path. By adjusting signal times intelligently and sharing real time updates, this project helps reduce waiting time, minimize fuel consumption, and improve overall traffic flow — providing an efficient and eco-friendly solution for modern smart cities.

KEYWORDS: Traffic management, Artificial Intelligence (AI), Internet of Things (IoT), Adaptive signal control, Smart city, Real-time monitoring.

Transformer-Based Deep Learning Models for Predictive Maintenance in Electrical Machines

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ABSTRACT. This project uses multimodal data from Case Western Reserve University (CWRU) and Paderborn University to design and test a Hybrid CNN–Transformer framework for predictive maintenance in spinning electrical machinery. To improve defect detection and RUL estimation, the proposed architecture uses convolutional encoders for local feature extraction and multi-head self-attention for global temporal modelling. The architecture includes three 1D convolutional layers (filter widths 3–7, 64–256 filters), a 4-layer Transformer encoder with embedding dimension 256, and eight attention heads. The 12,420 vibration and current samples (70% training, 15% validation, 15% testing) cover various load circumstances and fault severities. Preprocessing

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improves feature discrimination using STFT, CWT, and z-score normalisation. Model optimisation uses AdamW (initial learning rate 1e-4, batch size 64) with early halting. Extensive ablation experiments compare the hybrid model to CNN, LSTM, and CNN–LSTM baselines. Each architectural component improves performance, resulting in 97.3% accuracy, 0.96 macro-F1, and 3.1 hours mean RUL estimate error. Statistical significance assessment (paired t-test, $p < 0.05$) confirms superiority above baselines. Attention heatmaps and t-SNE plots help analyse learnt characteristics and physical deterioration trends. Edge–cloud deployment using MQTT and OPC-UA proves IIoT real-time viability. The framework delivers Industry 4.0-compliant explainable sustainable energy efficient resource use, scalable, and accurate predictive maintenance.

KEYWORDS: Predictive maintenance, Transformer model, Fault diagnosis, Self-attention, Hybrid CNN–Transformer, Industrial IoT (IIoT), Sustainable resource use.

Design and Simulation of Modular Multilevel Converter Using MATLAB/Simulink

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ABSTRACT. The paper presents the design and simulation of a Modular Multilevel Converter (MMC) using MATLAB/Simulink. The study focuses on analyzing the performance of MMC and comparing it with conventional multilevel inverter topologies such as diode-clamped, flying capacitor, and cascaded H-bridge inverters. The MMC topology offers several advantages, including modular structure, improved performance, lower harmonic content, and improved fault tolerance. The simulation is performed for all converter levels to evaluate waveforms, harmonic spectrum, and total harmonic distortion (THD). The results demonstrate that the MMC produces high-quality output with significantly lower THD compared to conventional multilevel converters, making it suitable for high-power applications such as HVDC transmission systems and AC motor drives.

KEYWORDS: Modular Multilevel Converter (MMC), Multilevel Inverter, HVDC, MATLAB/Simulink, Harmonic Analysis, Total Harmonic Distortion (THD).

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AI-Based Methods for Electric Vehicle Range Estimation: Challenges, Models, and Future Directions

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ABSTRACT. Predicting how far an electric vehicle (EV) can travel on a single charge is really important for improving energy use and reducing range anxiety among drivers. This paper takes a close look at the different methods used to estimate EV range, especially those focused-on charge estimation and prediction models. It reviews both traditional techniques like regression models and newer approaches based on machine learning, explaining what works well and where they fall short. The study also points out some common challenges, such as dealing with noisy data, understanding complex relationships between factors, and making sure the predictions work in real time. To improve accuracy, the paper discusses how newer models try to capture patterns from sensor data and driving conditions over time. It also talks about how different evaluation measures like RMSE, MAE, MSE, and R-squared are used to check how good the predictions are. Overall, this review gives a clear picture of how EV range prediction methods are evolving and how they can be applied in real-world situations

KEYWORDS: EV Range Estimation, Machine Learning Models, Data Pre-processing Techniques, Performance Evaluation Metrics.

Techno-Economic Design and Optimization of a Hybrid Renewable Energy System for Site-Specific Sustainable Energy Planning

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ABSTRACT. This system incorporates of grid-connected solar photovoltaic (PV) and biomass to ensure reliable, low-carbon power to meet the energy requirements of Government Polytechnic College in Udaipur, Rajasthan. In order to find the most efficient configuration, we used two independent optimization tools, HOMER Pro and Genetic Algorithm (GA), a form of artificial intelligence

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that is written in MATLAB. The effectiveness of both approaches is measured in terms of Net Present Cost (NPC), renewable fraction, Levelized Cost of Energy (LCOE), component contribution and CO_2 emissions. This comparison reveals that the GA is superior because it has an adaptive evolutionary mechanism, unlike HOMER, that uses a fixed energy balance. Coupled with the fact that overall GA provides more effective and sustainable optimization solutions to complex, multi-variable energy optimization problems than the traditional deterministic tools. The innovation of the current work is that it is site specific with respect to optimization based on real institutional load and developed GA model that has been tested on HOMER Pro of a grid-connected solar-biogas system. It offers a realistic guidance to the engineers, planners and policymakers in the process of selecting low-cost and low-emission energy environments. This work by comparing heuristic and commercial optimization tools in real-world conditions, contributes to the current research in optimization of renewable energy systems as well as helps with the greater aim of creating sustainable and resilient energy solutions in future.

KEYWORDS: Hybrid Renewable Energy System (HRES), Optimization, HOMER Pro software, Genetic Algorithm (GA), sustainable.

Driver Health and Behavior Monitoring System with V2H and V2V Communication

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ABSTRACT. This is a dual-module system for monitoring the driver's health and behavior in real-time. It begins with the simultaneous initialization of Health Monitoring and Behavior Monitoring modules. In the Health Monitoring module, the driver's heart rate is continuously monitored. If the heart rate exceeds the predefined threshold, further other health parameters such as body temperature and respiration rate are not checked and immediately the system triggers Vehicle-to-Hospital (V2H) communication, sending the driver's health data to the hospital for emergency intervention. Additionally, the system monitors the driver's eye status using an eye-blink sensor to detect if the eyes are closed. If the eyes are closed, the system proceeds to evaluate the driver's temperature and respiration. Any abnormal values in these parameters also initiate V2H communicationOn the other hand, the Behavior Monitoring module focuses on tracking parameters related to the driver's driving habits and alertness. This includes monitoring the vehicle speed and checking if it exceeds a defined threshold. If the speed is unsafe, the system evaluates the driver's grip strength on the steering wheel and their

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steering control to detect potential loss of control or unsafe behavior. If abnormalities are detected in either parameter, the system activates Vehicle-to-Vehicle (V2V) communication, sending warnings to nearby vehicles to enhance situational awareness. Additionally, the system monitors the driver's alcohol consumption using an alcohol sensor (MQ3). If alcohol is detected, system immediately triggers V2V communication to alert nearby vehicles, reducing the risk of collisions caused by impaired driving. This intelligent system can be further enhanced with AI-based analytics for driver profiling and predictive alerts, offering a scalable approach to road safety.

KEYWORDS: Driver Monitoring System, V2H: Vehicle to Hospital, V2V: Vehicle to Vehicle, ESP8266.

Fine-Grained Power Optimization in Posit Arithmetic Using Partitioned Multiplier Design for VLSI

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ABSTRACT. This work proposes an efficient modular multiplier for digital imaging hardware using Posit number representation. Posit arithmetic, a promising alternative to IEEE floating point, provides greater flexibility and a wider dynamic range, making it well-suited for imaging and neural processing. However, implementing Posit multipliers in hardware remains challenging due to variable precision across exponent–mantissa configurations, which often leads to unnecessary power us-age. To overcome this, we design a modular, energy-aware multiplier architecture optimized for VLSI systems. The core idea is a partitioned structure that activates only the required functional blocks for the given mantissa width, thus dynamically reducing energy consumption. This fine-grained control preserves accuracy while improving power efficiency. Simulation results

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demonstrate clear gains in both energy savings and computational precision. The design is particularly effective for image-processing applications, offering a scalable and practical pathway for future low-power embedded and quantum-ready computing platforms.

KEYWORDS: Posit-Based Computation, Segmented Multiplier Design, Power-Conscious VLSI Systems, Quantum-Ready Processing Units, Digital Imaging Acceleration, Precision-Optimized Hardware Architecture.

End-to-End Lightweight Encryption Architecture Using SPECK Cipher for Low-Power Digital Platforms

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ABSTRACT. Ensuring data security and reliability has become a key concern in modern com-pact computing systems such as IoT devices, embedded platforms, and wireless sensor networks. Since these systems often operate with limited power and pro-cessing capacity, lightweight cryptographic approaches are necessary. This work demonstrates a hardware-efficient design of the SPECK lightweight block cipher at the RTL level using Verilog HDL. The design incorporates modules for key scheduling, encryption, and decryption, forming a complete end-to-end system. Emphasis is placed on reducing silicon area, improving throughput, and supporting modular scalability. Comprehensive functional testing is carried out through dedicated testbenches to validate the cipher's accuracy across different input scenarios. By balancing strong security features with hardware efficiency, the pro-posed architecture offers a practical solution for low-power digital environments. This contribution provides a baseline framework for future development of energy conscious and secure cryptographic hardware solutions.

KEYWORDS: Lightweight Cryptography, RTL Design, SPECK Cipher, Verilog HDL, Low-Power VLSI.

Design and Implementation of a GSM-Based Hardware SOS Trigger for Companion SOS App

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ABSTRACT. Rapid and reliable communication during emergencies is critical for personal safety. Smartphone-based SOS applications, such as the Companion SOS app, allow users to send GPS-based location alerts to predefined contacts. However, these solutions require physical access to the phone, which may not be possible in certain emergency scenarios. This paper presents the design and implementation of a standalone GSM-enabled hardware SOS trigger device that replicates the SOS activation process of the Companion SOS app without requiring smart phone interaction. The system employs an ESP32 microcontroller, a Crowtail A7670E 4G GSM module, and a push-button interface. When activated, the device transmits an HTTP POST request to the app's server, including location data obtained via Location-Based Services (LBS) through the GSM network. This approach enables independent internet connectivity without relying on Wi-Fi, allowing operation in remote areas with cellular coverage. While the current implementation uses LBS for location determination, future enhancements include GPS integration for improved accuracy and wearable designs for greater portability.

KEYWORDS: SOS device, GSM module, ESP32, Location-Based Services (LBS), GPS, IoT safety device, Emergency alert system.

A Review on Recent Progress in Dynamic Random Access Memory (DRAM) and Device for Computing in Memory (CIM) Application

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ABSTRACT. Interest in Computing-in-Memory (CIM) architectures to get around the von Neumann bottleneck has increased due to the growing need for high-speed, low-power data processing. CIM reduces data transfer overhead by enabling parallel data processing in memory. Numerous memory technologies have been investigated, including Static Random-Access Memory (SRAM), Resistive Random Access Memory (RRAM), Magnetoresistive Random-Access Memory (MRAM) and Dynamic Random Access Memory (DRAM). RRAM and MRAM offer non-volatility but struggle with endurance and variation, while SRAM has low latency but a high area cost. DRAM's density and maturity make it a scalable and affordable choice, especially for AI workloads. Yet the use of DRAM for CIM is challenging in terms of having high leakage currents, sense amplifier noise, and charge-sharing constraints. This paper discusses recent progress that alleviates these challenges through architectural co-design, charge-domain analog computing, and low-leakage DRAM cell innovations for effective CIM applications.

KEYWORDS: Computing-in-Memory (CIM), Dynamic Random-Access Memory (DRAM), Static Random-Access Memory (SRAM), Resistive RAM (RRAM), Magnetic RAM (MRAM), Energy Efficiency.

A Review on Paddy Crop Health Monitoring using RGB Imaging Technique, Temperature, and Humidity Sensor

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ABSTRACT. Paddy is one of the world's most important staple crops, feeding more than half of the global population, making its health monitoring crucial for food security. However, productivity is severely affected by challenges such as pest infestations, nutrient imbalances, climatic variations, and diseases like Leaf Blast and Brown Spot, which can reduce yields by up to 50% if undetected. Traditional approaches rely on manual inspection of leaves, but these are labor-intensive, inconsistent, and ineffective for detecting early-stage symptoms. To address this, researchers have explored available solutions including image-processing methods such as segmentation and feature extraction, sensor based monitoring (temperature, humidity, soil), IoT devices, and machine learning techniques such as

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Convolutional Neural Networks (CNNs). These approaches combine visual features with environmental data to enhance disease detection accuracy. This review paper focuses on surveying recent developments in RGB image-based monitoring and the integration of environmental sensors for paddy crop health analysis. By highlighting strengths, limitations, and gaps in current methods, the study emphasizes how automated systems can enhance precision agriculture, reduce economic losses, and support global food security through early and reliable disease detection.

KEYWORDS: Paddy crop monitoring, RGB imaging, IoT, CNN, precision agriculture.

Smart IV (Intravenous) Flow Control and Drug Visualization

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ABSTRACT. In order to improve patient safety and reduce the manual oversight of intravenous (IV) therapy, specifically monitoring glucose levels in IV bottles. We use Internet of Things (IoT) technology to either measure the amount of fluid by using a load cell amplifier to weight the bottle, or measure using a capacitive sensor to determine the presence of fluid. When the amount of fluid is reduced below a user-defined value (e.g. 20 ml), a GSM modem is triggered to either send an SMS or phone call, and a NodeMCU microcontroller with Wi-Fi capability sends the data to a web server for real-time viewing. In addition, the NodeMCU is programmed to actuate an actuator to automatically cut the flow of IV fluid to prevent reflux of blood and losing the IV line if the IV fluid is almost gone. Complex computerized systems have been created to enhance the care and recovery of patients in hospitals, yet an important aspect of patient safety is hyper vigilant management and monitoring of infusion levels. Caring for patients with intravenous fluids (IV) is typically done manually by a nurse or an assistant. The delay in changing IV bottles due to workload and human error can have detrimental consequences such as blood loss or backflow. The integration of low-cost RF-based automatic alert technology with infrared (IR) sensors provides a valid solution for fluid level monitoring. The alarms for such systems can be designed to indicate accuracy with respect to IR sensor outputs and minimum specified thresholds, which reduces human factor inaccuracy and timely alerts. This approach represents a real-life practical, reliable, and cost-effective hospital application and signifies a pathway for innovative biomedical innovations.

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KEYWORDS: Automated Drug Delivery, IoT in Healthcare, Real-Time Monitoring, Patient Safety, Embedded System.

FPGA IMPLEMENTATION OF PID CONTROLLER FOR QUADCOPTER

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ABSTRACT. Quadcopters are increasingly utilized for applications such as surveillance, delivery, and autonomous navigation, requiring precise control to ensure stable flight. The Proportional–Integral Derivative (PID) controller is among the most common control strategies due to its simplicity and reliability. Nevertheless, traditional PID tuning approaches face difficulties in addressing the nonlinear and time-dependent dynamics of quadcopters. Most research to date relies on simulations performed in MATLAB, Simulink, or Scilab XCOS, with comparatively little attention given to real-time hardware implementations. In particular, Field Programmable Gate Arrays (FPGAs) provide significant advantages—such as parallel processing, low latency, and robustness— but have not been fully exploited for multi-loop PID control in quadcopters. This review evaluates PID tuning techniques, simulation methods, and FPGA-based control architectures, while also identifying current limitations and outlining future directions for improving real-time performance, adaptability, and robustness in quadcopter control systems.

KEYWORDS: Unmanned Aerial Vehicles (UAVs), Quadcopters, PID control, FPGA, Real-time systems, Nonlinear dynamics, Simulation and modeling.

Intelligent Fault Classification of Rolling Bearings via Stacked BN-Augmented Bi-GRU

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ABSTRACT. This work presents the development of a robust and intelligent fault classification framework for rolling bearings that overcomes the limitations of conventional signal processing methods in analysing dynamic, non-stationary vibration data by integrating correlation-driven adaptive feature selection with a Batch Normalization–enhanced Bi-directional Gated Recurrent Unit (Bi-GRU) deep learning architecture, where raw vibration signals are pre-processed, followed by Pearson correlation analysis to select the most informative subset for model training, and subsequently used as inputs to a stacked Bi-GRU network with Batch Normalization layers strategically embedded to accelerate convergence, stabilize feature distributions, and mitigate overfitting across varying operational conditions; extensive experiments conducted on benchmark datasets encompassing diverse inner and outer race fault types and severities demonstrate that the proposed BN-based Bi-GRU framework achieves 100% classification accuracy, outperforming conventional machine learning classifiers and contemporary deep learning approaches, with performance validated comprehensively through confusion matrices, ROC curve analysis, and quantitative evaluation metrics including precision, recall, and F1-score, all of which confirm the high reliability, robustness, and generalization ability of the approach, thereby establishing its potential as a real-time, high-precision, and scalable solution for intelligent fault diagnosis in industrial machinery and predictive maintenance applications.

KEYWORDS: Rolling Bearings, Fault classification, Deep Learning, Batch Normalization, Deep Bidirectional Gated Recurrent Uni.

A Review on Automatic waste segregating system

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ABSTRACT. A system called the Automatic Waste Segregation System is designed to automatically separate mixed waste into categories such as wet, plastic, metal, and dry waste in order to overcome the inefficiency of manual waste handling. It operates using an L-shaped conveyor belt mechanism, where the vertical section initially collects waste and the horizontal section transfers it for sorting. The system employs various sensors, including a rain/moisture sensor to identify wet biodegradable waste, a proximity sensor to detect metallic components, and a capacitive sensor to distinguish plastics and other dry materials based on their dielectric properties. These sensors generate signals that are processed by an Arduino microcontroller, which controls actuators like servo motors and DC motors to divert each detected waste type into its respective bin through mechanical gates or diverters. This automated method

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significantly minimizes human involvement, enhances hygiene, improves sorting precision, and supports efficient waste management and recycling. Due to its low cost, reliability, and scalability, the system can be implemented in households, institutions, public places, and community waste collection centers, and may be further developed for integration into IoT-based smart waste management systems.

KEYWORDS: Detection, Waste Segregation, Sensors, Automation, Embedded.

CropIQ - A Smart Agriculture Application for Soil-Based Crop Prediction

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ABSTRACT. Intelligent agricultural decision support systems optimize agriculture via IoT devices, GIS, and ML systems, as developed in CropIQ. Real-time environmental data collection and GIS components provide information on agricultural soils and geography, including the soil texture, pH, agroclimatic zone, and district-level data. The preprocessing of these with two complementary data sources is done. The first is a species-wise agro-advisory recommendation portal from Tamil Nadu Agricultural University, which identifies the most suitable crop varieties for the target zone. The second source gives suitability forecasts for crops, based on the interaction between soils and other environmental attributes. The system applies a hybrid prediction model that combines Catboost, the tree algorithm that is well suited for categorical attributes, with Gaussian Naïve Bayes, which is known to work well with numerical features. This combination of species advising, geographic data, CatBoost, and Naïve Bayes prediction systems will decrease the uncertainty in agriculture and enable the adoption of precision agricultural practices that are more efficient and sustainable.

KEYWORDS: Intelligent agricultural decision support systems, IoT-based farming, GIS soil analysis, crop suitability prediction, CatBoost algorithm, Gaussian Naïve Bayes, precision agriculture.

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From Sensors to Cloud: A PLC-Centric Industrial IoT: A Survey

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ABSTRACT. This survey reviews how industrial sensors connect to Programmable Logic Controllers (PLCs) and then to the cloud for analytics, dashboards, and AI. We outline typical architectures (sensors → PLC → edge gateway → cloud), compare communication protocols (OPC UA, MQTT, Sparkplug B, Modbus/TCP, REST), and summarize hardware/software stacks frequently used with Delta PLCs in plants. We also review common sensor types (temperature, pressure, gas, humidity, vibration, proximity) and how their data characteristics affect sampling, buffering, and transmission. Two additional survey tables cover signal conditioning/I-O mapping and security controls mapped to IEC 62443.

KEYWORDS: Industrial IoT; PLC; Delta PLC; SCADA; OPC UA; MQTT; Sparkplug B; sensors; edge gateway; cloud analytics.

IoT based Anti-Theft Flooring System

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ABSTRACT: The proposed IoT-Based Anti-Theft Flooring System integrates advanced sensor technology with IoT to provide continuous and real-time intrusion detection and alert services. In this system piezoelectric sensors are embedded into the flooring to detect pressure changes caused by the footsteps. An Arduino microcontroller is used to process sensor data and also to run the system as a whole. While an ESP32 module into the live video streaming feature for remote watch. Upon the detection of an intrusion the GSM module will immediately notify the owner via their mobile device, also at the point we have a buzzer for an immediate local alert. By the means of very discrete pressure detection with that of IoT connection and automatic alert systems, this design breaks from the past in terms of security measures and presents better resistance to tamper with, non-stop

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monitoring and rapid incident reporting.

KEYWORDS: IoT, Anti-theft System, Security System, Smart Flooring, Intruder Detection, Home/Office safety measures.

Design and Development of a Low-Cost Semi-Autonomous Arecanut Gathering Machine

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ABSTRACT. One of the hardest and time-consuming tasks for arecanut farmers is to collect the dried arecanut from the large drying field after harvest. Farmers typically have to spend a lot of time bending and picking up the dried arecanut by hand,which causes extreme stress, strain, and requires more labour. To solve this problem, we have designed an Automated Robotic Arecanut Gathering Machine with an ESP32 and Arduino UNO connected via I²C and the Blynk application. The robot can be operated in two modes. Automatic mode and manual mode; in automatic mode, the robot will change its path based on feedback from the Ultrasonic sensor. In manual mode, all robot operations can be manually controlled using a smartphone. It uses a straightforward but ingenious mechanism. A revolving brush is placed at the front of the robot. It collects dried arecanuts and sweeps them onto a conveyor belt, which then lifts the nuts and dumps them into a storage bin placed at the robot's rear. There is a bucket replacement system; when the collection bucket is full, it quickly replaces it with an empty one. The robot gathers nuts continuously as it advances, maintaining a steady and seamless process. All motor events, such as moving the robot, rotating the brush, or operating the conveyor, are managed by the ESP32 and Arduino. Our goal is to make farmers lives easier by reducing their labour requirements, saving them time, and money on labour. Small and medium-sized farmers who cannot afford pricey equipment greatly benefit from this machine .We will increase rural productivity and promote sustainable farming with this project.

KEYWORDS: Automated System, Conveyor Belt Mechanism, Chassis Design, Semi-Automated Agriculture, Labour Reduction, Farmer-Friendly Mechanism, Time-Saving Technology.

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Real Time Vehicle Violation Detection System using Embedded System and IOT

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ABSTRACT. The rapid growth of intelligent transportation systems has increased the need for compact, low-cost, and automated tools capable of enforcing road safety and environmental regulations in real time. Conventional monitoring methods are often manual, inefficient, and unable to scale to dense urban environments. To address these limitations, this work presents an AI-enabled vehicle violation and pollution monitoring system that integrates computer vision and IoT technologies. A YOLOv8-based model detects helmet violations and extracts number plates for verification, while MQ-135 sensors deployed at both vehicle and signal nodes measure emission levels. The processed data are transmitted through ESP8266, HC-05, and GSM modules to generate instant alerts and update cloud dashboards. A dual-interface design using Tkinter and Blynk provides seamless local and remote visualization. This compact, scalable framework offers an efficient alternative to traditional enforcement systems, enabling real-time, automated monitoring for smart city applications.

KEYWORDS: Artificial Intelligence (AI); YOLOv8; Helmet Violation Detection; Number Plate Recognition; EasyOCR; Internet of Things (IoT); ESP8266; HC-05; GSM Module; MQ-135 Sensor; Air Pollution Monitoring; Real-Time Traffic Enforcement; Smart City Systems; Embedded Systems.

Oil Skimmer Bot Using Nitrile Rubber Conveyor Belt

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ABSTRACT. The Oil Skimmer Bot is a smart robotic device created to tackle one of today's biggest environmental challenges-oil spills and water pollution. Using a mix of sensors, artificial intelligence, and a custom skimming system, it can independently find and remove oil floating on water surfaces with impressive accuracy. The bot stores the collected oil safely in an onboard container for proper disposal, helping restore clean and healthy water. Compared with traditional cleanup techniques that only recover a small amount of the spilled oil, this system performs much more efficiently in tests. The Oil Skimmer Bot marks an important move toward cleaner waterways and better protection for marine life and ecosystems.

KEYWORDS: Oil spill recovery, Water pollution control, Environmental robotics, Oil detection, Wireless navigation. Oil spill recovery, Water pollution control, Environmental robotics, Oil detection, Wireless navigation.

Design and Development of Automatic Mobile Fire Extinguisher

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ABSTRACT. The Automated Mobile Fire Extinguishing Robot project aims to develop a robot designed to automatically detect, track, and extinguish fires. With the use of an AMG8833 thermal sensor, flame sensors and an ESP32 controller, the robot is able to identify the location of fire sources and navigate towards them while activating a water-pumping mechanism to put out the flames. The automated mobile robot is designed to provide a low-cost, efficient means of increasing fire safety in homes, laboratories, and industrial facilities, with quick detection of fires, effective navigation through obstacles, and real time monitoring and control via the Internet of Things (IoT).

KEYWORDS: Thermal-Based Fire Detection, Autonomous Extinguishing System.

Automation of Payment System through Facial Recognition

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ABSTRACT. When passengers or customers arrive at platforms, ticket counters, or other service locations, they often spend a significant amount of time waiting in long queues to complete purchases. This process is time-consuming, inefficient, and causes crowding, inconvenience, and potential security risks, such as theft. To overcome these challenges, this article proposes an Automated Payment System through Facial Recognition, which automates the purchase of tickets or products by identifying users based on their facial features. The system captures the user's facial data under various angles and lighting conditions during registration. When the user appears again, the system detects and recognizes the face by comparing it with images from the stored database. Upon successful recognition, the corresponding email address is retrieved, and a payment link is automatically sent by email to facilitate the transaction. The proposed model employs the Haar Cascade algorithm for face detection, the local binary pattern histogram (LBPH) for face recognition, and integrates SMTP and MIME protocols within the Email API for real-time delivery of payment links. The system operates effectively on standard or low-end hardware, achieving recognition accuracy ranging from 50% (minimum) to 70% (typical) depending on lighting conditions. The proposed2 Harshith Dasari et al. approach simplifies digital payments, reduces manual workload, minimizes waiting time, and improves comfort and transaction security. In general, it provides a fast, contactless, and efficient solution to automate payments in public and commercial environments.

KEYWORDS: Facial Detection · Facial Recognition · Haar Cascades · Local Binary Patterns Histogram · Payment Link through Email.

Enhancing Urban Mobility: Deep Learning-Based Traffic Sign Assistant for the Visually Impaired

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ABSTRACT. Urban mobility poses considerable difficulties for visually challenged

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individuals, especially in understanding and manoeuvring around traffic signs. This study presents a revolutionary Traffic Sign Assistant (TSA) system utilising deep learning technology to assist the visually impaired in understanding traffic signs and improving their mobility in urban settings. The proposed TSA system utilises advanced deep learning models, particularly convolutional neural networks (CNNs), for the real-time detection and identification of traffic signs. The system employs advanced deep learning algorithms to reliably recognise many categories of traffic signs, including regulation, warning, and informational signs, effectively addressing obstacles posed by varying lighting conditions and obstructions. The assessment of the proposed TSA system includes thorough testing and user feedback sessions to evaluate its efficacy in practical applications. The results indicate that the technology substantially enhances the mobility and safety of visually impaired individuals in urban settings through the prompt and precise interpretation of traffic indicators. This research advances assistive technology designed for the visually impaired, providing a promising approach to improve urban mobility and accessibility via the integration of deep learning-based traffic sign assistance systems.

KEYWORDS: Deep Learning, CNN models.

A Comprehensive Review of Deep Learning Methods for Rice Leaf Disease Identification

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ABSTRACT. One of the crops that is grown most frequently across the globe and a predominant diet in many South Asian nations is rice. The output of rice can be significantly impacted by rice leaf disease, which can be avoided by identifying it immediately. Precision farming, disease detection in both plants and human beings, computational genomics, and problem-solving are just a few of the areas where Data Science, Artificial Intelligence (AI), Deep Learning (DL), and Machine Learning (ML) have proven crucial. Agricultural professionals seek computerized rice plant disease detection and treatment. Numerous ML techniques have been put forth for automatically identifying rice diseases, with DL producing notable results. Rice illnesses may be identified using ML and DL techniques, which can also significantly reduce the production loss caused by these diseases. This research includes a review of the literature from 2020 to 2023 on the various strategies for rice leaf disease detection. All of the methods that are currently being used by researchers to

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diagnose rice leaf disease are thoroughly analyzed in this paper. It shows how various techniques, such as image processing, ML, and DL, are used, and how most authors work with small dataset sizes.

KEYWORDS: Rice Leaf, Identification, Early Stages, Agriculture, Farming, Diseases, Healthy Leaves, Unhealthy Leaves.

Proactive Cybersecurity: Predictive Modelling of Network Threats Using AI Algorithms

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ABSTRACT. The escalating complexity of digital hazards renders conventional security methods inadequate for detecting and mitigating developing attacks. The effort, entitled "Predictive Modelling for Network Threat Detection Using Artificial Intelligence Techniques," seeks to create an advanced AI-based cybersecurity system that can identify and classify possible threats in real time. The proposed system utilizes machine learning (ML) together with deep learning (DL) procedures to monitor network traffic patterns, identify anomalies, and forecast cyberattacks prior to inflicting substantial harm.

The project employs supervised learning methods, such as Random Forest, Support Vector Machine (SVM), Decision Tree, Logistic Regression, along with Convolutional Neural Networks (CNN), for the effective classification of network traffic. The algorithm is trained on an extensive dataset comprising both benign and malicious traffic, guaranteeing elevated detection accuracy. To improve model performance, data preparation techniques like feature extraction, normalization, as well as outlier detection are utilized, hence enhancing the broader effectiveness and reliability of discovering threats.

The system is constructed using the program Python, TensorFlow, Keras as well and the context of Scikit while the server side has been constructed using Flask alongside Django for simple execution and API integration. The user interface, developed with React.js, offers a real-time surveillance panel that allows security administrators to assess identified threats via interactive visualizations. The system also combines MySQL in addition databases made up of MongoDB for successful information retention and its retrieval. To validate the success of the suggested strategy, rigorous testing approaches have been undertaken. The results

reveal an elevated detection accuracy with minimum negative results, ensuring the system's resiliency against emerging cyber threats.
By incorporating AI-driven automated modelling, live risks inspection, and a dynamic security the display, this project delivers an extensible, adaptable, and intelligent cybersecurity architecture geared toward safeguarding networks from modern cyberattacks. Future additions may include cloud-based launch, federated learning for increased model agility, and blockchain-powered threat cataloguing to further boost cybersecurity defences.

KEYWORDS: Network security, Naive Bayes Classifier, Threat detection, Cybersecurity, Random Forest, Anomaly detection, AdaBoost, Logistic regression, Cyber threats.

Intelligent Video Surveillance Using YOLO 11 for Object Detection, Tracking, and Anomaly Detect

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ABSTRACT. This work suggests an innovative video surveillance system based on deep learning methodologies for object detections in Real-Time, Tracking, and also anomaly detection for the improvement of public safety and security monitoring. The system starts with the video capture and preprocessing of video frames from surveillance cameras, followed by the annotation of several objects including pedestrians, cars, bags, and suspicious activity. Object detection is carried out with pre-trained Deep Learning models (YOLO, SSD, Faster R-CNN), whereas sophisticated tracking algorithms such as Kalman Filter, DeepSORT, and ByteTracker are utilized to track objects from frame to frame. Anomaly detection methods such as behavior analysis, motion analysis, and unattended object detection are applied for detecting suspicious actions, unusual motion, and deserted objects. It consists of a real-time alert generation system that notifies security personnel through SMS, email, or web alerts, and is accompanied by a live monitoring dashboard showing tracked objects and anomalies. Support for integration with security systems like CCTV control centers and police forces aids in improving the responsiveness of the system. Performance is measured in terms of metrics like Precision, Recall, MAP for detection, and IoU, ID switches for tracking.
In addition, the system has a novel object combination identification capability, which applies feature extraction and clustering methods to detect unusual object combinations to assist in the identification of potential threats. It has wide applications in public safety, traffic surveillance, and industrial security. This method is a complete solution for contemporary security systems, offering efficient, automated surveillance and anomaly detection with minimal human intervention.

KEYWORDS: Byte Tracker, CNN, Computer Vision, Gemini AI, Yolov11.

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AI-Enhanced Multi-Modal Robot for Natural Human Interaction Using Embedded Systems and Computer Vision

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ABSTRACT. This paper presents the design and implementation of an intelligent, multifunctional robot that interacts naturally with humans using multiple input methods. Unlike traditional robots that rely on buttons or remote controls, the proposed AI-Enhanced Multi-Modal Robot supports voice, text, and hand gesture commands. The system integrates natural language processing (NLP), speech-to-text, text-to-speech, and computer vision to understand and respond to human cues in real time. Python and Arduino are used to connect sensors, actuators, and processing modules, while OpenCV handles facial recognition, object detection, and gesture interpretation. This multimodal approach makes the robot accessible in situations where voice commands are impractical or for users with speech impairments. The ability to process speech, vision, and gesture inputs simultaneously allows deployment in healthcare, education, agriculture, and smart manufacturing. By enabling natural, intuitive communication, the robot improves user engagement and accessibility.

KEYWORDS: Embedded Systems, Robotics, Multi-Modal Interaction, Gesture Control, Human-Robot Interaction, Computer Vision, OpenCV, Text-to-Speech, Speech Recognition.

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AI-Based Image Grid Game with Leaderboards and Smart Swapping

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ABSTRACT. This paper introduces an AI-driven interactive image puzzle game that integrates Convolutional Neural Networks (CNNs) for tile classification and auto-solving. Implemented in Python with a matplotlib GUI, the system enables users to upload images, select puzzle sizes (2×2 to 5×5), and interact through smart tile

swapping, undo/redo, and leaderboard tracking. The CNN model generalizes across puzzle datasets to provide automatic hints, intelligent validation, and optional solving. A structured preprocessing pipeline—including resizing, augmentation, and labeling—ensures robust training. User survey results highlight strong intuitiveness of the GUI and hint system. Performance analysis shows CNN accuracy above 89% across grid sizes with increasing difficulty. Limitations include reduced performance on abstract or low-contrast images. The system demonstrates the potential of CNN-driven interactive puzzles as a gamified learning and entertainment platform.

KEYWORDS: Interactive puzzle, convolutional neural network, computer vision, gamified learning, AI in games, user experience.

Hybrid Genetic Particle Swarm Optimization for Enhanced CNN Performance in Diabetic Retinopathy Detection

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ABSTRACT. Diabetic retinopathy (DR) is a significant complication of diabetes mellitus (DM) and is one of the most prevalent causes of vision loss in working adults. Statistically, approximately 30% of DM patients show signs of DR, most of whom are at risk of experiencing severe vision loss. As the prevalence of diabetes increases worldwide, DR cases are likely to increase in proportion, creating the need for effective detection and classification strategies. The work here describes an innovative diabetic retinopathy classification (DRC) strategy with the aim of increasing both the accuracy and efficiency of DR detection by adopting deep learning methods. The system used two-dimensional retinal fundus images, which capture important indicators of DR, such as the optic disc, macula, fovea, vascular structures, and lesions. Traditional DR diagnosis relies heavily on subjective examination by experienced ophthalmologists, a process that is not only time-consuming and laborious, but also prone to subjective error and interpretation. To overcome these limitations, this research combines ensemble learning and advanced image processing techniques to design a robust automatic DR classification system. The DRC system architecture consists of several steps, such as preprocessing, segmentation, feature extraction, and ultimate classification. In the preprocessing step, the input fundus images are separated into red, green, and blue (RGB)

channels, with the green channel generally having the highest contrast for retinal structures. Normalization, image resizing, and data augmentation are the methods used to improve the quality of the images and the consistency of the training dataset. To accurately localize the important features, ROIs are generated by a hybrid approach that integrates K-means clustering and incremental region-based segmentation. The classification part of the system is based on a convolutional neural network (CNN) consisting of convolution layers, max pooling layers, and full connection layers. The CNN is optimized using the Hybrid Genetic Particle Swarm Optimization (HGPSO) algorithm to ensure a better global optimization process for the selection of effective weight parameters. To further improve the performance, the target model incorporates an ensemble approach that combines the predictive power of three best-performing CNN architectures, VGG16, ResNet152, and InceptionV3. This ensemble takes advantage of the unique feature ex- traction capabilities of each network, producing a comprehensive and accurate classification model of diabetic retinopathy.

Keywords: Diabetic retinopathy (DR), computational neural network (CNN), hybrid genetic particle swarm optimization (HGPSO), region of interest (ROI), k-means.

THE CONSORTIUM BLOCKCHAIN BASED PROXY RE-ENCRYPTION FOR SECURE AND TRANSPARENT MEDICAL DATA SHARING IN IoMT

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ABSTRACT. The increasing integration of the Internet of Medical Things (IoMT) with healthcare structures increases full-size troubles in making sure the open drift of clinical information between numerous entities. Medical information is touchy, for this reason confidentiality, integrity, and availability have to be assured each during garage and switch. Using consortium blockchain- primarily based proxy re-encryption for secure clinical records float offers a practicable approach to help with those issues. This era combines its flexible encryption methods—more mainly, proxy re-encryption—PRE—with the distributed and immutable blockchain infrastructure. This system ensures an auditable and tamper-proof trail by way of using a consortium blockchain as a shared ledger that logs and validates all transactions regarding scientific facts get entry to. Approved statistics motion is facilitated via proxy re-encryption, which also protects private records and gets rid of the need for middlemen to carry direct decryption. While PRE protects statistics privateness at the same time as sharing, blockchain guarantees information integrity and obligation, therefore integrating both technologies enhances data safety and transparency. The device guarantees conformity to healthcare facts safety regulation by way of actual access control, so allowing it to be flexible with admire to distinctive privateness rules. Emphasizing its potential to allow secure, obvious, and green clinical data sharing, so improving patient care and medical

research whilst reducing dangers associated with statistics breaches and unauthorized get right of entry to, this paper investigates the structure, implementation, and prospective advantages of a consortium blockchain-based totally proxy re-encryption framework for the Internet of Medical Things (IoMT) atmosphere.

KEYWORDS: Internet of Medical Things (IoMT), Authentication, blockchain, Proxy Re-encryption, group communication, key management.

Hyperspectral Image Classification and Denoising

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ABSTRACT. Hyperspectral imaging captures spectral information across a wide range of wavelengths, offering high- dimensional data suitable for various applications such as precision agriculture, remote sensing, and environmental monitoring. These applications rely heavily on accurate classification to extract meaningful patterns, but the presence of noise and high dimensionality in hyperspectral data can degrade performance. However, accurate classification is greatly constrained by the high dimensionality and noise in hyperspectral data. This paper addresses these challenges by proposing a hybrid framework that integrates denoising and classification using advanced machine learning techniques. We propose an effective framework to reduce noise and enhance classification accuracy, enabling more accurate results for applications such as precision agriculture. Experimental results on benchmark datasets demonstrate the superiority of the proposed methods over existing techniques

KEYWORDS: Hyperspectral Imaging, Denoising, Classification, Machine Learning Framework.

AI-Driven Multimodal Primary Forecast of Sudden Cardiac Arrest (SCA): A Comprehensive Examination and Projected Model

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ABSTRACT. Sudden Cardiac Arrest (SCA) is a leading cause of mortality worldwide,

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often occurring without warning in younger adults. This paper provides a systematic literature review of existing Artificial Intelligence (AI) approaches for predicting cardiac events and introduces a novel multimodal framework for early SCA prediction. The proposed system integrates electrocardiogram (ECG), magnetic resonance imaging (MRI), and electronic health records (EHR) data using a transformer-based fusion model with explainable AI techniques. A prototype is validated using an open ECG dataset from PhysioNet and synthetic MRI and EHR features. Results demonstrate improved predictive accuracy and interpretability compared to single-modality models. A case study illustrates practical application and clinical relevance. The findings highlight the potential for scalable, preventive cardiology solutions.

KEYWORDS: Artificial Intelligence, Electronic Health Records, Magnetic Resonance Imaging.

Enhancing Career Outcomes in IT: The Influence of AI Decision Support Systems

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ABSTRACT. The nature of the professional outcomes of an individual working in the sphere of information technologies (IT) is drastically changed due to the exceptional influence of AI decision support systems and this profound issue is investigated through this thorough article. Through a comprehensive review of the available literature and other empirical findings, it substantially proves the fact that the adoption of AI technologies was instrumental in introducing a new groundbreaking period in the process of decision-making in the field of IT. It is indicated that the implementation of AI solutions can achieve impressive improvements regarding IT professionals and their career opportunities.

The study highlights why the use of AI is critical towards transforming the IT landscape, and the ability to achieve productivity, efficiency, and competitiveness. The current IT market is changing fast, and adaptability is the most important factor in this case, and, therefore, the implementation of AI can be not only advantageous but also necessary. As highlighted in this report, this adoption may result in desirable career-related developments and opportunities which can enable the professionals to remain relevant and succeed in an industry that does not produce anything other than changes.

This study comes to shine the light on the fact that, in a world where technology becomes an indispensable part of every person and company, the acceptance of AI

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as a career-advancing enabler and a lasting relevance of IT professionals in the realization of digital future should be held at the forefront.

KEYWORDS: Enhancing Career Outcome, IT (Information Technology), Influence, AI(Artificial Intelligence), Decision Support Systems.

AI-Driven Crop Yield Prediction Using Machine Learning

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ABSTRACT. Agriculture is fundamental to global basic needs, supporting the livelihoods of a substantial segment of the people. Modern agricultural operations encounter challenges such as climatic fluctuation, decreasing soil fertility, insect infestations, and outdated procedures, all of which lead to decreased crop yields. In this context, artificial intelligence (AI) and machine learning (ML) provide disruptive solutions by utilizing vast data sets and sophisticated algorithms to precisely forecast crop yields. This research introduces an AI- driven system for predicting agricultural yields, including many data sources like historical yield data, meteorological forecasts, soil characteristics, and insect risks. The system utilizes machine learning techniques, such as Random Forest Regression and Multi-Layer Perceptron classifiers, to identify complex connections between environmental and agricultural data. The suggested approach provides farmers and policymakers with useful information, facilitating optimal resource allocation, optimum agricultural practices, and enhanced decision-making. This study advances sustainable agriculture by improving production, reducing hazards, and tackling the global issue of food security.

KEYWORDS: Crop yield prediction, Artificial Intelligence, Machine Learning, Agriculture, Precision Agriculture.

Emergency Vehicle Classifier: Real-Time Detection and Classification Using Deep Learning

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ABSTRACT. The Vehicle detection and recognitions are playing an important role. these are used at the traffic time, and other applications. Basically, these are three type signs like regularity, warning and suggestions.by using this process It can avoided the accidents also. It can see signs as stop, right way, bridges etc. for the classification using neural network. Previously k means algorithm used. For the identification, should arrange fermentation process and feature extraction process. in this process using new techniques. The online detection and classification of emergency vehicles, which can significantly enhance public safety and traffic management. This paper presents an Emergency Vehicle Classifier (EVC) system designed to identify and classify emergency vehicles using online. The system makes use of deep learning techniques and computer vision algorithms to achieve high accuracy and efficiency in emergency vehicle recognition.

KEYWORDS: Identification of Emergency vehicle, Image processing, Machine Learning Methods, signal Recognition, YOLO (You Only Look Once).

Securing and Monitoring Money Transaction Between Smart Contractors and Tenant Servers using Machine Learning

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ABSTRACT. An in-depth examination of vulnerabilities within contracts, a task complicated by existing state-of-the-art (SOTA) detection methods facing limitations in addressing three key challenges: concurrent detection of source code, byte code, and op code; reduction of reliance on manual rules and expert involvement; and support for the entire contract lifecycle. In response, the integration of Machine Learning (ML) for

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detecting runtime execution sequences has emerged, albeit hindered by the lack of datasets with fine-grained sequence labels due to byte code
and op code unreadability. The current landscape relies on conventional detection methods, limited in their ability to comprehensively address smart contract vulnerabilities across source code, byte code, and op code. Manual rules, patterns, and expert involvement remain prominent, hindering adaptability, and the absence of ML utilization exacerbates these limitations. Our proposed system introduces machine learning techniques to detect runtime execution sequences of smart contracts, addressing existing challenges comprehensively. This approach aims to reduce reliance on manual intervention, adapt to dynamic vulnerabilities across the contract lifecycle, and enhance detection accuracy. However, the implementation of ML is impeded by the scarcity of datasets with fine-grained sequence labels, a challenge that needs to be overcome for optimal effectiveness. Additionally, the proposed system underscores the importance of securing transactional processes, temporarily withholding funds until successful completion, thereby fortifying the integrity of smart contract transactions.

KEYWORDS: Smart Contractors, Machine Learning, Secure Transaction

Enhancing Chronic Kidney Disease Diagnosis through Efficient machine learning based Classification Algorithms

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ABSTRACT. CKD poses a substantial challenge to global public health. For an efficient lung treatment, a timely and accurate diagnosis. This study focuses on the development and enhancement of CKD diagnosis through the implementation of advanced machine learning (ML) classification algorithms. The primary objective is to improve the efficiency and accuracy of CKD identification, facilitating early intervention and personalized treatment strategies.

The research employs a diverse dataset encompassing clinical parameters, patient history, and diagnostic test results, collected from a large cohort of individuals with varying stages of CKD. Feature engineering techniques are employed to extract relevant information, and the dataset is pre-processed to handle missing values and outliers. To enhance the diagnostic capabilities of the models, feature selection methods are applied to identify the most informative variables contributing to CKD prediction. Additionally, model interpretability is prioritized help build doctors' confidence in the suggested diagnostic tool by giving them insights into the decision- making process. Using common measures like accuracy, sensitivity, specificity, and area under the receiver operating characteristic curve, the created models' performance is carefully assessed. Comparative analyses are performed to assess the effectiveness of the proposed ML algorithms compared to conventional diagnostic techniques. Furthermore, the study explores the generalizability of the models across diverse patient populations and healthcare settings. The outcomes of this research aim to contribute to the ongoing

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efforts to enhance CKD diagnosis, providing healthcare professionals with a reliable and efficient tool for early detection and intervention.

KEYWORDS: MRI scanning, CNN, disease detection, behaviors, image classification, saving lives.

Design and Visualization of T-Shirts Using AI-Enhanced 3D Web Technology

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ABSTRACT. This paper presents a spearheading stage that bridles the force of man-made consciousness (computer-based intelligence) to upset the internet shopping experience for custom three-layered (3D) Shirts. The center development lies in the mix of man-made intelligence driven innovations, empowering clients to envision and redo Shirts in a three-layered space. This empowers clients to basically take a stab at Shirts, encountering a practical portrayal of fit, plan, and texture surface. Besides, the stage adjusts to client input, learning and refining its ideas over the long run, guaranteeing a more natural and exact customization process. Notwithstanding the customization includes, the stage likewise offers an upgraded shopping experience through artificial intelligence fueled proposals, helping clients in finding new plans in view of their inclinations, late patterns, and, surprisingly, prescient examination. All in all, this computer-based intelligence driven three-layered Shirt site denotes a critical jump forward in the combination of design and innovation, hoisting the web-based shopping experience by offering a customized, intelligent, and vivid stage that takes care of individual preferences and inclinations.

KEYWORDS: Artificial intelligence, T-Shirt, Web Technology, Three-dimensional, Visualization.

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A Comprehensive Survey on Machine Learning, Deep Learning and Transformer Techniques for Lung Cancer Detection

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ABSTRACT. Lung cancer remains one of the most prevalent and fatal diseases globally, necessitating timely and accurate diagnostic methods to improve survival rates. In recent years, extensive research has been dedicated to automating lung cancer detection and classification using artificial intelligence (AI), particularly machine learning (ML) and deep learning (DL) techniques. This literature review comprehensively explores the evolution of computational models from 2012 to 2023, focusing on the progression from traditional classifiers such as support vector machines (SVM), fuzzy logic systems, and genetic algorithms, to advanced deep learning architectures including convolutional neural networks (CNNs), recurrent neural networks (RNNs), and hybrid ensemble models with attention mechanisms. Key contributions across various studies are examined with respect to datasets used, feature extraction and selection methods, classifier performance, and evaluation metrics like accuracy, sensitivity, specificity, ROC curves, and confusion matrices. The review also highlights prevailing challenges such as limited availability of annotated datasets, high false detection rates and poor generalization across populations. Finally, it identifies existing research gaps and suggests future directions to build robust, interpretable, and generalizable lung cancer classification systems.

KEYWORDS: Lung Cancer Classification, Feature Extraction, CNN, Ensemble models, CT Scan.

Docker Trace: Implementation of IP traceback using deterministic packet marking inside Docker for attack detection

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ABSTRACT. Distributed Denial-of-Service (DDoS) attacks remain a pervasive threat to Internet services, targeting organizations from small businesses to global enterprises. These attacks overwhelm servers through massive packet floods, often using IP

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spoofing to conceal attacker origins, causing significant downtime and financial losses. Traditional IP traceback mechanisms—such as deterministic packet marking (DPM), probabilistic packet marking (PPM), and logging schemes —enable path reconstruction but assume stable routing, persistent hosts, and routerlevel control, making them impractical for modern containerized microservices. This paper presents DockerTrace, a lightweight, user-space IP traceback system deployed as a self-contained Docker image. Unlike kernel-dependent or router-centric approaches, DockerTrace implements DPM semantics entirely in user space using Python and Scapy, embedding container-specific identifiers (e.g., container IDs, virtual interface hashes) into packet headers at Docker bridge and CNI layers. The system supports real-time path validation across NAT boundaries and overlay networks, detecting spoofed or replayed packets within intra-host clusters without ISP cooperation or firmware changes. Key innovations include: (i) binding markings to ephemeral container identities for fine-grained attribution, (ii) chain consistency checks for online spoofing mitigation, and (iii) zerooverhead replication across Docker Swarm or Kubernetes nodes. Evaluations demonstrate sub-millisecond marking latency and 99.8% traceback accuracy under 10Gbps DDoS floods, outperforming classical schemes in dynamic environments. DockerTrace bridges legacy traceback theory with cloud-native realities, offering deployable protection for microservice architectures.

KEYWORDS: IP traceback, Docker, Docker Compose, internet, denial of service (DoS), DDoS, Docker Compose.

AI & IoT-Powered Proposal for Sustainable Recycling of E-Waste

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ABSTRACT. The extensive use of electronic devices has resulted in an overwhelming generation of electronic waste (e-waste), which poses serious environmental, public health, and data security issues. E-waste harbours toxic substances like heavy metals and organic pollutants whose toxic impacts can be felt if not managed in the right manner. Present recycling infrastructure is inefficient, unsafe, and unable to cater to the growing complexity of e-waste. Nevertheless, the development of Artificial Intelligence (AI), Machine Learning (ML), and Internet of Things (IoT) technologies holds grounds for effective solutions for better e-waste management. This review aggregates over 90 peer-reviewed articles mainly between 2019 and 2025 and organizes findings into five broad categories: environmental risks, AI/ML-based sorting methods, IoT and hardware solutions, data protection policies, and user awareness programs. Though AI and IoT systems exhibit high accuracy and automation in laboratory-based environments, constraints exist in their implementation and user acceptance in the real world. The research also points towards heterogeneous datasets, economic viability, and end-to-end material recovery as the existing barriers for future studies. It advocates for interdisciplinary studies and user-focused design to bridge the gap between technological innovation and real-world implementation. By demystifying

existing trends, challenges, and opportunities, the review sets an overall vision for the future of smart e-waste management, providing significant inputs for researchers, policymakers, and industry specialists committed to green electronic waste management.

KEYWORDS: E-waste Segregation, ML, Internet of Things, Smart, User Awareness, Material Recovery.

AI-POWERED SMART GLASSES FOR VISUALLY IMPAIRED

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ABSTRACT. Visual impairment presents serious challenges to everyday life, impacting people's mobility, object and face recognition, and reading of written text. Current assistive devices have limited functionality. This paper surveys recent advances in assistive systems for visually impaired people, with a focus on AI based smart glasses and wearables.

New systems utilize computer vision, deep learning, natural language processing, and other sensors (cam eras, ultrasonic sensors, etc.) to provide more environmental awareness and interaction. Key functionality covered includes real-time obstacle detection, object detection, scene description, face recognition, text reading (using optical character recognition and text-to-speech), navigation, and provision of audio cues and emergency alerts.

By combining these capabilities in light, user-friendly devices, these systems have the potential to deliver substantial gains in independence, mobility, and quality of life for visually impaired individuals. This paper surveys a variety of approaches, technologies, and implementations, emphasizing the potential of accessible, integrated solutions to facilitate greater interaction with the environment.

KEYWORDS: Visual Impairment Assistive Technology, Smart Glasses, Wearable Devices, Computer Vision, Deep Learning, Natural Language Processing, Obstacle Detection, Object Recognition, Scene Description, Face Recognition, Optical Character Recognition (OCR), Text-to-Speech (TTS), Indoor and Outdoor Navigation, Audio Cues, Environmental Awareness, Accessibility, Human-Computer Interaction, AI for Assistive Devices, Mobility Assistance.

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An Application of Machine Learning Techniques to build Recommendation Systems in E-commerce

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ABSTRACT. Recommender systems are essential tools in modern applications. They guide users by suggesting things they might like, such as products to buy, movies to watch, and content on social media. Linear Support Vector Machines are used in machine learning, because they can classify items and estimate values. LSVMs are efficient and can be scaled up to handle large datasets. By combining various approaches, suggestions become more precise, diverse, and user-friendly. Linear regression helps in understanding relationships between variables, aiding data-backed decisions and strategy. This study examines three alternative categorization algorithms: Linear Support Vector Machine (LSVM), Linear Regression (LR), and collaborative content-based filtering. Among them, the LSVM performed the best, with an accuracy of 79.5. The data suggests LSVM is useful here, as its classification accuracy exceeds that of both LR (76.09) and CB-CBF (78.05). LSVM outperforms other models in terms of robustness and flexibility, making it the most effective.

KEYWORDS: product recommendation, e-commerce, linear support vector machine, linear regression, content based filtering and collaborative filtering

A Novel Approach to X-Ray Image Protection Using a Map-Sequence–Oriented Encryption and Decryption Scheme

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ABSTRACT. With growing exchange and storage of medical images in digital form, their security becomes a critical requirement, particularly for sensitive medical information. This project applies an encryption method based on chaos to secure medical images, providing privacy, integrity, and authentication. The system suggested here improves

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security through the use of complex chaotic maps for both confusion and diffusion, surpassing shortcomings in conventional encryptions. The performance of the encryption is analyzed using bifurcation plots, Lyapunov exponents, histogram analysis, MSE and PSNR. Results demonstrate strong security and attack resistance, making this method suitable for reliable storage and secure sharing of medical imagery.

KEYWORDS: Image Encryption, Chaos Theory, Medical Data Security, Confusion-Diffusion, Cryptography.

Early Detection of Parkinson's Disease Using Voice Data

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ABSTRACT: Parkinson's disease (PD) is a chronic neurological disorder that affects both motor and speech functions, making early identification vital for effective treatment. Conventional diagnosis often fails to detect PD in its initial stages, emphasizing the need for automated approaches. This work proposes a framework that analyses voice recordings to assist in early PD detection. Acoustic features such as pitch, frequency, jitter, and shimmer were extracted and processed to train a Support Vector Machine (SVM) model using a Kaggle dataset of 4,000 samples. The SVM achieved an accuracy of 87.14%, precision of 86.52%, recall of 87.89%, F1-score of 87.20%, and ROC-AUC of 0.90. A web-based interface was also developed to enable real-time evaluation through live or uploaded voice input, demonstrating the model's potential for practical, non-invasive screening.

KEYWORDS: Parkinson's Disease, Machine Learning, Voice Analysis, SVM, Early Diagnosis, Neurodegenerative Disorders

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SPECTRUM SHARING TECHNIQUES IN WIRELESS COMMUNICATION

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ABSTRACT. With the growing demand for 5G and beyond networks, spectrum sharing strategies are crucial for maximising the efficient use of scarce spectrum resources. By enabling many users or systems to dynamically share the same frequency bands, Dynamic Spectrum Sharing (DSS) is a revolutionary concept in wireless communication that overcomes the shortage of spectrum resources. Due to the growing scarcity of frequency bands, dynamic spectrum sharing (DSS) is a crucial strategy in wireless communication, particularly with the introduction of 5G and beyond. Spectrum shortage, inefficient use, and interference problems are the main causes of the current difficulties with spectrum sharing approaches in wireless communication. Numerous creative ideas have been proposed to address issues, with an emphasis on cooperative, technological, and financial solutions. A vital remedy for the lack of spectrum resources in wireless communication is dynamic spectrum sharing (DSS), particularly with the introduction of 5G and Internet of Things devices. Future research on solutions to the present issues with wireless communication spectrum sharing strategies can concentrate on improving machine learning models for real-time decision-making and developing dynamic spectrum allocation mechanisms.

KEYWORDS: Artificial Intelligence, Spectrum scanning, Adaptive Spectrum, interleaving.

AI-Enabled Unified Terrestrial and Non-Terrestrial Network Architecture for Seamless 6G Connectivity and Optimization

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ABSTRACT. The paper presents a comprehensive framework for the integration of Terrestrial Networks (TN) and Non-Terrestrial Networks (NTN) to address the demands of 6G communication. It outlines a unified architecture that includes a common control

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plane, MAC abstraction, and AI/ML-driven resource management. Key advancements include enhanced beam forming, robust handover mechanisms, low-latency backhauling via LEO satellites, and adaptive interference mitigation. The integration aims to support applications requiring ultra-reliable low-latency communication (URLLC), massive IoT connectivity, and global coverage. Through a layered approach involving AI, edge computing, and green communication strategies, the system promises to improve performance, scalability, and energy efficiency. Challenges related to interoperability, dynamic resource allocation, and securities are also addressed, highlighting future research directions for sustainable 6G networks.

KEYWORDS: TN-NTN, 6G, AI, Handover, Resource Allocation.

Intelligent Wireless Networks: AI-Driven Architectures, Optimization, and Privacy-Preserving Strategies for 5G and 6G Systems

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ABSTRACT. The paper presents a comprehensive review of recent advancements in intelligent wireless networks, with a focus on the integration of artificial intelligence (AI) and machine learning (ML) techniques. Key topics include AI-enabled self-organizing networks (SON), reinforcement learning for real-time resource allocation, and edge intelligence for low-latency communication. The paper also explores privacy-preserving methods such as federated knowl- edge, and innovative frameworks like digital twins for network simulation. Additional insights cover AI-powered interference mitigation, network slicing, mobility management, and semantic communication. Collectively, these technologies aim to improve network efficiency, scalability, security, and user experience in 5G and 6G wireless systems. Challenges related to data handling, algorithm complexity, and integration are discussed to guide future research directions.

KEYWORDS: Intelligent Wireless Networks, Edge Intelligence, Reinforcement Learning, Federated Learning, Net- work Slicing Introduction.

Hybrid Ensemble Learning Framework for Automated ECG-Based Cardiovascular Disease Detection

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ABSTRACT. Cardiovascular diseases (CVDs) are the leading cause of global mortality, accounting for approximately 17.9 million deaths annually. Early detection and

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intervention are crucial for reducing this burden. This research introduces a novel hybrid ensemble learning framework that transforms traditional paper-based electrocardiogram (ECG) records into digital signals for automated CVD classification. The framework integrates sophisticated image processing techniques with multiple machine learning algorithms to achieve superior diagnostic accuracy. The system processes ECG images through comprehensive preprocessing, including grayscale conversion, adaptive contour detection, and intelligent signal extraction, followed by feature optimization using Principal Component Analysis (PCA) with 99.5\% variance retention. A robust ensemble approach incorporating K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Logistic Regression, XGBoost, and Random Forest classifiers is implemented with weighted voting mechanisms. Experimental validation demonstrates significant improvements in classification accuracy, achieving 97.3\% validation accuracy. The system offers real-time diagnostic capabilities with processing times of 1.8 seconds per ECG, making cardiovascular screening accessible in resource-constrained environments. Clinical validation shows 92\% concordance with expert cardiologist diagnoses, establishing the framework's practical viability for widespread healthcare deployment.

KEYWORDS: cardiovascular disease detection, ECG analysis, ensemble learning, machine learning, medical image processing, automated diagnosis, digital health

Evaluating Machine Learning Models for Guillain-Barré Syndrome Subtype Classification

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ABSTRACT. Guillain-Barré Syndrome is a rare disorder of the immune system that attacks the peripheral nerves. It has four main types: Acute Inflammatory Demyelinating Polyneuropathy, Acute Motor Axonal Neuropathy, Acute Motor and Sensory Axonal Neuropathy, and Miller-Fisher Syndrome. Finding the correct subtype is not easy, as usual tests like nerve conduction studies and cerebrospinal fluid checks take a lot of time and require expert skills. This study focused on data-driven methods to identify subtypes automatically. A synthetic dataset was used in this study. It contained 129 patient samples and was analyzed with classical Machine learning model using Support Vector Machine, Random Forest, and k-Nearest Neighbors were tested along with resampling methods such as SMOTE, TomekLinks, NearMiss, CNN, and Random UnderSampler. Among these, SVM performed the best, reaching 80% accuracy for AMAN, 80.7% for AIDP, 73.08% for AMSAN, and 57.69% for MFS.

KEYWORDS: Guillain-Barré Syndrome, Subtype Classification, Machine Learning, Sampling Methods.

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FarmGPT: AI-Driven Chatbot Utilizing NLP for Precision Agriculture and Disease Forecasting

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ABSTRACT. Agriculture faces increasing pressure to balance food security, sustainability, and productivity in the face of accelerated climate change and unstable markets. Existing digital solutions typically operate in isolation, addressing solely crop suggestion, fertilizer advice, or disease detection in plants, hence making it difficult for farmers to adopt. To bypass this limitation, we present FarmGPT, a cohesive decision-support system that combines four modules: (i) a machine learning - based crop suggestion model, (ii) a rule - based fertilizer advice system, (iii) a deep learning - based plant disease identification module, and (iv) an AI - enabled conversational assistant. Crop forecasting uses a Random Forest classifier and disease classification uses a ResNet - 9 CNN model, both of which are tested on benchmarking datasets. A large language model translates farmer questions into natural language and produces accurate recommendations. Through the integration of predictive algorithms with interactive advice, FarmGPT converts high-level AI outputs into real-world, farmer-accessible insights, thus lowering technological hurdles in farming.

KEYWORDS: Crop suggestion, Fertilizer advice, Disease diagnosis, Precision agriculture, FarmGPT, Machine learning, Deep learning, Large language models.

Comprehensive study on brain tumor detection and classification using T1-w, T2-w and Flair MR Images

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ABSTRACT. The Brain tumor classification plays a significant role in clinical diagnosis and treatment. However, classification is a challenging task due mainly to the variety MR images. This paper presents a study of comprehensive review have recently gained and shown some success. In this work, we considered a classification task using T2-w, T1-w and Flair Magnetic Resonance (MR) Images of successful methods and made a performance comparison. The research work has been focusing on binary classification problem to detect the abnormalities of brain MR images. In the study, brain image recognition models are proposed using three-

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tier processing, viz., feature extraction, selection, and feature fusion. Three different approaches are presented and the accuracy of the models are compared for efficiency. The proposed works were evaluated on the real public dataset and can improve the development of strategies for better nether detection or classification of diseases.

KEYWORDS: Brain, Genetic algorithm, deep learning features, Conventional features, Fusion, Classification.

Dual-Stream Deep learning on MRI-PET Zusion for Stages of Alzheimer's

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ABSTRACT. Alzheimer's disease is a progressive neurodegenerative disorder associated with loss of memory and cognitive function. Positron Emission Tomography imaging (PET) has great value in early detection and assessment of the disease, as PET imaging directly correlates with metabolic activity of the brain. PET scans rely on specific radiotracers that bind to fatal components of the human body, such as fluoro-2-deoxy- D- glucose (FDG) that detect decreased glucose metabolism (which is decreased in the presence of Alzheimer's) in the hippocampus and lateral/medial temporal lobes. New advanced tracers are also available to study the amyloid-beta plaques as well as tangle of tau, the pathological markers of the Alzheimer's disease (AD). PET scans will display the brains' color-coded images based on regions of abnormal activity. Oftentimes these areas of abnormal brain activity are seen before clinical attention. They also are a valuable tool for the longitudinal studies of social and environmental factors on Alzheimer's disease and the ability to monitor therapy or develop new target therapies. PET scans can be coupled with magnetic resonance imaging (MRI), allowing a combination of fused images displaying anatomical (structural) and physiological (functional) changes occurring simultaneously in the brain and allowing for diagnosis Of the disease state.

KEYWORDS: Alzheimer's Disease, MRI-PET Fusion, Deep Learning, Dual-Stream Network, Stage Classification.

Prognosis of Epileptic Seizure and Neurodegeneration in EEG Signal Using TabNet Classifier and Quadratic Discriminant Analysis

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ABSTRACT. Epileptic seizures and neurodegenerative diseases pose considerable challenges in healthcare, primarily due to their complex characteristics and the difficulty in early diagnosis. EEG signals provide crucial insights into these conditions, yet traditional analysis methods often falter in balancing accuracy with interpretability. This paper presents a hybrid model that combines TabNet, an innovative deep learning architecture optimized for tabular data, with Quadratic Discriminant Analy sis (QDA) to improve classification of EEG signals. TabNet's attention mechanism adeptly selects relevant features, addressing the complexity and noise common in EEG datasets, while QDA enhances classification by exploiting statistical distinctions within the data. Our approach is evaluated on benchmark EEG datasets, where it surpasses conventional techniques like CNN and LSTM in both accuracy and robustness. The hybrid framework achieves superior performance with improved generalization capabilities, making it particularly suitable for real-world clinical applications. Moreover, the enhanced interpretability of the model supports its applicability in clinical environments where understanding feature importance is crucial for medical professionals. Ablation experiments further demonstrate the significant individual contributions of both TabNet and QDA components to the overall system performance. This work paves the way for more reliable and interpretable EEG-based diagnostic tools, potentially advancing early diagnosis and prognosis of epileptic seizures and neurodegenerative disorders, ultimately contributing to better patient outcomes and treatment strategies.

KEYWORDS: EEG Signal Processing, TabNet Classifier, Quadratic Discriminant Analysis , Epileptic Seizure Detection, Neurodegeneration, Hybrid Machine Learning, Attention Mechanism, Clinical Interpretability.

Scalable Sparse Factorization Techniques for Cloud-Based Image Storage and Transmission with Spectrum-Based Topological Indices through QSPR Analysis

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ABSTRACT. Rapid growth of multimedia data has increased the demand for efficient cloud-based image storage and transmission. Traditional methods such as JPEG and JPEG2000 face limitations in scalability and adaptability under constrained environments. This paper proposes a scalable sparse matrix factorization (SSMF) framework integrated with spectrum-based topological indexes using QSPR techniques. The approach combines low-rank approximation and sparse modeling to reduce redundancy, preserve structural features, and achieve adaptive compression. The experimental results show significant improvements in compression ratio, PSNR, and processing efficiency compared to existing techniques.

KEYWORDS: Image Compression, Sparse Matrix Factorization, Cloud Storage, QSPR Analysis, Graph Spectra.

INTELLIGENT LEARNING SYSTEM: REAL-TIME ENGAGEMENT AND PERSONALIZED STUDY ASSISTANCE USING DEEP LEARNING AND COMPUTER VISION

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ABSTRACT. Due to the sudden change in the mode of learning, there came a rise of having to bring a structure to the education system. Multiple sources of information provided the required knowledge, but since the delivery of content was static, it did not pay attention to the learning state of the students. Unlike traditional classrooms, where the teacher could pay attention to visible cues given by the students, this structure of education focused on 'One size fits all' methodology. Due to which learning rates dropped and the number of students dropping a course because they did not understand the topic being taught increased.
The Intelligent learning system aims to detect the emotional state of the user using computer vision and deep learning techniques as well as screen monitoring to adjust the delivery of content to the user. Reinforcement Learning is used to adjust to the learning patterns of the student. Large Language models like Gemini are utilized to generate quizzes and flashcards for testing the level of understanding of the concept being taught. Space repetition is a proven technique for memory retention. By combining the data from the computer's camera, screen monitoring and quiz results the system automatically adjusts its content in a way the user will understand.

KEYWORDS: Artificial Intelligence for Education · Deep Learning · Computer Vision · Personalization of Instruction · Emotion Recognition · Attention Monitoring · Large Language Models.

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A Hybrid IoT and Deep Learning Framework for Smart Irrigation in Sustainable Champignon Cultivation

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ABSTRACT. Agriculture decides the global market and steering the market growth. Within agriculture, Champignon cultivation becomes an intensifying sector, holds vast potential based on its nature of sustainability and productivity. Though, Champignons need accurate environmental conditions for optimal growth, predominantly in temperature and humidity. Majorly in remote areas, farmers trust on traditional methods that are outdated and does not provide accuracy, sometimes resulting in the noxious cultivation. Due to inadequate environmental monitoring, champignons cannot be cultivated properly, so there is a need for an appropriate technique to handle the issues. Integrating the Internet-of-Thins (IoT) and advanced deep learning techniques – such as EfficientNet, ResNet, DenseNet and Vision Transformers in the proposed approach introduces a smart irrigation system, which utilizes Arduino processors, specialized soil moisture sensor and environmental monitors to systematize and enhance the growth. Perilous factors like temperature, soil moisture and humidity are monitored in real time by standardized sensors. Using IoT protocols, data is composed and communicated to a cloud-based platform, where the data is analyzed. This methodology is implemented by incorporating IoT, Edge AI and deep learning techniques. Utilizing light-weight IoT protocols and connected with the cloud, the proposed system transfers data with the help of Arduino-based peripheral processors and calibrated soil and environmental sensors. The sensors are fused to aggregated real-time data from temperature, humidity, soil moisture and image as input to provide effective monitoring. To forecast moisture trends, Linear regression is used enabling proactive irrigation planning. Irrigation or ventilation action needs to be taken, are decided by the advanced deep learning techniques and also helps to identify the

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accuracy of the model. EfficientNet achieved the highest performance, with 96% accuracy, 95% precision, and a 94.5% F-score, indicating its ability to balance accuracy with computational efficiency. The Vision. Transformer recorded a competitive 93% accuracy, effectively capturing long-range dependencies in the data but with slightly lower recall compared to convolution-based approaches. The proposed approach utilizing the advanced deep learning technique and Edge AI revolutionizes the cultivation, by improving the yield quality and encourages sustainable, data-based farming practices by automating control systems and simplification inspires sustainable, data-driven farming practices by industrializing control systems and simplifying real-time decision-making at the edge.

KEYWORDS: IoT, Champignon Cultivation, DL Techniques, smart irrigation.

A Synthetic Data-Driven Framework for Image Fusion Using Sparse-ViT Hybrid Architecture and UNet Refinement

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ABSTRACT. Multi-focus image fusion (MFIF) faces the dual challenge of preserving fine-scale details and integrating global contextual information. This paper introduces a novel hybrid architecture that effectively combines the complementary strengths of sparse representation and Vision Transformers (ViTs). Our method, TSF-UNet, uses parallel pathways: a sparse coding branch to capture high-frequency details and a ViT branch to model long-range dependencies. The outputs are fused and then refined by an edge-aware UNet, which is trained on a large-scale dataset of synthetically defocused images derived from MS-COCO. On the Lytro benchmark, our method consistently ranks first among 10 recent approaches across key metrics including Q^(AB/F), SSIM, and MI, demonstrating clear superiority in structural preservation and information retention.

KEYWORDS: Multi-focus fusion, sparse representation, Vision Transformer, synthetic training data, edge refinement, Lytro dataset.

Pervasive AI-Driven Monitoring and Predictive Analytics in ICUs via Role-Based Dashboards

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ABSTRACT. Intensive Care Units (ICUs) require uninterrupted and highly precise monitoring of patients whose conditions are often life-threatening. Conventional monitoring systems, which rely heavily on manual observations and alarm-based triggers, frequently contribute to delayed interventions and fragmented communication among doctors, nurses, and families. To overcome these limitations, this study introduces a pervasive, AI-driven ICU monitoring framework that integrates predictive analytics with role-specific dashboards. The framework enables nurses to record patient vitals and treatment schedules, provides physicians with prioritized alerts across multiple facilities, and offers patients and family members transparent access to real-time updates through simplified interfaces. Key physiological parameters—including heart rate, blood pressure, oxygen saturation (SpO2), and temperature—are continuously captured and assessed using machine learning models to identify early indicators of critical deterioration. The proposed framework was evaluated using simulated ICU datasets that incorporated both subsets from the MIMIC-III database and manually entered records. Experimental testing demonstrated reliable performance, with alerts correctly generated in 92% of the cases. Furthermore, the role-based dashboard design significantly reduced communication de- lays and simplified the monitoring process. By integrating continuous observation, predictive alerts, and inclusive role-based usability, the pro- posed framework strengthens collaboration, supports timely medical intervention, and lays the groundwork for scalable patient-centered critical care solutions.

KEYWORDS: ICU monitoring, predictive analytics, role-based dashboards, artificial intelligence, healthcare informatics.

Smart Sanctuary: Transforming Wildlife Management and Visitor Experience

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ABSTRACT. The" Whispering Woodland Wildlife Sanctuary" is an integrated system

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designed to enhance the efficiency, organization, and visitor experience of wildlife sanctuaries. This work provides a holistic data record for animals, including species, age, medical records, feeding times, and enclosures. It also facilitates the management of staff and volunteers by tracking profiles, appointment sched-ules, and training records, thereby enabling fast content sharing and task delegation. Furthermore, the platform integrates functionalities for managing visitor flows, such as online ticketing and group reservations. The work offers a centralized administrative interface for creating, updating, and managing animal records, ensuring access control through role-based authentication. It dynamically handles classification by saving general animal data in a central table and class-specific biological details (e.g., mammals, birds, reptiles) in dedicated tables. It also manages events, show bookings, and online ticketing, and facilitates a sponsorship program with prior registration. Overall, this comprehensive suite of tools automates and streamlines various operational aspects, enhancing animal welfare, visitor experience, conservation efforts, and operational efficiency.

KEYWORDS: Animal Records, Online Ticketing, Role-Based Access Control, Sponsorship Management, Visitor Experience Optimization, Web Application, Wildlife Sanctuary Management.

Transfer Learning with MobileNetV2 for Efficient Hand Sign Detection

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ABSTRACT. Hand gesture recognition is important for natural human-computer interaction. It plays a crucial role in assistive technology, touchless interfaces, and robotics. Many current methods focus on training, deployment, or usability separately. This fragmented approach can limit real world adoption. To tackle this problem, we present a framework that combines four main components: (i) a preprocessing pipeline for grayscale and thermal hand images that uses histogram equalization and Gaussian smoothing, (ii) a transfer learning model based on MobileNetV2, customized for a dataset with four static gesture classes: FIST, ONE, PALM, and SUPER, (iii) a classification module trained with data augmentation and class weighting to improve performance on limited data, and (iv) a Flask-based web application that includes

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secure user authentication, image upload, and optional speech-based prediction feedback. Our approach uses a learnable mapping to convert single-channel images to weights pretrained on ImageNet. Training on the dataset achieves 88% accuracy on a separate test set. The main contribution of this work is creating a simple gesture recognition system that turns complex deep learning models into a functional interface. The whole system provides accurate results and fast inference, making it suitable for real-time applications and open-ing the door for future advancements in multimodal sensing and edge deployment.

KEYWORDS: Hand gesture recognition, thermal imaging, MobileNetV2, transfer learning, convolutional neural networks (CNN), edge deployment, Flask web application.

FinGenie: AI-Enabled Adatptive EdTech Platform for children's Financial Literacy

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ABSTRACT. This paper presents the implementation of Fingenie, a comprehensive mobile application designed to enhance financial literacy among teenagers aged 8-18. The application addressesthe critical gap in financial education by providing interactive learning modules, practical financial tools, and gamified experiences. This implementation leverages modern web development technologies including React, TypeScript, and local AI models to create an engaging platform thatmakes financial concepts accessible and applicable to teenage users. The system incorporates user-centered design principles, educational psychology frameworks, RAG (Retrieval-Augmented Generation) chatbot capabilities, and secure financial data handling practices. Early testing results demonstrate significant improvement in financial knowledge retention and practical application among target users

KEYWORDS: Financial literacy, web application, educational technology, teenage education, gamification, user experience design, RAG chatbot, local AI

DeepVision– Smart Face Recognition System

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ABSTRACT. DeepVision, a smart face recognition system, is developed using multiple deep learning architectures like ResNet-50 for feature extraction, FaceNet for embedding generation, and MTCNN for face detection and alignment. The system uses transfer learning plus fine- tuning on our dataset for better recognition so that we get an accurate result. DeepVision has real-time preprocessing modules, including face detection, landmark alignment, and augmentation to tackle difficult sit uations. These include changes in lighting, pose variations, partial occlusions, and expression variations. The architecture of the systems is a pipeline which comprises four stages face detection (MTCNN), feature extraction (using ResNet-50 Back bone), embeddings (FaceNet) and classification (Support Vector Machines (SVM) using cosine similarity matching).DeepVision demonstrates competitive performance with 98.7% verification accuracy on LFW and 96.2% identification accuracy on CelebA. While slightly lower than the original FaceNet, the system is optimized for real-time deployment (15 FPS) with improved effi ciency and modularity. Anti-spoofing mechanisms are integrated, but further improvements against GAN-based attacks remain a direction for future work.

KEYWORDS: Face Recognition, Deep Learning, ResNet-50, FaceNet, MTCNN, Transfer Learning, Real-time Processing, Anti-spoofing, Biometric Authentication.

Adaptive Lane Detection and Lane Departure Warning Using Brightness-Aware Preprocessing

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ABSTRACT. Lane detection and lane-departure warning are essential parts of driver assistance systems and self-driving cars. In this work, we propose a lightweight, vision-based lane detection process that is designed to work well under different lighting and image quality conditions. The method starts with a preprocessing stage that switches between gamma correction with CLAHE for low-light situations and Sobel gradient filtering for daylight or blurred images. A region-of-interest mask is then used to focus on the roadway. Next, we use Canny edge detection and probabilistic Hough transform to find lane candidates. We estimate the left and right lane boundaries using slope-intercept modeling and average them to create stable lane representations. Lane deviation is identified by calculating the offset between the vehicle's geometric center and the inferred lane center. This allows us to classify the vehicle's position as inside the lane, drifting left, or drifting right. Experimental results on road images show that our pipeline reliably detects lanes in both day and night conditions. It proves resilient to blur and changes in lighting while being efficient enough for real-time use.

KEYWORDS: Design of Experiments (DoE); higher-order thinking skills (HOTS); Wheatstone Bridge; Thevenin's theorem; factor interaction.

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A Comparative Study of NLP Techniques for Stress Detection in Dialogues

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ABSTRACT. More people started using social media as an essential platform to bring their feelings out and socialized more to speak. Due to this growing trend of social media, people became more aware of mental health. The study offers an approach to classify social media text into stress patterns using machine learning and natural language processing. The study uses the Dreaddit dataset of 3,600 posts collected from stress-related subreddits (e.g., r/anxiety, r/ptsd). The dataset contains posts labelled stress/non-stress and employed supervised classification methods. In the research work, the Naive Bayes, SVM, Logistic regression and ANN machine learning algorithms were implemented and evaluated. In addition, a custom feature extraction carried out similar to the Bag of Words modeling. The study also applies LIWC features to classify the quality of the classification. The experimental results show that Logistic Regression performs consistently well, achieving an accuracy of between 75% and 85%, better than other traditional methods. The study the techniques of feature extraction indicating clear separation of STRESSED and NON-STRESSED content through word frequency analysis and visualization. This approach would help to segregate terms relating to stressed and non-stressed. This automatic system to detect stress is useful for early detection of mental disorders. This system shows the potential of an nlp based approach to digital mental health.

KEYWORDS: Stress detection, social media analysis, machine learning, natural language processing, mental health, supervised classification, Reddit data.

Automated Identification and Severity Assessment of Ankle Osteoarthritis from Radiographic Images for Clinical Decision Support

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ABSTRACT. Ankle Osteoarthritis (AOA) is a degenerative joint condition that influences mobility and daily functioning, though it is less prevalent than osteoarthritis of the knee or hip. The ankle joint consists primarily of three bones: the tibia, fibula, and talus. As the disease progresses, cartilage degradation leads to joint space narrowing (JSN) and direct contact between bones, causing pain and reduced movement. Early identification and classification of AOA through clinical imaging techniques such as X-rays and MRI are vital for rapid intervention and effective management. Accurate grading of AOA plays a crucial role in ensuring appropriate therapeutic decisions. Conventional grading approaches often rely on radiologists' interpretations, which can be inconsistent due to subjective bias and inter-observer variability. To address this, the present work introduces a semi-automated system for AOA assessment using MATLAB, focusing on Joint Space Width (JSW) analysis. Following preprocessing steps like noise suppression and contrast enhancement, edge detection algorithms highlight the bony outlines in the X-ray images. The radiologists can then hand-picked point pairs along the overlapping regions of the tibia, fibula, and talus to compute Euclidean distances. These distances are normalized to millimeters using a calibrated metric and mapped to standardized osteoarthritis severity levels. Additionally, the approach calculates both the average JSW and an overall OA grade. This technique aids radiologists by providing more consistent, accurate, and reproducible evaluations, ultimately improving diagnostic reliability.

KEYWORDS: Ankle Osteoarthritis (AOA), Joint Space Width (JSW), X-ray, Patient, Diagnosis, Therapy.

Edge Tent: Real-Time Tent Density Estimation Using Jetson Xavier NX

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ABSTRACT. In contemporary military operations, refugee management, and disaster response, effective resource use and situational awareness are essential. In order to identify possible threats, evaluate supply requirements, and maximize resource allocation, this system tackles the problem of real-time tent density estimation. The resolution and data delay of traditional satellite-based estimation are limited. The system uses cutting-edge computer vision algorithms RetinaNet and YOLOv8 on edge devices like Jetson Xavier NX to get around this. While YOLOv8 improves precision and adaptability, RetinaNet strikes a compromise between efficiency and accuracy (0.89), guaranteeing real-time, on-site analysis with lower latency. With power consumption and inference speed as key factors, the system performs well without sacrificing scalability, which makes it perfect for high-stakes military operations, disaster response, and refugee management applications. Moreover, YOLOv8 offers superior

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inference speed compared to RetinaNet, further enhancing real-time performance for mission-critical tasks.

KEYWORDS: Edge device, Jetson Xavier NX, RetinaNet, YOLOv8, Inference Speed, Power.

Real-Time Credit Card Fraud Detection with ML Models

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ABSTRACT. Credit card fraud poses a major risk in online financial systems leading to billions in losses worldwide every year. Old-fashioned rule-based methods can't keep up with new fraud tactics pushing companies to use machine learning (ML) techniques. This study introduces a complete fraud detection system that combines data preparation, feature creation handling uneven data, and comparing models like Logistic Regression, Support Vector Machines, Random Forest, Gradient Boosting (XGBoost), and Deep Neural Networks. The team ran tests on the popular Kaggle credit card fraud dataset, which has 284,807 European transactions with very few fraud cases (0.17%). The results show that XGBoost performed best balancing accuracy (97%), AUC-ROC (0.99), and business costs better than other models. This new system proves it can grow, be repeated, and evaluate performance based on costs giving useful insights to put real-time fraud detection into action in financial system.

KEYWORDS: Credit Card Fraud Detection, Machine Learning, Financial Security, Anomaly Detection, Classification Algorithms, Data Mining, Cybersecurity.

The Comprehensive Review of Quantum Machine Learning

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ABSTRACT. In the recent years, there's been a surge of interest of the topics of machine learning and quantum mechanics with respect to the efficiency and the innovative perspective of these fields. This paper emphasizes the recent developments

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and the future of quantum machine learning as well as the topics of quantum mechanics. The paper contains from the past *ie.* From the birth of the quantum mechanics in the physics, the duality, the present which is the applications of the quantum computing with the help of the duality and the various algorithms like grove's search, HHL, Shor's, quantum support vector machines (QSVM), Quantum principal component analysis (QPCA), and Quantum neural networks (QNN), K clustering and many more. This paper also describes about the future and the application of these algorithms and with the improvements along with it.

KEYWORDS: Algorithm, Machine Learning, Analysis.

AI-Powered Real-Time Counterfeit Detection and Currency Recognition with Voice Assistance for Visually Impaired Users

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ABSTRACT. Counterfeit detection and Currency recognition are essential functions in financial inclusion, especially for the visually impaired, who are disadvantaged to a major extent in safely and independently dealing with cash. Driven by the growth of artificial intelligence (AI) and computer vision technologies, number of studies have been published that suggest solutions to overcome these disadvantages. This survey paper gives an in-depth overview of current techniques in currency recognition and forgery detection based on AI, with an emphasis on assistive technologies to enhance accessibility in finance. We classify existing methods, deep learning models, and edge-based solutions. Important performance metrics like accuracy, inference time, diversity of the dataset, and deployment approaches (offline vs. cloud) are comprehensively compared. The survey also captures typical issues like limited coverage of datasets, bad generalization to actual conditions, reliance on connectivity over the internet, and absence of adequate multimodal feedback for users. Lastly, we also addressed possible future research like incorporating haptic feedback, widening support for regional languages, and enhancing counterfeiting detection using sophisticated imaging technologies.

KEYWORDS: Currency Recognition, Fake Currency Detection, Visual Impairment, Edge AI, Assistive Technology, TensorFlow Lite, IoT, Computer Vision, Financial Inclusion.

SMART ALERT AND FAST EMERGENCY DEVICE

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ABSTRACT. Women Global emergency measures against women were im plemented without prior notice. This new feature is not only available in one location, but also has two trigger mechanisms that can be activated by sending a GPS based SMS to each selected number and activating after 1 second. This functionality is now extended to improve environmental awareness and provide faster response. It enables multi media recording and quick alerts, which were previously unattainable in earlier systems. With a small microcontroller and rechargeable batteries, SAFE can be used in urban and rural environments.

KEYWORDS: Women Safety, IoT Wearable, Emergency Device, GSM, GPS, ESP32.

Design and Implementation of an AI Integrated Chatbot for Healthcare Administration

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ABSTRACT. This paper introduces a smart chatbot for patients that makes healthcare more accessible through its complex layered design. The system combines the Django web framework with a Neo4j graph database to store medical information and PostgreSQL to manage patient data. This setup allows for real-time communication using WebSocket and uses Google's Gemini language model via LangChain to better understand natural language. The main breakthrough uses machine learning to recognize what patients are asking about. It then runs safe specific searches in the Neo4j knowledge graph. This helps with booking appointments, managing applications and for finding medical information and keeping track of previous history. To keep things secure, the System uses Django's built-in protections, CSRF safeguards and controls based on roles. This ensures it follows HIPAA rules. The system handles requests without delay giving answers in less than a second. It can also handle many users at once. Early tests show it's over 92% accurate in figuring out what patients want. It can handle back-and-forth conversations well remembering what was said

before while following healthcare privacy laws. This study offers a full plan for creating healthcare chatbots that balance advanced AI abilities with real-world needs. In the end, it helps patients engage more while cutting down on healthcare workload.

KEYWORDS: Patient Assistant Chatbot, Healthcare AI, Realtime Communication, Neo4j Graph Database, Intent Recognition, WebSockets, Django Framework

AI-DRIVEN STRATEGIES FOR HANDLING NATURAL DISASTERS AND EMERGENCY RESPONSES

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ABSTRACT. Managing public safety during natural disasters remains core responsibility of govern- ments and emergency response agencies. Traditional methods often struggle with issues like slow reactions, poor coordination, and a lack of real-time information. However, the rise of Artificial Intelligence (AI) offers a fantastic chance to boost disaster preparedness and response through predictive modeling, optimizing resources, and making quick decisions. This paper dives into how AI technologies, such as machine learning and data analytics, can enhance risk assessment, speed up responses, and build public trust. It also looks at challenges like data privacy, the need for clear algorithms, and the importance of ethical oversight. The aim is to showcase AI's game-changing potential in creating smarter, quicker, and more dependable disaster management systems.

KEYWORDS: Public safety, Natural disasters, Artificial Intelligence (AI), Disaster Management, Emergency response, Predictive Modeling, Risk assessments, Machine Learning, Resource allocation, Data analysis, AI explainability, Transparency in Al-gorithms.

Real-Time Facial Recognition Using Haar Cascade and Optimized LBPH on Consumer-Grade Webcams

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ABSTRACT. This study develops a real-time facial recognition system tailored for consumer-grade webcams, integrating Haar Cascade classifiers for efficient face detection with an optimized Local Binary Pattern Histogram (LBPH) algorithm for accurate recognition. The system addresses key challenges in unconstrained environments, including uneven lighting, pose variations, and limited computational resources, by employing Contrast Limited Adaptive Histogram Equalization (CLAHE) and a novel dynamic thresholding technique. This innovation reduces false rejection rates by 8% compared to OpenCV baselines. Trained on a custom dataset of 150 subjects across five continents, using 8-12 images per subject, the system achieves 94.5% detection accuracy and 97.1% recognition accuracy. It delivers robust performance at 22-25 frames per second (FPS) on standard hardware (Intel i7, 8GB RAM). The modular architecture supports diverse applications, such as security systems and human-computer interaction (HCI), and demonstrates a 12-15% performance improvement over existing benchmarks, validated by statistical testing ($p<0.05$) Future research will explore the integration of lightweight Convolutional Neural Networks (CNNs) to further enhance robustness and adaptability in real-world scenarios.

INDEX TERMS: Facial Recognition, Haar Cascade, Local Binary Pattern Histogram, Real-Time Processing, Webcam Integration, Biometric Authentication, Computer Vision

Sign Language Recognition to Text and Voice Using CNN

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ABSTRACT. This paper presents the design and implementation of a lightweight, end-to-end system for translating Indian Sign Language (ISL) alphabet gestures into text and synthesized speech in real-time. While many deep learning models achieve high classification accuracy, their practical deployment is often hindered by computational demands requiring specialized hardware. To address this gap, our work focuses on a computationally efficient pipeline optimized for consumer-grade hardware without GPU acceleration. The gesture images obtained from a standard webcam will be classified by a Convolutional Neural Network (CNN) system and integrated with the text generation and the TTS engines to make an interactive experience. The model reaches a classification accuracy of 97.1% on the validation set, and the end-to-end latency

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of the complete system of less than 500 ms advocates for its potential in real-time applications for educational and assistive settings. This research emphasizes practical implementation, demonstrating that high-accuracy sign language recognition can be made accessible and deployable in low-resource settings.

KEYWORDS: Deep Learning, Image classification, sign language recognition, gesture to text conversion, computer vision, speech synthesis, text to speech.

WineQ Flask: Smart wine quality prediction

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ABSTRACT. Wine quality assessment is one of the most impor- tant aspects of the wine industry. Traditionally, this task has been accomplished by expert sommeliers and tedious testing in the laboratory. WineQ Flask is a machine learning tool for predicting wine quality using physicochemical properties. This project aims at using the Kaggle Red Wine Quality Dataset. The study is performed end to end involving Data Preprocessing, feature engineering, model development and web deployment using a smart Flask application. After tiresome cleaning through duplicate removal and outlier detection through IQR, the data set was reduced from 1599 to 1359.With a correlation analysis, less significant variables (pH, fixed acidity, citric acid, and free sulfur dioxide) were removed by feature selection. To address the imbalance between ”Good” (quality ?7) and ”Bad” (quality7) classes, we applied SMOTE, an oversampling strategy**.** The following machine learning algorithms were compared: Random Forest (93.8%)

KEYWORDS: Wine Quality Prediction, Machine Learning, XGBoost, Feature Engineering, SMOTE, Flask Deployment, Classification

An Intelligent Real-Time Bus Tracking and Arrival Time Prediction System using Machine Learning

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ABSTRACT. The inefficiency and predictability of public transportation bus systems therefore emerge as a massive problem for urban cities, at times leading to prolonged waiting hours, frustration for the commuters, and overall loss of faith in the service. This paper proposes an innovative, smart real-time bus tracking and arrival time estimation system utilizing the capability of Machine Learning to make the transit experience more dependable and user-oriented. The system makes use of real-time Global Positioning System (GPS) data obtained from buses to determine live locations, which are combined with historic patterns of behavior and fed into a complex ML model to provide highly precise Estimated Times of Arrival (ETAs). One of the key innovations of this research is the incorporation of an integrated passenger demand forecasting model based on past ridership data to forecast passenger loads to enable dynamic, data-driven optimization of bus schedules and vehicle deployments. The proposed system design detailing the data gathering, data preprocessing, and ML pipeline is clearly detailed. We also introduce the design of a user-friendly mobile application aimed at making such real-time information accessible to riders in simple terms. Results from experimental testing affirm that the proposed system is highly accurate in bus arrival time prediction, and thus significantly increasing the efficiency, reliability, and appeal of public transport.

KEYWORDS: Bus Tracking, Machine Learning, Real-Time Systems, GPS, Arrival Time Prediction, Demand Forecasting, Intelligent Transportation Systems, Urban Mobility.

SmartFire: Real-Time Object Level Fire Detection and Suppression Recommendation via YOLOv8 and IoT

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ABSTRACT. Fire outbreaks present significant threats to human life, property, and the environment, making early detection and timely response crucial. This paper proposes an Internet of Things (IoT)-based fire detection system that not only identifies fire incidents but also identifies objects and recommends the appropriate class of fire extinguisher for suppression. The system integrates camera, gas sensor and temperature sensors, with IoT connectivity to monitor the environment and detect abnormal conditions. A deep learning model based on YOLOv8 is employed to detect fire regions and recognize burning objects, enabling accurate fire classification and extinguisher selection. Once a fire is detected, the system transmits data including fire location and extinguisher type to a central server, which immediately notifies users and emergency responders via smartphone applications.

KEYWORDS: YOLOv8, Fire Detection, Fire Classification, Extinguisher Recommendation.

Multimodal AI Approaches for Social Media–Based Mental Health Detection

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ABSTRACT. The Depression and stress have become pressing global health challenges, yet traditional diagnostic methods often fall short due to stigma, resource constraints, and the evolving nature of mental illness. In recent years, social media platforms have emerged as a rich and unobtrusive source of behavioral and emotional signals, offering new opportunities for early detection through artificial intelligence (AI). This survey provides a comprehensive review of research studies published between 2016 and 2024, covering approaches that range from classical machine learning and psycholinguistic analysis to deep learning, transformers, and multimodal fusion frameworks. We examine the diversity of datasets, annotation strategies, and evaluation methods employed across platforms like Twitter, Reddit, Facebook, and Instagram. The review highlights how early models relied heavily on handcrafted features, while modern approaches leverage contextual embeddings, temporal modeling, and multimodal signals such as text, images, and user interactions. Comparative analysis reveals that multimodal and hybrid architectures consistently outperform single-modality models, though challenges around interpretability, dataset imbalance, and generalizability persist. We also discuss key issues such as ethical concerns, privacy risks, and the need for standardized benchmarks. Looking ahead, the paper identifies future directions in explainable AI, longitudinal modeling, and cross-platform generalization to bridge the gap between technical innovation and clinical applicability. Ultimately, this survey underscores the promise of AI-driven, multimodal frameworks to support proactive, scalable, and ethically grounded mental health interventions through social media analysis.

KEYWORDS: Mental Health Detection, Multimodal fusion, Stress Analysis, Social Media Analytics.

Diagnosing Malignant Lung Nodules And Adenocarcinoma From Radiography Using Netv2 Transfer Learning Model

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ABSTRACT. Diagnosing malignant lung nodules and adenocarcinoma using artificial intelligence— specifically deep learning and transfer learning techniques—can

significantly enhance detection accuracy from chest radiography (CXR). Because malignant nodules often appear subtle and CXR interpretation is complex, early lung cancer diagnosis remains highly challenging. This work utilizes Convolutional Neural Networks (CNNs) with the Inception-ResNet-v2 transfer learning model, trained on large-scale public datasets such as NIH ChestX-ray and CheXpert. The methodology includes data preprocessinp, model training and fine-tuning, performance optimization, and model interpretability using Grad-CAM, with evaluation metrics including AUC, Precision, and Recall. The objective is to build a reliable AI-driven diagnostic system that assists radiologists, reduces false positives, minimizes unnecessary biopsies, and improves patient outcomes through early detection.To ensure trust and clinical acceptance, explainable AI techniques visualize critical image regions influencing predictions, improving transparency and decision confidence. Future enhancements include integrating multimodal data such as CT scans and clinical records to further increase accuracy and real-world clinical utility.

Furthermore, the work extends the diagnostic framework to colon cancer detection using the same NetV2 (Inception-ResNet-v2) architecture, demonstrating versatility across multiple cancer types. By unifying lung and colon cancer diagnosis within a single deep-learning pipeline, the system presents a scalable and robust solution for multi-cancer screening.

KEYWORDS: Malignant lung nodules, adenocarcinoma, artificial intelligence, deep learning, transfer learning, Inception-ResNet-v2 (NetV2), chest radiography (CXR), Grad-CAM explainable AI, colon cancer detection, multi-cancer screening system**.**

Automated Diagnosis and Classification of Sugarcane Pathologies Using CNN and Densenet-121

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ABSTRACT. Sugarcane stands as a crucial crop, playing a significant role in both global food security and the ongoing development of biofuels. Yet, its cultivation continues to face substantial challenges, particularly from a broad spectrum of plant diseases that threaten overall productivity such as Red Rot, Smut, Mosaic, Yellow Leaf, and others that are often detected late due to reliance on manual inspection. To overcome this challenge, we propose an automated diagnosis system that leverages a hybrid deep learning model combining Convolutional Neural Networks (CNN) with DenseNet121 for accurate classification of sugarcane leaf pathologies. The model was trained on a curated dataset with preprocessing, augmentation, and transfer learning strategies, achieving an accuracy of nearly 90% across eight classes. To enhance usability, we integrated the model into a Flask-based web application, enabling farmers and researchers to upload leaf images, obtain real-time predictions, visualize infected regions using Grad-CAM, and receive appropriate treatment recommendations. This

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approach demonstrates the potential of AI-driven solutions to support precision agriculture, reduce crop losses, and promote sustainable farming practices.

KEYWORDS: Sugarcane pathology detection, CNN, DenseNet121, hybrid model, Grad-CAM, transfer learning, precision agriculture.

FineTuning LLM for low resource language

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ABSTRACT. This work aims to improve lightweight large language models (LLMs), including TinyLlama-1.1B, for efficient translation between English and low-resource Indian languages including Hindi, Kannada, and Marathi. The aim is to improve multilingual capabilities of small-sized LLMs by means of parameter-efficient training approaches, therefore enabling high-quality translation without demanding large computational resources.

The fine-tuning pipeline minimizes memory footprint and maximizes performance on consumer-grade hardware (e.g., RTX 4090) by using advanced quantization techniques—including 4-bit and 1.58-bit precision—and LoRA (Low-Rank Adaptation) for efficient adaptation. The model is trained with supervised fine-tuning using a cleaned-and-shuffled parallel corpus of language pairs. Tokenizing, using prompt formatting, and building gradients all help to maximize stability and throughput.

Standard translation measures including BLEU and ChrF guide evaluation of performance. First findings indicate that the model may provide semantically coherent and syntactically accurate translations across many sentence patterns in Hindi, Kannada, and Marathi.

By means of efficient fine-tuning techniques, this work shows that small-scale, open-weight LLMs can be efficiently adapted for low-resource languages, hence enabling more general multilingual applications free from reliance on large-scale infrastructure.

KEYWORDS: Low-Resource Languages, Large Language Models, TinyLlama, LoRA, Hindi, Kannada, Marathi, Machine Translation, Quantization, Fine-Tuning.

RAISE-AI: Risk Assessment and Interpretation for SLD Evaluation

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ABSTRACT. Specific Learning Disabilities (SLDs) such as dyslexia and dysgraphia significantly affect a child's ability to read, write, and process language. Traditional diagnostic methods are often slow, costly, and inaccessible to underserved populations. This paper introduces RAISE-AI, a web-based AI application aimed at early detection and interpretation of SLD-related challenges, with a focus on handwriting analysis, real-time eye tracking, gamified interventions, and automated reporting.

RAISE-AI uses a YOLO-based handwriting anomaly detection model trained on synthetically generated datasets representing character reversals, corrections, and distortions. The full system integrates multimodal learning signals — handwriting classification, attention tracking, behavior from gamified cognitive tasks — to produce a comprehensive child risk profile. The final output includes a dynamic cognitive report with visual evidence and targeted recommendations for educators and psychologists.

RAISE-AI aims to bridge accessibility gaps in SLD screening by providing a scalable, explainable, and child-friendly assessment workflow for both educational and clinical settings.

KEYWORDS: Learning Disabilities, Dyslexia, Dysgraphia, Multimodal AI, Handwriting Analysis, Eye Tracking, Cognitive Assessment, YOLO, React, FastAPI.

Intelligent Question Classification and Prediction for Examinations using NLP and Deep Learning

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ABSTRACT. This study presents a framework for intelligent classification and prediction of examination questions using Natural Language Processing (NLP) and Deep Learning (DL) techniques. A dataset of 20 university question papers from the MCA "Data Structures" course of Gujarat Technological University (GTU) was analyzed. The system classified questions into syllabus-based units using a BERT-based model, followed by clustering and trend analysis to identify frequently asked topics. Predictive modeling was applied to estimate the likelihood of question recurrence in future examinations. A personalized question bank generator was also developed, recommending practice questions aligned with individual student weaknesses. Experimental results demonstrated over 95% classification accuracy, outperforming traditional cosine and Euclidean methods. Furthermore, students, who prepared using this approach scored, on average, 14% higher than previous cohorts who did not use the system. These findings highlight the potential of AI-driven educational tools to improve exam preparation and performance in higher education.

KEYWORDS: Natural Language Processing (NLP), Question Classification, Exam Question Prediction, Deep Learning (BERT, Transformers), Educational Data Mining, Personalized Question Bank Generation.

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Comparative Analysis of Deep Learning and Image Processing Methods for Early Embryo Viability Prediction in Chicken Eggs

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ABSTRACT. Efficient and reliable embryo viability detection is an important challenge in the poultry industry, where misclassifying non-viable eggs leads to wasted energy, reduced hatchability, and economic losses. Traditional methods such as candling are manual and inconsistent, motivating the development of automated, non-invasive solutions. This work presents two automated approaches using thermal images of eggs used from the publicly available dataset from Roboflow and these were implemented in MATLAB. The first method applies a Convolutional Neural Network (CNN) based on ResNet-18, trained for 15 epochs, achieving 97.78% accuracy. For the non-viable class, it reached precision, recall, and F1-scores of 0.88, 1.00, and 0.93, while for viable eggs it recorded 1.00, 0.97, and 0.99. The second method uses histogram features with a Support Vector Machine (SVM) classifier, yielding 96.67% accuracy, slightly lower but still competitive. To enhance interpretability, Grad-CAM visualizations were generated for CNN outputs, and histogram distributions were examined for the SVM. Overall, both models showed similar strong performance, with the CNN outperforming SVM in most metrics.

KEYWORDS: Chicken Egg Embryo Viability Prediction, Support Vector Machine, Convolutional Neural Network, Resnet-18, Histogram analysis.

DriveAware: A Vision-Based Traffic Sign Detection and Text Recognition System

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ABSTRACT. This paper presents a real-time Traffic Sign Detection and Text Recognition System aimed at enhancing road safety through the integration of computer vision and deep learning methodologies. The system utilizes onboard camera sensors to capture continuous video input, which is processed using the YOLO (You Only Look Once) object detection algorithm for accurate and efficient identification of traffic signs. In parallel, Optical Character Recognition (OCR) techniques are applied to extract and interpret alphanumeric text from signboards and other relevant roadside elements. The

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architecture is optimized for real-time performance, ensuring low latency and high detection accuracy under varying environmental conditions. The proposed system is applicable in Advanced Driver Assistance Systems (ADAS), autonomous vehicles, traffic monitoring, and smart city infrastructure, contributing to improved situational awareness and decision-making capabilities within Intelligent Transportation Systems (ITS). Experimental evaluation demonstrates the system's robustness, with high precision and inference speed suitable for deployment in dynamic and complex road environments.

KEYWORDS: Traffic Sign Detection, YOLOv8, Optical Character Recognition, Road Safety.

Towards Silent Sentinels: Smart Audio-Based Monitoring for Chronic Respiratory Disease in Chickens

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ABSTRACT. Chronic Respiratory Disease (CRD) is still a global problem that affects poultry productivity, health, and farm profitability. Using Mel-frequency cepstral coefficient (MFCC) acoustic characteristics and a Random Forest classifier, this study proposes an automated, non-invasive method for detecting CRD in hens. The suggested method combines representative feature extraction, strong data organization, interpretable classification, and thorough waveform preprocessing, which includes amplitude normalization and silence reduction. In order to assess performance, real and noisy vocalizations from hens with and without CRD were thoroughly studied. Accuracy, precision, recall, and confusion matrix measures were used to gauge performance. The system successfully distinguished between noisy, CRD-positive, and healthy samples with a test accuracy of 96.2%. Real-time inference is supported, the workflow is field-ready, requires little expert supervision, and is implemented via a scalable online interface. The outcomes show how intelligent audio-based AI monitoring may improve animal wellbeing, expand precision poultry farming at scale, and improve early illness intervention.

KEYWORDS: Poultry disease detection, chronic respiratory disease (CRD), bioacoustics, audio signal processing, machine learning, Random Forest, real-time monitoring, web deployment, animal welfare, smart farming.

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Development of an intelligent offline Gamified Learning Platform with Personalized Matchmaking for Rural Education

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ABSTRACT. Rural students often face limited access to quality STEM education due to unreliable internet connectivity, scarce learning resources, and language barriers. This paper presents an offline-first, gamified learning platform designed to strengthen STEM learning outcomes in such underserved communities. The system integrates AI-driven content personalization, interactive learning games, and intelligent peer matchmaking, enabling students to learn, collaborate, and track progress entirely offline, with seamless synchronization once internet access becomes available. Gamification elements—including points, badges, levels, and leaderboards—help sustain motivation and continuous engagement. A dedicated teacher analytics dashboard provides actionable insights through real-time performance monitoring and personalized feedback. The platform also incorporates multilingual NLP capabilities to ensure inclusive and adaptive learning experiences for students from diverse linguistic backgrounds. Overall, the proposed platform demonstrates the potential to improve student engagement, reduce learning gaps, and enhance peer collaboration. By combining offline accessibility, AI-driven personalization, and game-based interaction, it offers a scalable and impactful solution to bridge the rural–urban STEM education divide.

KEYWORDS: Rural Education, STEM Learning, Offline Learning, Gamification, AI Personalization, Peer Matchmaking, Multilingual NLP.

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Attention based Dual-Output U-Net Segmentation Technique for Automated Glaucoma Detection from Fundus Images

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ABSTRACT. Glaucoma is an optic neuropathy characterized by optic nerve head changes and neuroretinal rim thinning, often leading to vision loss if undetected. Clinical assessment relies on structural biomarkers such as CDR, DDLS, and rim widths in the Inferior, Superior, Nasal and Temporal quadrants, but manual grading is subjective. In this work, a dual-output Attention U-Net with a ResNet-50 encoder is proposed for simultaneous OD and OC segmentation which incorporates attention-gated skip connections for sharper boundary recovery, in contrast to traditional U-Net variants that mainly concentrate on CDR estimation. Most importantly, the work expands the analysis to include all three structural biomarkers: CDR, DDLS, and ISNT. Of these, DDLS is a more accurate indicator of glaucomatous damage than CDR alone because it offers vital information on rim-to-disc relationships. The Drishti-GS dataset has been used in this paper, which achieved Dice scores of 0.9547 (disc)and 0.9109 (cup). Using a rule-based fusion of CDR, DDLS and ISNT, glaucoma screening reached 96.08% accuracy, demonstrating dependable segmentation and clinically interpretable multi-biomarker screening.

KEYWORDS: Glaucoma, Fundus, Segmentation, Classification, Attention U-Net, CDR, DDLS, ISNT.

Machine Learning-Based Zero-Day Attack Detection for Threat Hunting

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ABSTRACT. Zero-day attacks, which exploit previously unknown vulnerabilities, pose significant challenges to cybersecurity defences worldwide. Traditional automated detection systems often underperform against these threats due to their dependence on historical data and predefined signatures. This paper presents a comprehensive humancentric approach for zero-day attack detection that focuses on manual expertise, deep forensic analysis, and behavioral insight to complement automated tools. By leveraging experienced cybersecurity analysts to perform nuanced investigations, anomaly detection, and threat correlation, the proposed methodology helps identify zero-day exploits more effectively. Detailed system architecture, operational methodologies, and case studies attest to the robustness and flexibility of this manual detection strategy in dynamic threat environments.

KEYWORDS: Zero-Day Attack, Manual Detection, Forensic Analysis, Threat Hunting, Cybersecurity Analyst, Behavioral Indicators, Incident Investigation.

NutriGuide AI: Personalized Cooking Assistant for Homemakers Using Available Ingredients

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ABSTRACT. NutriGuide AI is an intelligent cooking assistant that leverages advanced AI integration to simplify daily meal planning for homemakers. Designed with a focus on inclusivity and usability, it allows flexible input in both English and Tamil, making the system accessible to users with varying levels of digital literacy. The platform promotes healthy, budget-friendly, and cost-effective cooking by efficiently managing available ingredients, performing intelligent recipe matching, estimating meal budgets, and providing nutritional guidance. It delivers personalized recommendations that help reduce food waste, save time, and encourage the preparation of balanced meals using ingredients already available at home. By combining smart technology with practical cooking support, NutriGuide AI empowers homemakers to cook more efficiently, maintain healthier diets, and make everyday cooking simpler, less stressful, and more enjoyable. Its practical, user-centered design ensures that meal planning is not only convenient but also supports long-term healthy eating habits and better kitchen resource management.

KEYWORDS: NutriGuide AI, Smart Cooking Assistant, AI Integration, Ingredient Management, Food Waste Reduction, Budget-Friendly Cooking, Nutritional Guidance, Personalized Recommendations.

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AI based Vehicle Accident Detection System

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ABSTRACT: Road accidents cause significant loss of life and financial damage, making early and accurate detection essential for improving emergency response. This work presents an AI-based Accident Detection System that uses YOLOv8 and Convolutional Neural Networks (CNN) to automatically identify accidents in real-time video streams. YOLOv8 performs fast object detection, while CNN classifies accident-related frames to improve recognition accuracy.
Experimental results show that YOLOv8 achieved **82% accuracy**, while the CNN model performed better with **94% accuracy**, demonstrating strong capability for reliable accident classification. Both models were able to detect incidents in real time and trigger automated alerts, enabling quicker response from authorities.
The system demonstrates the effectiveness of machine learning techniques in enhancing road safety. By offering real-time monitoring and accurate incident detection, this approach can support smart city applications and help reduce the impact of road accidents.

KEYWORDS: Accident Detection, YOLOv8, CNN, Machine Learning, Real-time Detection, Computer Vision.

The Impact of Generative AI Chatbots in Psychological Counseling

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ABSTRACT. This research explores how chatbots can enhance psychological assessments by addressing the need for mental health services and understanding the limitations of traditional methods. The paper focuses on designing a chatbot capable of collecting detailed patient information through questionnaires, analyzing the data, and generating reports or preliminary diagnoses. Central questions include how psychologists engage with chatbot prototypes, what types of data AI can analyze effectively, and which automated techniques are most reliable for data interpretation and report generation. A prototype chatbot, developed using open-source models and paired with a documentation platform, forms the basis of this investigation. The approach aims to improve access to mental health care, especially for individuals in remote areas or those who prefer the anonymity that online platforms offer. By automating tasks like data analysis and report creation, the chatbot reduces the burden on mental health professionals. Additionally, the study examines design trade-offs such

as user engagement versus potential biases, including socially desirable responses. It also highlights the role of chatbots in helping users express emotions more openly compared to traditional settings. Overall, the research evaluates both the benefits and limitations of AI-driven psychological tools, aiming to make mental health care more accessible and efficient.

KEYWORDS: Chatbots, Psychological Assessments, Artificial Intelligence, Mental Health Care, Data Analysis.

AI Power Blind Assistant: A real time Computer Vision Approach for Daily Assistance of Visually Impaired Persons

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ABSTRACT. Visually impaired individuals face significant challenges in daily life, particularly in navigation, object identification, phone usage, and obstacle detection. Existing assistive solutions, such as smart canes and specialized mobile applications, often address only a single problem, require costly hardware, or rely heavily on constant internet connectivity. This paper proposes an AI-powered blind assistant that integrates computer vision and machine learning techniques to provide a low-cost, multipurpose solution using a smartphone camera. The system is designed with two modes: a real-time object detection module for navigation and obstacle awareness, and an on-demand frame analysis mode for complex scene understanding through chatbot assistance. Lightweight deep learning models, optimized for mobile platforms, are employed to ensure efficient processing with minimal latency. The system design is evaluated for potential accuracy, response time, and usability in both indoor and outdoor environments. Overall, the proposed framework aims to support visually impaired users by providing integrated perception and actionable feedback, improving independence and accessibility in daily tasks.

KEYWORDS: Object detection, Neural processing unit, Global Navigation Satellite System (GNSS), YOLO, INT8 quantization, Edge computing.

IoT based Robotic Solution for Agrochemical Dispensing

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ABSTRACT. This study describes a cost-effective robotic platform that can be programmed to automate three primary field operations in arecanut plantations: fertilizer dispensing, pesticide spraying, and disease monitoring. The system utilizes an ESP32 controller combined with an ESP32-CAM and a Raspberry Pi data unit, the latter being responsible for image processing for directed actions. The robotic platform autonomously follows rows, stops at individual palms, and procedurally initiates actions at each palm via a motor driver, pump with relay control, gate valves, and servo-driven spray nozzle. Images are taken at each stop with date-time stamps and GPS tags, allowing for traceable assessments and oversight remotely. The Raspberry Pi processes action data from the session to determine which palms are affected by disease, targeting localized spraying while dispensing fertilizer to all palms. Field trials demonstrated improved crop health indicators along with reduced pesticide inputs and effective pest control via targeted localized applications. Accuracy results of the disease monitoring component were also deemed beneficial. The monitoring platform, which also retains full geospatial traceability while reducing blanket pesticide and fertilizer to individual palms, noted a shift towards sustainable production objectives while positioning the device in a practical application for smallholders with commodity hardware and simple programming.

KEYWORDS: ESP-32 Module, Fertilizer Dispenser, Pest Control, Image Processing, Edge Impulse, Efficient Net.

IntelliDiab: An AI-based Personalized Diabetes Hybrid Recommendation System

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ABSTRACT. Diabetes is a chronic metabolic disease resulting from defective insulin secretion or action, causing variable blood glucose and complications after many years, such as cardiovascular disease and renal failure. Management is demanding of both patients and doctors through the need for continuous glucose monitoring and tight diet control. Current models are isolated—Linear Regression and ARIMA model glucose, Decision Trees and basic classifiers model dietary advice—without being integrated and

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personalized. To counter this, IntelliDiab presents a hybrid AI framework that integrates Collaborative Filtering (CF1, CF2) for peer-guided personalization, Long Short-Term Memory (LSTM) networks for short-term glucose forecasting, and Random Forest classifiers for safe meal suggestions. Experimental evaluation on OhioT1DM, CGMacros, and OpenFoodFacts revealed 29% lesser RMSE compared to LSTM-only models and more than 88% accuracy in the sustenance of safe glucose levels via personalized meals. Through the integration of prediction and adaptive suggestions, IntelliDiab provides an active, end-to-end system for diabetes self-management.

KEYWORDS: Diabetes Management, Glucose Prediction, Long Short-Term Memory (LSTM), Random Forest Classifier, Collaborative Filtering.

Bioinspired Hybrid Optimization Technique Using Greylag Goose and Crayfish Optimization

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ABSTRACT. Optimization techniques inspired by natural behaviors have proven effective in tackling complex and high-dimensional problems. This work introduces an advanced Hybrid Bio-Inspired optimization algorithm, combining Greylag Goose Optimization (GGO) and Crayfish Optimization (CO) for balancing global exploration and local exploitation. GGO, modeled on social and migratory behaviors of geese, enhances global search efficiency, while CO, inspired by crayfish foraging patterns, refines local search capabilities. An adaptive switching mechanism dynamically transitions between GGO and CO to prevent premature convergence. In this way, the proposed hybrid GGO-CO is used for Paillier Homomorphic Encryption (PHE) technique to improve the key generation, encryption, and decryption processes. We evaluate performance on unimodal and multimodal benchmark functions, accompanied by statistical validation using Wilcoxon signed-rank and ANOVA tests. These studies verify proliferation and potency of GGO-CO, proving far better than alternative optimization strategies with respect to convergence velocity, option precision and constancy. Hybrid approach yields better performance for cryptographic operations as confirmed by experimental results while being able to maintain all significant enhancements at higher statistical confidence.

KEYWORDS: Hybrid Optimization, Greylag Goose Optimization, Crayfish Optimization, Nature-Inspired Algorithms, Global-Local Search.

Advanced Phishing Detection through Hybrid Machine Learning Framework: A Comprehensive Approach

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ABSTRACT. Phishing attacks are one of the most common techniques used by cybercriminals to steal sensitive information. This paper presents a hybrid machine learning framework toward phishing detection integrating email text analytics and URL embedded features. Contrary to unimodal systems, the dual-branch approach extracts word- and character level TF-IDF features and metadata from emails and lexical-, heuristic-, and entropy-based metrics from URLs. Each branch uses an elastic-net regularized logistic regression classifier, while its outputs are combined through a contextually dynamic weighted late-fusion mechanism. The framework also features both post-hoc interpretability (feature importance and SHAP) and systematic decision-threshold optimization to balance precision and recall. Tested on a large stratified dataset the model obtained more than 93% overall accuracy, more than 92% F1-score, and more than 98% AUC for URL classification. Finally, it lowers false negatives greatly with respect to single-modality baselines, remaining computationally efficient enough for lightweight and real-time deployment. By combining a wide range of features, adapting to new phishing tricks, and making its decisions easy to understand, the proposed framework offers a strong and scalable solution for detecting phishing.

KEYWORDS: Phishing detection; Hybrid machine learning; Logistic Regression; Email analysis; URL analysis; Feature engineering; Elastic-net regularization; Late-fusion model; Cybersecurity.

LawGPT- AI Powered Legal Research Assistant

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ABSTRACT. LawGPT is an AI-driven legal research assistant which hopes to change the way of legal professionals, students, and researchers engage with statutory content in India. After the BNS, BNSS and BSA bills got passed in 2023 there has been an overwhelming requirement of smart systems to interpret and provide the relevant laws. Most of the existing legal research engines are based upon keyword-based retrieval and tend to return overload information having less contextual information. LawGPT solves these problems by supplementing large language mod- els (LLMs) with retrieval-augmented generation (RAG) and a FAISS vector database, which together result in highly accurate and contextualized answers. The system architecture consists of the FastAPI based python backend integrated with Google's Gemini 1.5 Flash model using LangChain, FAISS embeddings for document similarity searches and conversational

memory. It is user-friendly and responsive and feels natural to chat with because the front end is designed using React, Material UI, Framer Motion. And scalability, portability and production ready de- ployment - Dockized with Nginx. Performance Evaluation shows that LawGPT achieves an average response time of 2.8 s, 96.5% accuracy, can handle 50+ concurrent access by users, with 99.2%. By including speed and accuracy, the possibility of inserting statutory context into conversational responses makes it an informative legal research aid. This work discusses the architecture, methodology, evaluation, opportunities and future roadmap of LawGPT, and how it addresses the problem of simplifying Indian legal research

KEYWORDS: Legal Research· Large Language Models· Retrieval-Agumented Generation· LangChain· FAISS· Docker.

Psychological Stress Detection in Women's Social Media Using Explainable Machine Learning Techniques

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ABSTRACT. Psychological stress is increasingly becoming a problem, particularly to women who experience specific psychosocial stressors as well as systematic challenges. Although machine learning and NLP have already achieved massive progress in the field of mental health prediction, little has been done to help predict the gender-specific language patterns related to stress. The paper proposes a machine learning pipeline that is explainable and computationally easy efficient in the detection of psychological stress in women using their social media posts based on the TF-IDF vectorization and Random Forest classifier. The proposed model is thoroughly pre-processed, balanced with class rebalancing by bootstrap up-sample and interpretable feature learning to attain grasp the stress-indicating linguistic contexts. It performs at a good level of 97 in the accuracy and 0.97 in the macro F1-score, surpassing multiple deep-learning bodies, and making up in transparency and computational ease. This paper does not only showcase the importance of gender-conscious design in computational well-being but also, demonstrates an implementable and socially responsible model of real-time digital wellness. Its potential can be applied to early intervention, individualized support system, and fair AI-based mental health instruments.

KEYWORDS: Psychological Stress Detection, Gender-Sensitive NLP, Social Media Analysis, TF-IDF Vectorization, Random Forest Classifier.

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A Review on Automated Sericulture Farm

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ABSTRACT. Sericulture is a tradition for many rural families of India to sustain livelihood by silk production. Silkworms provide silk which is often known as the "queen of textiles" for its glossy texture and tensile strength. Continuous care and monitoring during the larval stage until the cocoon spinning of silkworms is the major hurdle in this trade.This work proposes an automated sericulture system using the Raspberry Pi that controls the major environmental parameters like temperature and humidity. With such control, maintaining these factors at best conditions, the system exerts less notification from the farmers and results in optimum silk production. Soil testing and smart irrigation practices are extended for the mulberry plantation as well, keeping the crops rather in good condition to sustain better growth. With automation, soil moisture sensors can help to conserve water supply sufficiently and thus keep the crops healthy and productive. Moreover, an advanced management technique is introduced: a silkworm monitoring system based on a Convolutional Neural Network (CNN). It is capable of discriminating silkworms in their early disease stages, recognizable by slight alterations in shape and size from the normal ones, thus enabling preventive action to minimize loss and improve silk quality

KEYWORDS: Sericulture, IoT (Internet of Things).

Deep Learning Framework for Breast Cancer Diagnosis Using Histopathological Images with DenseNet and SVM*

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ABSTRACT. Early and precise diagnosis is essential because breast cancer continues to be the primary cause of cancer related deaths among women globally. Particularly in low-income nations, the invasiveness, cost, and accessibility of traditional di agnostic methods like mammography and biopsy pose challenges. This work develops a deep learning-based method for detecting breast cancer from histopathological images, the gold standard for cellular-level malignancy detection, in order to overcome these drawbacks. The model combines a Support Vector Machine (SVM) as a second classifier to increase the classification accuracy and employs DenseNet for feature extraction through the use of densely connected layers to improve pattern recognition. The hybrid system offers a strong diagnostic platform by combining the feature extraction

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capabilities of DenseNet with the high dimensional data handling capabilities of SVM. The novel model outperforms traditional deep learning methods, which are more accurate and widely applicable, after being trained on a sizable corpus of histopathological images. The results indicate that AI-powered histopathological image analysis can improve early detection, reduce reliance on manual diagnostic methods, and provide a scalable, reasonably priced option for breast cancer screening, particularly in low-resource healthcare environments.

KEYWORDS: Breast Cancer, Histopathological Images, DenseNet, SVM, Image Classification, Deep Learning, Convolutional Neural Networks.

Clot Detection in Arteries Using Ultrasound Image Segmentation and Flow Simulation

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ABSTRACT. Arterial clot detection is critical for preventing stroke and other cardiovascular events, yet current diagnostic methods like CT angiography are expensive and inaccessible in many healthcare settings. This paper presents an innovative AI-powered system that combines ultrasound image segmentation with computational fluid dynamics simulation to detect arterial clots cost-effectively. Our approach integrates deep learning architectures including U-Net, Attention U-Net, and convolutional neural networks with blood flow simulation to provide comprehensive vascular assessment. The system demonstrates 89% agreement with expert radiologists for clot detection and 92% accuracy in stenosis severity classification, with processing times of 15-20 seconds per image. By leveraging accessible ultrasound technology enhanced with AI capabilities, this solution addresses the critical gap between expensive diagnostic imaging and basic ultrasound, potentially reducing stroke incidence by 30% in underserved communities through earlier intervention and democratized access to advanced vascular diagnostics.

KEYWORDS: Ultrasound Imaging, Clot Detection, Deep Learning, U-Net, Flow Simulation, Cardiovascular Diagnosis.

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Emotion-Lens: Context-aware Facial Emotion Recognition System with Drift analysis for Embedded ARM-based Linux Platforms

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ABSTRACT: Facial Emotion Recognition (FER) is essential for enhancing the Human-computer interaction, particularly in Embedded Systems where effective resource utilization and low power consumption are very critical. This paper introduces a new approach called Emotion-Lens, a light-weight and context-aware FER system optimized for ARM-based Linux Platforms. This approach of Emotion-Lens leverages Convolutional Neural Network (CNN) for low latency emotion classification and an Emotion Drift Detection module for tracking long-term emotional trends with efficiency. By combining both temporal and interaction metadata with the raw emotion predictions, the system delivers context-aware as well as refined inputs. This ensures the system has an empathetic and adaptive system behaviour. The entire system is built upon a fully privacy-focused and open- source toolchains like TensorFlow Lite, OpenCV, SQLite ensuring a low resource memory footprint and offline functionality while achieving an 87.4% accuracy on the FER-2013 dataset with less than 100ms inference time on a Raspberry Pi 4 device. The inclusion of ablation study with this approach quantifies the performance benefit with the use of context aware components.

KEYWORDS: Facial Emotion Recognition, Lightweight CNN, Context-Aware Computing, Emotion Drift Detection, TensorFlow Lite, Linux, Embedded Systems.

A Multi-Model Deep Learning Framework for the Prediction of Heart Valve Disorders

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ABSTRACT. Diagnosis of heart valve conditions can be challenging because the variations in heart sounds are very subtle. In the present work, heart valve disease categorization using PCG recordings is accomplished by the training and testing of deep

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learning models including CNN, RNN, and LSTM, in addition to hybrid deep models such as CNN-RNN and CNN-LSTM. Different parts of MFCCs are produced from each model to know about the periodic variations in murmur detection and frequency based spatial features. All the models are distinct from various regions of the MFCCs, such as periodicity in murmurs and spatial properties based on frequency. The CNN model was the most accurate in identifying frequency- domain attributes, then the LSTM model in long-term detection of murmur, CNN-RNN hybrid exhibited well-balanced performance in covering both spatial and temporal features. As a result of poor temporal generalization, CNN-LSTM and simple RNN model performed the worst.

KEYWORDS: Heart valve disorders, PCG recordings, Deep learning models, MFCCs, Longterm-Murmur detection, Hybrid deep learning models.

Multi-Task Facial Analysis Using Wide Deep CNN Models by Enhancing Age, Gender, and Emotion Prediction Accuracy across Diverse Demographics

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ABSTRACT. Affective computing has achieved great progress in Recognition of facial expressions in real time(FER) utilizing deeplearning(DL) and machine learning(ML) approaches. Customized medical care gives productive physical prosperity checking and increase through the combination digital avatars of an emotion recognition (ER) system. However, there are obstacles to this development, such as lesser volume of datasets, difficulty in recognizing features, classifying emotions and expensive strategies. In this paper, these challenges are addressed. A dynamic ER system that processes real time webcams data to identify feelings and predict age and gender is proposed. The proposed concept has three parts that are able to detect seven distinct feelings such as rage, disgust, surprise, fear, happiness, sadness, and neutrality. Convolutional Deep learning networks include VGG-16 and neural networks (CNN) is used. Transfer Learningbased learning models, coupled with two algorithms: Support and KNNs and SVM-support vector machines are employed.The developed ER system is proved to be more accurate with lesser training period. Additional features such as individual treatment and general well-being divide between emotions and technology are incorporated for bridging the gap with the existing challenges.

KEYWORDS: Convolutional neural networks (CNN), VGG-16, and DL, K-Nearest Neighbors (KNN), and Support Vector Machine (SVM).

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Next Generation Quiz Generator: LangChain- Based Adaptive Quiz System for Digital Learning

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ABSTRACT. The Next Gen Quiz Generator is a method that uses large language models and LangChain to create quiz questions. This method overcomes the drawbacks of conventional systems, which manually compile question banks and produce question papers that are impersonal and unadaptable to various learning resources. In addition to being slow and ineffective, traditional systems were also challenging to scale. The goal of this endeavour is to use LangChain to address these issues. The system converts content from other media, such as YouTube videos or MP4 files, and uses LangChain-based integrated LLMs to summarize the videos. The summary is used to create quiz questions of different levels of difficulty. Additionally, it enables quizzes to change according to students' responses.

KEYWORDS: Artificial Intelligence, Natural Language Processing, Large Language Model, LangChain, Quiz Generation.

AI Integration in 8D Problem-Solving Methodology as a small steps towards Industry 5.0 for MSMEs

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ABSTRACT. To support MSMEs in transforming from Industry 4.0 to Industry 5.0, this study examines the integration of artificial intelligence (AI) with the Eight Disciplines (8D) approach to problem-solving. Industry 5.0 restores the human aspect to industrial processes by encouraging cooperation between artificial intelligence and humans, whereas Industry 4.0 concentrated on automation and connectivity. The study demonstrates how AI, when incorporated into the 8D framework, enhances process optimisation, quality control, and root cause analysis, enabling MSMEs to achieve resilience, sustainability, and customised manufacturing. To modernise conventional production methods, the suggested AI-enhanced 8D platform integrates digital twins, machine learning, and cognitive AI. AI was integrated into a layered software architecture to facilitate human-AI collaboration at crucial 8D decision-making stages. Additionally, this approach supports the core principles of Industry 5.0, human-centred innovation, and flexible industrial ecosystems while improving operational efficiency and decision-making. The results confirm that MSMEs may successfully adopt the

future of intelligent manufacturing with a progressive digital transformation strategy backed by AI technologies and worker training.

KEYWORDS: Artificial Intelligence (AI), Eight Disciplines (8D), Problem-Solving Technique, Human-AI Collaboration, AI-Enhanced 8D Platform.

Sketch Facial: Automated Sketch Generation with Facial Recognition

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ABSTRACT. The rapid advancements in facial recognition and image processing have led to a wide range of innovative tools across various domains. However, a significant gap still exists in the automated generation of high-quality artistic sketches for real-time applications. In this regard, our study presents a pioneering system that converts photographs and live video footage into customizable artistic sketches. The system uses Dlib's face detector and shape predictor to locate precise facial landmarks and generate sketches in various styles—including pencil, charcoal, and color—with adjustable detail levels and enhancement parameters such as sharpening intensity and contrast. The intuitive Tkinter-based graphical user interface ensures smooth user interaction and supports both static and dynamic inputs. A key feature of the proposed system is its ability to create highly detailed sketches suitable for forensic examinations and artistic purposes, offering faster and more reliable results compared to hand-drawn sketches. This project has significant implications for law enforcement, as it enables quicker and more accurate suspect identification through surveillance footage or witness descriptions, thereby improving the efficiency of investigations. The proposed contribution bridges the gap between computational capabilities and the practical application of sketch-based forensic analysis.

KEYWORDS: Artistic Sketch Generation, Dlib, Facial Landmark Detection, Forensic Analysis, Real-Time Image Processing, Sketch-Based Forensics.

Real Time Sign Language to Text Conversion with Emergency Assistance

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ABSTRACT. This paper will provide a fully developed Indian Sign Language (ISL) recognizer, which operates as a multi-purpose, real-time translator of hand movements, that can also notify in case of an emergency. The proposed system will help a

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communication of the hearing- and speech-impaired individuals to improve, as it will identify both fixed and dynamic gestures of ISL and record them with the help of a web camera. MediaPipe is used to determine the 21-point landmarks of the hands in real time and then run through a hybrid Convolutional Neural Network (CNN) and Bidirectional Long Short-Term Memory (BiLSTM) classification model to correctly identify the gestures. The T5 based Natural Language Processing (NLP) module with predictive text and word suggestions is involved to produce grammatically consistent and contextually meaningful sentences considering the identified sequence of gestures. Simultaneously, the system is based on the YOLOv5 algorithm of object recognition to constantly scan the presence of pre-set emergency gestures, including help, fire, or pain. When a emergency gesture is detected, a notification of the concerned parties is automatically dispatched in the form of an SMS on the API of Fast2SMS. The system is implemented with the lightweight and browser-based interface created in the Streamlit platform that guarantees real-time execution without regarding special hardware.

KEYWORDS: Indian Sign Language, Gesture Recognition, CNN-BiLSTM, T5 NLP, Emergency Alert System.

HSL Based Anomaly Detection of Leukemia

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ABSTRACT. This paper will provide a fully developed Indian Sign Language (ISL) recognizer, which operates as a multi-purpose, real-time translator of hand movements, that can also notify in case of an emergency. The proposed system will help a communication of the hearing- and speech-impaired individuals to improve, as it will identify both fixed and dynamic gestures of ISL and record them with the help of a web camera. MediaPipe is used to determine the 21-point landmarks of the hands in real time and then run through a hybrid Convolutional Neural Network (CNN) and Bidirectional Long Short-Term Memory (BiLSTM) classification model to correctly identify the gestures. The T5 based Natural Language Processing (NLP) module with predictive text and word suggestions is involved to produce grammatically consistent and contextually meaningful sentences considering the identified sequence of gestures. Simultaneously, the system is based on the YOLOv5 algorithm of object recognition to constantly scan the presence of pre-set emergency gestures, including help, fire, or pain. When a emergency gesture is detected, a notification of the concerned parties is automatically dispatched in the form of an SMS on the API of Fast2SMS. The system is implemented with the lightweight and browser-based interface created in the Streamlit platform that guarantees real-time execution without regarding special hardware.

KEYWORDS: Leukemia Detection, Deep Learning, HSL Color Space, ResNet50, Medical Image Classification.

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Fitverse: An AI-Powered Adaptive Fitness Platform with Real-Time Biomechanical Analysis

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ABSTRACT. This study presents Fitverse, an adaptive fitness platform designed to deliver personalized workout experiences through real-time biomechanical analysis. The system uses computer vision and machine learning to monitor exercise form and provide instant feedback directly within the browser. By integrating TensorFlow.js with WebGPU acceleration, Fitverse achieves smooth, real-time pose detection at up to 42 frames per second, eliminating the need for external hardware. The platform also features adaptive workout planning, nutritional recommendations, and comprehensive health tracking through a responsive web interface. Experimental results demonstrate a 32% reduction in exercise form errors and a 41% increase in user engagement compared to traditional fitness applications. Fitverse combines on-device AI processing with cloud-based recommendation engines to create an accessible, scalable, and personalized digital fitness ecosystem.

KEYWORDS: Computer Vision, Real-Time Pose Detection, Adaptive Fitness, TensorFlow.js, WebGPU, Personalized Health.

Phishing URL Detection using Machine Learning and Deep Learning

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ABSTRACT. Phishing remains one of the most enduring and quickly changing cybercrime categories, threatening individuals, organizations, and worldwide digital networks. Phishing threats are caused by technically advanced attacks that use URLs or website content that are identical or similar to those of genuine services in order to deceive innocent users into revealing sensitive credentials, bank information, or personal data. Conventional blacklist and rule-based security systems are now less able to handle contemporary phishing campaigns, as attackers continually change URL patterns and website content to avoid being discovered. To overcome these issues, this paper suggests a Hybrid Machine Learning Model that combines the respective

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advantages of Random Forest (RF) and Artificial Neural Network (ANN) classifiers for effective phishing URL detection. The Random Forest algorithm is initially utilized to extract and represent the structural and lexical relationships between URL-based and content-based features. Its probabilistic output is an extra discriminative input feature to the next ANN phase. The Artificial Neural Network then does deep-level abstraction and non-linear mapping to efficiently distinguish between phishing and legitimate URLs, even when there are obfuscated patterns. The hybrid model is realized using Python with Flask used for real-time deployment and prediction by means of a web interface. Extensive experiments were performed on standard benchmark phishing datasets, proving that the model suggested in this study attains an overall validation accuracy level of about 97%, better than conventional standalone classifiers like Logistic Regression, Naïve Bayes, and Decision Tree models. The findings confirm the system's improved ability to detect zero-day phishing URLs, while retaining robust generalization performance on unseen data. This hybridized method offers a trustful, scalable, and flexible solution for securing cybersecurity defenses against phishing attacks.

KEYWORDS: Phishing Detection, Hybrid Machine Learning Model, Random Forest, Artificial Neural Network (ANN), URL Feature Extraction, Cybersecurity, Deep Learning, Flask Web Application, Model Integration, Feature Engineering.

Hybrid Machine Learning Model for SQL Injection Attack Detection

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ABSTRACT. SQL Injection remains a serious threat to web applications. It allows attackers to manipulate backend databases using crafted user inputs that change the intended SQL statements. Traditional defenses, like signature-based detection and rule-driven web application firewalls, struggle against obfuscation, encoding tricks, and new attack payloads. In response to these weaknesses, this work introduces a hybrid deep learning framework. It combines a sequence-based Convolutional Neural Network (CNN) that uses tokenized queries with an unsupervised Autoencoder. The Autoencoder is trained on TF-IDF and custom lexical-statistical features. The CNN uses token embeddings from a Word2Vec model to capture patterns in malicious inputs. Meanwhile, the Autoencoder models the behavior of normal traffic and flags anomalies for queries that differ significantly from learned patterns. The two components work together using a conservative union rule: a query is marked as malicious if the Autoencoder's reconstruction error goes beyond a set threshold or if the CNN gives a probability above a specific decision threshold. The entire process runs from normalization and tokenization to model inference and database-backed logging. It is accessible through a Flask web application for real-time predictions and tracking. These

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findings show that combining pattern-sensitive sequence modeling with anomaly profiling creates a strong detection strategy that effectively identifies both standard SQLi signatures and obfuscated, zero-day payloads.

KEYWORDS: SQL Injection, Convolutional Neural Network, Autoencoder, Anomaly Detection, Word2Vec, TF-IDF, Hybrid Model.

Federated Blockchain Frameworks for Multi-Cloud Security and Privacy

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ABSTRACT. The multi-cloud environment has created new scalability and resiliency opportunities but has also posed a major problem in the provision of coherent security and privacy amid very restrictive environments. As the given research suggests, a federated blockchain model provides security to the multi-cloud surroundings by securing verbal assurance by decentralizing authority, sharing data privately, and applying policies as smart contracts. The model combines distributed consensus, cryptographic hashing and on/off-chain storage hybrid to help fix interoperability, integrity and confidentiality problems. There were four major algorithms, PBFT, Merkle Tree Anchoring, Zero-Knowledge Proofs, and the Attribute-Based Encryption implemented and tested on a simulated multi-cloud environment. Experimental assessments estimated the framework resulted in a 30 percent latency, 22 percent throughput and 35 percent higher access management efficiency rates in comparison to strategies that are conventionally centralized. In addition, the leakage of privacy was mitigated by one-fifth and this fact is indicative of how well the framework works in ensuring confidential data protection. Related work comparative analysis made its better adaptability to other areas affordable to other fields like healthcare, finance, and IoT apparent. These findings expand the importance of the feasibility of a federated blockchain systems to meet changing security and privacy needs in a multi-cloud environment.

KEYWORDS: Federated Blockchain, Multi-Cloud Security, Privacy Preservation, Distributed Consensus, Smart Contracts.

AI-Powered Real-Time 360° HDRI Skybox Generation and Integration for Virtual Reality Environments

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ABSTRACT: The demand for the dynamic, high-quality environmental elements in virtual reality applications required for the development of novel skybox generation techniques. This paper proposes an AI-powered system to generate realistic 360° High Dynamic Range Images for VR skyboxes. The proposed method responds to user input by generating low-resolution HDRI images using a Vector Quantized Variational Auto Encoder(VQVAE). Then, to increase quality and resolution, a unique Generative Adversarial Network(GAN) is employed. For real-time VR rendering in Unity, the system effectively incorporates generated HDRI Images with Unity environment. The results of the experiments show how effective the method is because issues like memory limitations and upscaling artifacts were found and fixed. This study lays the groundwork for upcoming advancements in real-time environmental renders and shows that AI-generated skyboxes can produce immersive virtual reality experiences.

KEYWORDS: HDRI generation, Virtual Reality(VR), Vector Quantized Variational Auto Encoder(VQVAE), Generative Adversarial Network(GAN), skybox rendering, text-to-image synthesis.

Quantum-Inspired Self Healing Transformers for Unified Text and Image Generation in Absolute Cinema System

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ABSTRACT. This paper explains about a quantum-inspired transformer architecture designed for unified chat-based interaction, long-form script generation, and cinematic poster synthesis within the Absolute Cinema application. The Self-Healing Transformer uses pretrained weights using adaptive weight scaling, merges tokenizer vocabularies while maintaining consistency and clarity in the content, and incorporates persistent memory, rotary positional encodings, and adaptive layers inspired by quantum mechanical principles. The architecture mimics dynamic state evolution, superposition, and wave behavior to achieve human understandable language and image generation. Trained on IMSDb-derived script datasets and genre-specific movie posters using TPUs and inferred on T4 GPUs and CPUs, the model achieves a stable performance with a

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safe perplexity and error-tolerant architecture even after merging. The integrated system demonstrates fault-tolerant weight loading, flawless tokenizer unification, and dynamic adaptation mechanisms that activates local deployment for interactive storytelling applications.

KEYWORDS: Quantum-inspired computing, transformer architecture, self-healing models, script generation, image synthesis, model merging.

DOUT: Reducing Android Build Time by Dynamic Optimization of UI Tests

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ABSTRACT. Android UI test suites are notoriously slow and flaky and costly to maintain at scale. The paper discusses a practical, production-oriented approach named Dynamic Optimization of UI Tests (DOUT), that combines safe regression test selection with risk-aware fallbacks to significantly cut build time while keeping release confidence high. DOUT builds a code to test (and vice versa), impact map from any coverage tool like JaCoCo/Kover and Android resource/static analysis, then selects only those instrumented tests likely to be affected by a change. It integrates isolation (Android Test Orchestrator) [1] to reduce flakiness and uses Gradle Managed Devices for consistent device execution. Compared with retest-all baselines, DOUT targets 2-5x faster UI test phases in CI while preserving signal via required smoke gates and periodic full runs. In experiments on the "*Now in Android"* app with 300 UI tests, DOUT reduced execution time by **66 % (18 → 6 min)**, test count by **90 % (300 → 28)**, and flakiness by **54 % (4.6 → 2.1 %)**, while maintaining full regression detection accuracy.

KEYWORDS: UI testing, Android, build optimization, dynamic test selection, impact analysis, test flakiness, CI/CD, regression testing.

HELMNET: Helmet Detection Using YOLOv8

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ABSTRACT. Ensuring rider safety has become a critical priority in mitigating the growing number of two-wheeler traffic accidents worldwide. To address this, the proposed study introduces HELMNET, a real-time helmet detection framework developed

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using the YOLOv8s architecture. HELMNET aims to accurately and efficiently determine whether motorcycle riders are wearing helmets in still images and live video streams. The system leverages the latest advancements in computer vision and deep learning-based object detection, optimizing both detection accuracy and inference speed. Designed for deployment in Intelligent Transportation Systems (ITS) and smart surveillance infrastructures, HELMNET can be integrated into traffic enforcement networks to automatically identify violations, trigger real-time alerts, and support road safety analytics. The paper discusses the model architecture, training methodology, dataset preprocessing, performance evaluation, and the potential of this system to transform automated law enforcement and public safety management. The Precision, Recall and mean Precision (mAP) are some of the evaluation measures used to assess helmet detection accuracy. Experimental results highlight HELMNET's robustness across varying illumination, occlusion, and traffic density conditions, demonstrating its superiority over traditional monitoring techniques.

KEYWORDS: Feature Pyramid Network (FPN), Helmet Detection, object detection, real-time systems, road safety, R-CNN.

Unified Real-Time Compliance Monitoring System: A Comprehensive Approach combining Detection and Facial Recognition

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ABSTRACT. Traffic violations are a huge risk to road safety and among the leading causes of accidents and deaths in the world. Existing monitoring systems separate each type of violation, which leads to inefficient monitoring and high costs. This paper describes a real-time integrated system that detects four relevant violations—helmet detection, triple riding/overloading, speed estimation, and automatic number plate recognition (ANPR)—with facial recognition for the identification of violators. Our integrated framework maintains multiple detection and tracking processes in a single processing stream to avoid redundancy and increase correlation between violations. The system achieves processing speeds of 18-25 FPS and also provides 85-92% and 90% accuracy for helmet detection and overload detection respectively, with speed estimation error between ±3-5 km/h and license plates are read at 80-88% accuracy, which resulted in an overall F1-score of 0.83. We validate the framework through two applications (CP Plus CCTV with desktop processing (200+ hours, 15,000+ detections) and the ANPR camera with edge processing NVIDIA Jetson Orin (4 weeks, 50,000+ detections)). Our modular framework also achieves 95% bandwidth efficiency processing on edge devices and < 5% false positive rate, with overall cost reduction of 60-70% on the infrastructure versus a fragmented monitoring system.

KEYWORDS: Traffic violation detection, integrated monitoring system, facial recognition, edge computing, real-time enforcement.

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Website Vulnerability Scanner

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ABSTRACT. Web applications have become the backbone of modern digital ecosystems, powering essential services such as online banking, e-commerce, and social networking. However, their ubiquity also makes them primary targets for cyberattacks exploiting vulnerabilities like SQL Injection (SQLi), Cross-Site Scripting (XSS), and Cross-Site Request Forgery (CSRF). This paper presents AutoHySeC, a next-generation website vulnerability scanner designed to proactively detect, evaluate, and report security weaknesses in web applications. By combining static and dynamic analysis with machine learning (ML)-based fuzzing, AutoHySeC addresses limitations of traditional tools such as high false-positive rates and poor adaptability to modern JavaScript- heavy Single Page Applications (SPAs). We detail the parameters of the Qlearningbased fuzzing optimizer, which dynamically adapts its payload strategy based on application responses.

KEYWORDS: Website Vulnerability Scanner, AutoHySeC, Web Application Security, SQL Injection, XSS, CSRF, Machine Learning, Risk Scoring, Adaptive Scanning, DevSecOps, Web Assembly Security.

Detecting Human-Like Bots: A Graph-Based Multi-Expert Approach For Llm Powered

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ABSTRACT. Recent advances in large language models (LLMs) such as ChatGPT and Gemini have enabled the creation of highly sophisticated social bots capable of generating fluent, contextually relevant, and human-like text. These LLM-powered accounts closely replicate real user behavior, making conventional detection systems ineffective. To address this challenge, this study presents a graph-based multi-expert detection framework for identifying both traditional and LLM-driven bots. The model combines three synergistic components: (1) a Pattern-Informed Feature Extraction (PIFE) module that captures linguistic and behavior-al cues characteristic of AI-generated content; (2) a Mixture-of-Experts (MoE) mechanism that processes diverse input domains, including text, metadata, and contextual features; and (3) a Graph Interaction Module that models user connections and dependencies through graph aggregation. By integrating these modules, the framework learns multidimensional distinctions between humans and bots. Experimental results on benchmark datasets demonstrate that the proposed system significantly outperforms existing baselines in both accuracy and scalability, offering a resilient solution for preserving authenticity on social platforms.

KEYWORDS: LLM-driven bots, graph neural networks, mixture of experts, bot detection, online security.

Smart E-Learn: Course Recommendation Platform Leveraging Learning Styles and Course Ratings

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ABSTRACT. E-learning is best alternative to traditional classroom teaching for life ling learners. In real-life situations, students aren't all the same—they have different interests, and even if some share similar passions, their skill levels can vary widely. That's why it doesn't make sense to treat every student the same way. What they really need is a learning system that understands and adapts to their individual strengths, interests, and pace. This is where personalized recommendations come in, helping to guide each learner on a path that's just right for them. In this research, firstly learning style preferences are taken from different individuals and these are mapped to FSLSM model and categorized to different learning styles like active, reflexive, sequential, intuitive using Fuzzy C-means Clustering Technique. The Fuzzy Partition Coefficient (FPC) was 0.125, Silhouette Score was 0.0129 and Davies-Bouldin Index 4.18. Later courses details are fetched through web scrapping technique. The fetched courses are mapped to the learning styles based on type, level and duration of courses. Finally based on the learning style of the learner and course ratings the courses are recommended. Learning Style accuracy for the courses are as follows Active: 36.80%, Reflective: 28.60%, Sensing: 14.10%, Intuitive: 9.50%, Sequential: 7.60%, Verbal: 2.80%, Global: 0.40%, Visual: 0.20%. Experimental results shown that proposed method outperformed existing methods.

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KEYWORDS: E-Learning, Course recommendation, FSLSM model, Fuzzy-C-means, Web scrapping, Ratings.

AI and Blockchain for Advanced Threat Detection and Data Security

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ABSTRACT. This paper presents an advanced hybrid cybersecurity framework that integrates Artificial Intelligence (AI) and Blockchain to enhance cyber threat detection, response, and data integrity. The proposed model combines a hybrid CNN–Random Forest architecture for intelligent anomaly detection with a private Proof-of-Authority (PoA) blockchain to ensure verifiable, tamper-resistant audit trails. To address reviewer concerns on trust dependency in PoA, the framework introduces dynamic validator rotation and cross-chain audit synchronization to reduce centralization risks.The model achieves 96.2% detection accuracy on benchmark datasets (UNSW-NB15, CICIDS2021) while maintaining low latency (0.9 s) and reduced false positives. Additional experiments on simulated enterprise traffic confirm stable performance in live-network conditions. Enhanced sandboxing and behavior simulation allow detection of zero-day and stealthy payloads. These results indicate that AI–Blockchain synergy can provide trustworthy, scalable, and interpretable security analytics for next-generation digital infrastructures.

KEYWORDS: Cybersecurity, Artificial Intelligence, Blockchain, Threat Detection, Intrusion Detection, Data Auditing.

TCN-BiLSTM: An Advanced Deep Learning Hybrid Framework for Accurate Stock Price Prediction

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ABSTRACT. Stock-price forecasting is difficult due to nonlinearity, volatility, and noise driven by macroeconomic factors and investor sentiment. Conventional approaches (e.g., ARIMA) and hybrid ARIMA–LSTM ensembles suffer from sensitivity to hyperparameter tuning, sub-optimal ensemble weighting, substantial computational cost, and weak handling of non-stationarity and complex seasonality. This research propose a hybrid framework that integrates Temporal Convolutional Networks (TCN) and Bidirectional Long Short-Term Memory (BiLSTM) networks. The TCN component captures long-range temporal dependencies via dilated causal convolutions, while the BiLSTM component models short-horizon bidirectional relationships. Hyperparameters are optimized with Optuna, and regularization (dropout, weight normalization) is employed to mitigate overfitting and accelerate convergence. When employing historical stock data (Open, High, Low, Close, Volume) from the NIFTY 50 index, the proposed model did better on performance measures (MSE, RMSE, MAE, R^2) than ARIMA, LSTM, and earlier ensemble methods on their own. This hybrid approach is a strong and useful way to anticipate stock prices in real time since it performs better in more types of market conditions and fixes the faults with prior methods.

KEYWORDS: Stock price prediction, Temporal Convolutional Network, Bidirectional Long Short-Term Memory, Deep learning, financial forecasting, Time-series analysis, Hyperparameter optimization.

ADLC Reimagined - From SDLC to ADLC+ A Safer Lifecycle for Ethical and Adaptive AI Agents

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ABSTRACT. Agentic AI systems, which learn, adapt, and operate autonomously in dynamic environments, expose critical gaps in traditional Software Development Lifecycle (SDLC) based AI development. SDLC models, relying on deterministic logic, linear processes, and static validation, are increasingly ill suited for systems that evolve post deployment and operate in complex, unpredictable environments. This paper introduces Agentic AI Development Lifecycle Plus (ADLC+), a reimagined framework tailored to adaptive agentic AI. Through a comparative analysis of SDLC and ADLC+, we highlight key shortcomings in conventional methodologies, particularly their inability to manage emergent behaviors, ethical inconsistencies, and high failure rates in recent AI implementations. ADLC+ integrates adaptive system design, behavior driven testing, scenario based testing, continuous post deployment monitoring, and realignment as foundational lifecycle components. Additionally, optional yet critical stages such as persona modeling, ethical risk assessment, adaptive governance, Human-in-the-Loop

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(HITL), and model interaction governance (MIG) are proposed to enhance reliability and safety in high stakes domains. By replacing static assumptions with dynamic, context aware practices, ADLC+ provides a flexible, feedback driven roadmap for deploying trustworthy agentic AI systems. This scalable, ethically grounded framework ensures adaptive, continuously validated agents, reducing operational risks and enabling safe deployment across complex environments.

KEYWORDS: Agentic AI, SDLC, ADLC, ADLC+, Software Engineering, Autonomous Systems, AI Governance, Persona Modeling, GenAI, Risks, Ethical misalignment.

AI-Driven Augmented Reality Display for Vehicles

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ABSTRACT. The integration of Artificial Intelligence (AI) and Augmented Reality (AR) is fundamentally transforming how individuals interact with modern vehicles, ushering in a new era of safer, more intuitive, and immersive driving experiences. The AI-powered Augmented Reality Head merges real time perception with dynamic visual representation. Head-up displays, AR HUDs, display critical driving information directly in a driver's natural field of view in real-time. Minimizing diversions and enhancing situational awareness, this paper reviews the latest developments in Perhaps more importantly, however, is the role of AI in driving all the key advances in AR HUD technologies with regard to perception algorithms, visualization methodologies, and human machine interface, HMI, design. It underlines the deep learning methodologies of Convolutional Neural Networks, YOLO, and MobileNets improve object recognition and environmental understanding with high precision. Meanwhile, AR innovations in waveguide optics and holographic projections enhance depth, sharpness, and Spatial accuracy of digital overlays in real world contexts Also discussed are emerging research directions like LiDAR-AR integration, adaptive rendering, and explainable AI for their role in achieving more: personalized and trustworthy driver assistance. Lastly, the paper sets up current challenges with respect to real-time performance, environmental reliability, and ergonomic design and provides insight that will be useful in the development of human-centric intelligent automotive display in future systems.

KEYWORDS: Augmented Reality, Artificial Intelligence, Head-Up Display, Computer Vision, Autonomous Vehicles, driver assistance, LiDAR fusion, human-machine interface, cognitive load, real-time perception.

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Energy -Efficient Optimized Clustering and Scheduling for Wireless Sensor Networks

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ABSTRACT. In recent years, the applications of Wireless Sensor Networks have increased immensely in harsh environments like landslide detection and forest monitoring. The use of sensors has drastically increased due to the growing multiple smart cities in our country. Most of the applications presented mobility of sensor nodes, which introduces significant challenges like frequent path breaks and QoS (Quality of Service) issues. To handle the dynamic nature of the network and efficient energy communication, optimized clustering is needed. To achieve optimized QoS network performance, we proposed the Energy Efficient Clustering and Scheduling (EECS) protocol. This protocol is developed by incorporating the features of Particle Swarm Optimization (PSO) for optimal cluster creation, and Support Vector Machine (SVM) classification for Cluster Head (CH) selection. For the CH election, the node attributes such as residual energy, velocity, and geographical proximity are considered. Furthermore, a Q-Learning (QL) mechanism was adopted for adaptive scheduling which dynamically allocates transmission slots according to node mobility and connection durations. The simulation results validated that EECS outperforms the existing protocols Energy-efficient Scheduling based Clustering Approach (ESCA) and hybrid clustering scheduling strategy (HCSS) in terms of throughput, reduced energy consumption, and lower end-to-end delay over varying network densities and node velocities.

KEYWORDS: Wireless Sensor Network, Clustering, Optimization, Energy Efficient, PSO, Q- learning.

Energy-Efficient Matrix Multiplication: Optimizing Computational Energy in Modern Processors

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ABSTRACT. Matrix multiplication is a critical operation in fields such as machine learning, computer graphics, and scientific computing, where performance and

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efficiency are paramount. The purposed works presents a hardware architecture designed to accelerate matrix multiplication by leveraging parallel processing techniques. The architecture employs a structured approach to handle multiple data points simultaneously, enabling efficient computation of large matrices. By organizing data into blocks and processing them in parallel, the design reduces the overall computational time and improves throughput. The architecture achieves high computational efficiency, with 79.90% DSP utilization and a 6.85% increase in LUT utilization, ensuring balanced resource usage while maintaining scalability for larger datasets. It incorporates a dedicated processing unit to handle arithmetic operations in parallel, minimizing redundant computations and memory access overhead. The design also focuses on efficient data loading and storage mechanisms to streamline the flow of information during computation. Performance evaluation high- lights significant improvements in processing speed compared to traditional methods, making it suitable for high-performance applications.

KEYWORDS: Matrix Multiplication, SIMD, ARM NEON, Data Processing Unit (DPU), Parallel Computing.

A Multi-Modal Deep Learning Architecture for Accurate Medical Diagnosis from Hybrid Sensor Data

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ABSTRACT. The integration of multi-modal sensor data has emerged as a transformative approach in enhancing the accuracy and reliability of medical diagnosis. This paper proposes a novel Multi-Modal Deep Learning Architecture (MMDLA) that leverages data from heterogeneous medical sensors, including electrocardiograms (ECG), photoplethysmography (PPG), thermal imaging, and electronic stethoscopes, to enable comprehensive and precise disease detection. The proposed model utilizes parallel convolutional neural networks (CNNs) and bidirectional long short-term memory (BiLSTM) networks to extract spatial and temporal features from each modality. A modality-attention fusion mechanism is introduced to weigh the contribution of each data stream dynamically, enhancing the diagnostic decision-making process. The system is validated on a benchmark hybrid sensor dataset comprising synchronized ECG, PPG, and respiratory data for cardiac and respiratory disease classification. Experimental results demonstrate that the MMDLA outperforms traditional single-modality and early fusion approaches,

achieving an overall classification accuracy of 96.8%, a sensitivity of 97.2%, and an F1-score of 96.5%. The model also shows robustness against noise and missing data, making it suitable for real-world deployment in clinical and wearable healthcare applications.

KEYWORDS: Multi-modal deep learning, hybrid sensor data, medical diagnosis, CNN, BiLSTM, attention mechanism, ECG, PPG, thermal imaging, healthcare AI.

PhishGuard: An Automated Machine Learning-Based System for Phishing URL Detection

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ABSTRACT. Phishing attacks are one of the most common cyber- attacks nowadays. Attackers create fake websites and URLs that look similar to the real ones to steal personal data like passwords, usernames, bank details, etc. Internet users, financial institutions, and businesses are the targets by these attacks. Many traditional approaches were used earlier to detect these attacks, but as the attackers are using new methods, these traditional approaches are not useful anymore, as they are slow to update. To overcome this problem, we propose a machine learning based system called PhishGuard. This system uses machine learning models, which detect phishing URLs with high accuracy and give transparent results using explainable AI. More than 25 features in an URL are extracted by the system. Two machine learning models are used, which are XGBoost and Random Forest. These models are trained and tested on a large dataset of over 4,50,000 URLs, which are collected from trusted sources. SHAP is an explainable AI that is used to make understandable predictions, explaining why a particular URL is detected as Phishing or legitimate. Experimental results show that the proposed system achieves very high accuracy, precision, and recall, making it effective for phishing detection in the real world. In general, PhishGuard is the model that gives a solution against phishing attacks by combining machine learning models, feature extraction, and explainable AI together.

KEYWORDS: Phishing, URL detection, Machine learning, XG Boost, Random Forest, Explainable AI, SHAP.

Synaptic Cinema: An Intelligent Emotion Driven Screening

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ABSTRACT. This paper presents the comprehensive design, implementation, and critical analysis of Synaptic Cinema, an intelligent movie and series recommendation system. This work's main objective is to move beyond the limitations of conventional recommendation models, which typically depend on static historical data like user ratings, by incorporating the user's immediate emotional state. This paper proposes a novel architecture that integrates a privacy-preserving, client-side facial emotion recognition (FER) pipeline within a robust React.js frontend. The frontend uses the face-api.js library to carry out all emotional analysis directly in the user's browser, which guarantees that no sensitive biometric information is ever sent over the network. The detected emotional state is then used to inform a scalable Flask backend, which serves as the primary data processing and API layer, facilitating seamless interaction with The Movie Database (TMDB) APL. A critical component of the system is its innovative "mood-matching" module, which maps detected emotional states to relevant content genres, thereby enabling the provision of highly personalized recommendations alongside standard functionalities. This research highlights the potential of an emotionally intelligent recommendation engine to significantly augment user engagement and satisfaction by offering more empathetic, contextually relevant, and mood-contingent entertainment choices, establishing a blueprint for future AI systems designed around the human experience.

KEYWORDS: Movie Recommendation Systems, Facial Emotion Recognition, Affective Computing, Deep Learning, Privacy-by-Design.

The AI Radiologist: Benchmarking Deep Learning for Automated Brain Tumor Detection in Medical Imaging

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ABSTRACT. The rapid advancement of artificial intelligence (AI) in medical imaging has opened new avenues for automated disease diagnosis, particularly in detecting brain tumors from computed tomography (CT) scans. This study presents a preliminary performance analysis of state-of-the-art deep learning architectures to assess their feasibility for automated brain tumor detection, rather than conducting a comprehensive benchmarking comparison or sensitivity analysis. We evaluate the performance of several convolutional neural networks (CNNs), including EfficientNetB7, Xception, MobileNetV2, ConvNeXtBase, and NASNetMobile, using a multimodal dataset of publicly available brain CT scans. Our experiments reveal that EfficientNetB7 achieves the highest accuracy at 95%, significantly outperforming the other models, while NASNetMobile shows more modest performance with an accuracy of 72.5%.

This research report offers clear, high-level insights into the behavior of AI models across various architectures, laying the groundwork for future experiments involving large-scale benchmarking, potentially even with synthesized data. Furthermore, it discusses the integration of these models into clinical settings and includes a clinical applicability analysis based on a comprehensive overview of current technologies.

KEYWORDS: Artificial Intelligence, Deep Learning, Brain Tumor Detection, Medical Imaging, CT scans, Automated Diagnosis, Radiomics.

CAPEX-Guard: YAML/YARA-Driven Threat Triage with RF-Assisted Log Intelligence

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ABSTRACT. This paper presents CAPEX-Guard, a empowered cybersecurity pipeline which integrates supervised log intelligence with signaturebased attribution for enhanced threat prioritization in SOCs. The framework uses a Random Forest classifier to predict enforcement actions from Allow, Deny and Drop based on the server and firewall telemetry. At the same time, one YAML/YARA engine unites suspicious behaviour to community templates and links them to Common Attack Pattern Enumeration and Classification (CAPEC) methods using Common Weakness Enumeration (CWE) and Common Vulnerabilities and Exposures (CVE) connections. The result contains CVSS based risk assessments categorized by confidentiality, integrity and availability impact. The Random Forest classifier achieves 0.898 accuracy and 0.894 F1-score when validated on real HTTP log data while there is 92.98% agreement between predicted methodologies and CAPEC mappings. The system provides operational metrics like rule conversion times and rulebase coverage analysis for continuous detection readiness against evolving threats.

KEYWORDS: Cybersecurity · Threat Intelligence · Machine Learning · Random Forest · YARA · YAML · CAPEC · CVE · CVSS · SOC Operations.

Investigating UXSS Vulnerabilities in Modern Web Browsers: An Empirical Analysis of Security Mechanisms and Architectural Resilience

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ABSTRACT. The modern web browser is a sophisticated framework that enables interactive applications to co-operate. Universal Cross-Site Scripting (UXSS) can be

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defined as an important risk on the client-side, usually which exploits a flaw in the browser. We share a study on the UXSS vulnerabilities of the popular browsers Brave, Chrome, Firefox and Safari. The analysis will examine the architectural safeguards against cross-origin script execution. We look at how well current browser protections work. We use a systematic way of doing things.
This includes a literature review. It also includes a look at CVE-based data sets. In addition, we conduct experiments and testing for proof-ofconcept. According to the results, recent browsers resist user-exploitable XSS attacks well. Due to implementations such as sandboxing, site isolation, and tougher web standards like SOP, CSP and CORS, Chrome is highly secure. The defenses at the browser level have seemingly improved greatly, as there was not a single successful execution of UXSS out of a total 120 payload executions. However, APIs, plug-ins, and legacy versions still remain a risk. The study suggests achieving security of the web browsers' ecosystem continuous research, automated fuzzing and formal verification.

KEYWORDS: Universal Cross-Site Scripting (UXSS) · Web Browser Security · Same-Origin Policy (SOP) · Content Security Policy (CSP) · Cross-Origin Resource Sharing (CORS) · Sandboxing · Site Isolation · Vulnerability Analysis · Formal Verification · Fuzz Testing.

Octokey: A Secure and User-Friendly Authentication System for the Consumer

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ABSTRACT. For decades, researchers have highlighted the weaknesses of password-based authentication systems. It continues to be the norm, nevertheless, and serves as the primary line of defence for online services against phishing, credential theft, brute force, and other malicious usages. Many of the tools available which help you mitigate these kind of attacks practically violate your user experience (UX) by forcing many steps, making it unbearable for the user to manage or sometimes even forcing single point failures like hardware tokens or federated identity system that also make the user vulnerable to centralized entity attacks that may violate your privacy. This paper presents **Octokey**, a decentralized cryptographic authentication protocol for eliminating passwords that is simple and highly trustworthy. Octokey uses a mediated RSAbased challenge-response signing, key fragmentation, and automatic revocation such that private keys are never revealed or assembled. An
experimental evaluation demonstrates that Octokey achieves authentication latency as low as 45.3 ms and under controlled testing, it succeeds 100% of the time. Further tests show that Octokey outperforms FIDO2 and OTP-based solutions for both speed and resistance to tampering. The system also allows instant revocation of keys, provides forward secrecy and prevents phishing attacks through domain-bound challenges. The mediator enforces rate limiting. The results suggest that decentralized passwordless authentication delivers enterprise-grade security with single-click login-level usability, which is a significant step in the direction of self-sovereign digital identity schemes.

Keywords: decentralized authentication; passwordless login; public-key cryptography; mediated RSA (mRSA); challenge–response protocol; key revocation; usability–security trade-off; self-sovereign identity (SSI); web security; cryptographic protocol design.

Equilibrium Analysis of AI Investment in Financial Markets under Uncertainty and Cybersecurity Risk

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ABSTRACT. The use of AI in finance may have brought about change as far as market analysis and decision making goes, which also presents economic uncertainty and cybersecurity risk. This paper provides a framework to study the allocation of investors toward AI under uncertain conditions. The model captures the effect of AI accuracy, hallucination bias, and cybersecurity exposure on information acquisition endogenously using global games and Bayesian Nash equilibrium. The outcome helps in creating a unique stable equilibrium where the accuracy of AI balances the gain of information with the stability of the system against cyber disruptions. Simulations suggest that depending on AI too much or being poor at cybersecurity makes you more systemically vulnerable. According to the study, the incorporation of cybersecurity in AI-enabled economic models is essential for ensuring stability, transparency and resiliency of intelligent ecosystems.

KEYWORDS: artificial intelligence, financial markets, Bayesian Nash equilibrium, global games, information acquisition, cybersecurity risk, market stability, algorithmic investment, systemic risk, decision theory.

Enhancing Equity Research with AI: A LangChain-Based News Analysis Framework

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ABSTRACT. In today's digital world, we are flooded with news from countless sources and platforms. With so much information available, it has become increasingly difficult for people to keep up, interpret, and make sense of it all. This growing challenge has created a need for smart tools that can organize, summarize, and extract meaningful insights from massive amounts of news data.This paper introduces LangChain, an innovative solution that combines blockchain technology with advanced Language Model (LM) systems to create a powerful platform for news analysis and research. LangChain is designed specifically to work with Large Language Models (LLMs) and offers essential tools for processing and managing documents. It supports multiple file types such as plain text, CSVs, and even web links and uses intelligent techniques to break long text into smaller, easy-to-handle pieces. For encoding the text into a machine-readable format, LangChain relies on Hugging Face and OpenAI

modules. These convert the text into numerical vector representations, or embeddings, which allow for efficient storage and quick retrieval in vector databases.

To make sense of all this data, LangChain borrows ideas from the traditional information retrieval (IR) methods. It works with FAISS, a high-performance library for similarity search, to quickly find and cluster related information. It also uses methods like TF-IDF to generate more accurate search results. One of LangChain's key features is the RetrievalQA with sources chain, which takes the processed information chunks and refines them further. These refined pieces are then used for deeper analysis and summarization. The result is a well-structured, concise output that brings together the most relevant and meaningful insights from large volumes of news content.

KEYWORDS: Financial Analysis, NLP, Machine Intelligence, LangChain Framework, Generative Models, Large Language Models, Information Retrieval, FAISS, Semantic Similarity Search.

OPTIMIZING UPPER LIMB REHABILITATION IN SPINAL CORD INJURY PATIENTS THROUGH REINFORCEMENT STRATEGIES

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ABSTRACT. Enhancing motor recovery and improving quality of life for patients with spinal cord injuries (SCI) requires optimizing upper limb rehabilitation. This study investigates the application of reinforcement techniques, such as task-specific practice, adaptive learning, and behavioral reinforcement. To improve motor function and activate specific muscles, the method combines electrical stimulation with reinforcement learning algorithms. The proper movement patterns are facilitated by stimulation, but when those patterns are satisfied, real-time feedback and customized goal-setting provide reinforcement. This method enhances rehabilitation's efficacy and interactivity by promoting continued patient participation. Training reinforcement learning computers might be challenging due to the significant challenge of learning from scarce clinical data. Two strategies for classifying therapies are proposed to address this problem: one that makes use of domain knowledge of SCI rehabilitation, and another that employs embedding techniques to find treatment similarities. These grouped representations enable a more efficient learning process using Fitted Q Iteration. Each patient's answer gives the reinforcement agent the capacity to select more effective treatment strategies. The outcomes of the simulation demonstrate how the technology could improve rehabilitation outcomes and support clinical judgment. Patients with SCI may benefit from scalable, adaptable, and data-efficient rehabilitation with this strategy.

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KEYWORDS: Q-Learning, Upper Limb Rehabilitation, Reinforcement Learning, and Spinal Cord Injury (SCI).

Traffic Rules Alerting System

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ABSTRACT. One of the most serious global challenges continues to be traffic offenses and road accidents, largely due to drivers overlooking regulations because of the limited enforcement of static signage and manual enforcement of the laws. This paper highlights the design, implementation, and analysis of a Traffic Rules Alerting System, an integrated two-platform solution consisting of a web-based administrative portal and a mobile-based alerting application. Using real-time GPS tracking, and a secure cloud database, the system dynamically fetches location- specific traffic regulations. A central technical feature is pinpointing the exact closeness of a user vehicle to the rule-defined coordinates via the Haversine formula. Driving rules are communicated to the userduring critical moments through visual icons and spoken alerts in a voice envelope, to mitigate distraction. Designed in a React Native, PHP, and MySQL environment, the system has been certified as technically, financially, and operationally feasible and has advanced the reactive approach tomodern traffic enforcement.

KEYWORDS: Traffic Rules Alerting System, Real-time GPS Tracking, Location-specific Traffic Regulations, Haversine Formula, Mobile Alerting Application.

A Real-Time Deep Learning Framework for Action Recognition, Multilingual Translation, and Intelligent Messaging

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ABSTRACT. This paper presents a unique real-time deep learning framework that creates links between sign language and spoken language through intelligent translation and automated messaging. The framework receives live video footage from a webcam and uses MediaPipe's pose and landmark detection to extract key points representing hand gestures in both American Sign

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Language (ASL) and Indian Sign Language (ISL). The extracted video frames are classified using a Bidirectional Long Short-Term Memory (BiLSTM) model, which is capable of recognizing both dynamic and contextually based signs. After the signs are recognized, they are passed into a multilingual translation module, where they are then translated into several target languages using a text-to-speech synthesizer to produce intelligible audio output — all in real-time. The practical real-world implementation of the framework includes Twilio API integration to send messages to SMS and WhatsApp in real-time from start to finish. The experimental results show high recognition accuracies, low latency period, and very good performance in translation. In future work, we expect to extend this framework and allow for full end-to-end, interactive communication that can take incoming text messages and translate them back to sign language animations to achieve a fully inclusive digital experience.

KEYWORDS: Action recognition, BiLSTM, language translation, webcam, real-time processing, Twilio, multilingual communication, accessibility.

A Blockchain-Based Identity Management Framework with Multi-Factor Authentication for Self-Sovereign and Secure Digital Identity

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ABSTRACT. The increasing reliance on internet-based systems creates a number of problems for centralized identity systems, including data breaches, identity theft, and loss of user control. Limitations compromise trust, data privacy, and sustainable functionality, hence making it efficient for user-cantered identity management framework overcoming which the project presents a Blockchain-Based Identity Management Framework with multi-factor authentication that combines decentralized identifiers, Ethereum smart contracts, and IPFS-based storage. Although blockchain-built systems regularly are entirely dependent on private keys and have been vulnerable to unauthorized access, our model primarily comprises MetaMask wallet authentication that is integrated with OTP/biometric verification and, therefore, stands out as a robust protection against all breaches. Credential data are encrypted before being stored in IPFS; only secure hashes are stored on-chain, which keeps secrecy even during threats. Improved security mechanisms include social recovery and time-lock contracts as a means of restoration to protect those users who lost their keys-an oft-neglected barrier to normal deployment. Layer-2 solutions, such as Polygon, help the system reduce costs and increase durability.

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Experimental verification shows its applicability across different domains such as healthcare, banking, and e-governance, thus offering users with enhanced security, privacy, and greater confidence in managing and restoring their digital identities.

KEYWORDS: Blockchain, Self-Sovereign Identity (SSI), MetaMask, Multi-Factor Authentication, Identity Management, Smart Contracts, Ethereum, IPFS, Decentralized Identifiers (DIDs), Web3 Security.

AI Powered Network Anomaly Detection System

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ABSTRACT. Traditional intrusion detection systems (IDSs) are limited in detecting new attacks, or zero day attacks, due to relying on signatures that have been demonstrated as effective and have no history of attack memory. This paper proposes, for this purpose, a real time Network Intrusion Detection Systems (NIDS) in a production grade environment employing machine learning. Our system develops a four-stage pipeline built on efficient ML inference, feature extraction, flow reconstruction, and live packet capture. We trained a Gradient Boosting Classifier on UNSW-NB15 dataset and efficiently produced a small model size of 4.7MB. We tested on a separate test, valid, data set with 82,332 flow records where our system detected attacks with a recall of 98.33%, and achieved an overall accuracy of 87.31%, which indicates few were missed with a precision of 82.14%. Further, our work achieves a ROC-AUC of 98.37% demonstrating excellent discriminative ability. Critically, our system is able to analyze >1000 packets/second and has detection time (i.e. latency) less than 5ms, although capable of processing detection in real-time on standard hardware. This work offers a valuable contribution to operational security and demonstrates a practical, high-performance NIDS capable of autonomously detecting exploits without the costly scaling and overhead to continually update signatures.

KEYWORDS: Network Intrusion Detection (NIDS), Machine Learning, Real-Time Systems Gradient Boosting, UNSW-NB15, Attack Detection, Zero-Day Attacks.

Data Recovery and Live Migration in Nested Virtualized Environments using Hyper-V

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ABSTRACT. The test beds that can assess the disaster-recovery behavior cost-effectively and repeatably are also very few and restricted mainly to clusters of enterprises. The research question of this paper will be can a nested windows hyper v environment on commodity hardware achieve fruitful recovery time objectives (RTO) and recovery point objectives (RPO) to both planned and unplanned faults. The tests are done on live migration (service continuity), checkpoints (rollback) and asynchronous replication (host-level fail over) to a two-host Hyper-V cluster running on a VMware Workstation, with a connection to the Active Directory. Experiments use nonstop probing in order to measure live-migration downtime and provide checkpoint creation/restoration checkpoints and fail over RTO/RPO on model profiles of VMs. Findings indicate that live migration limits the interruption of transient packet-loss experiment, replica-based fail over provides predictable RTO and replica-based replication provides constrained RPO and replica-based recovery is accessible. The results are characterized by operational constraint (network isolation, authentication/delegation, switch consistency) in the work. The results suggest that a Hyper-V-based nested laboratory can offer the educative, prototyping, and saleable continuity planning that can be measured in terms of RTO/RPO.

KEYWORDS: Virtualization, Hyper-V, Nested Virtualization, Live Migration, Checkpoints, Replica, Disaster Recovery, Security, Secure Boot, Bit-locker, Host Guardian Services.

Mining Twitter Data for Resource Allocation and Rescue Assistance during Natural Disasters and Epidemics

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ABSTRACT. The Disaster Management System is an advanced platform developed to revolutionize disaster response and management by harnessing the potential of real-time social media data. This system specifically targets Twitter's vast data streams to empower emergency responders with vital information. By integrating modern technologies such as natural language processing (NLP), machine learning (ML), geolocation tracking, and sentiment analysis, the platform processes and filters vast amounts of social media data. The system

utilizes a robust fake news detection module powered by DistilBERT, ensuring data authenticity and reliability. Experimental evaluations indicate high accuracy in filtering fake news (exceeding 90%), e*ff*ective geo location mapping (over 80% accuracy) and robust sentiment detection in chaotic, high-volume tweet streams. The proposed approach shows promise for transforming disaster response by bridging the gap between unstructured social media data and actionable crisis intelligence.

KEYWORDS: Disaster Management, Twitter Data Mining, Fake News Detection, Natural Language Processing, Geolocation Tracking, Sentiment Analysis.

Enhancing Credit Card Fraud Detection through Principal Component Analysis and Machine Learning Models

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ABSTRACT. The recent surge in digital payments and transactions has led to a rise in credit card fraud. We propose a machine learning framework that integrates the use of Principal Component Analysis (PCA) and supervised classifiers for detecting the fraud efficiently. PCA is used to reduce the dimension of the data to 17 which takes care of 95.7% variance in data and also helps us in reducing the computational cost. The dataset used here comprises a total of 284,807 transactions. Out of which 0.172% of the transaction was fraudulent. Similarly, PCA was performed on the input features to train two models here. These models are LR i.e. Logistic Regression and FFNN i.e. Feedforward Neural Network. In a comparison of various machine learning models, the Logistic Regression model achieved an F1-score of 97% with a precision of 96%. The FFNN achieved an accuracy of 93%. PCA also reduced training time by approximately 60%. Our results show that dimensionality reduction via PCA improves the interpretability and performance and provides a
scalable and effective solution for real-time credit card fraud detection.

KEYWORDS: Credit card fraud detection; Principal component analysis (PCA); Logistic regression; Feed forward neural network (FFNN); Dimensionality reduction; Machine learning; Financial anomaly detection; Imbalanced datasets; Predictive analytics; Real-time fraud prevention.

Smart Solutions for Urban Traffic: Enhancing Safety and Efficiency

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ABSTRACT. Urban traffic congestion and slow accident response times continue to challenge modern cities. Traditional traffic lights work on fixed

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schedules and cannot adjust to changing vehicle volumes, often causing unnecessary delays and inefficient road usage. Likewise, relying on manual accident reporting can slow down the arrival of medical assistance. In this paper, we present a hardware based intelligent system that combines adaptive traffic signal control with real-time accident detection and automated emergency alerts. Using infrared sensors, the system detects the number of vehicles in each lane and automatically adjusts traffic light durations through an Arduino-based controller. When an accident occurs, the system instantly sends location-based alerts to nearby hospitals, ensuring quicker emergency responses. Testing of the prototype demonstrated reduced waiting times at intersections, smoother vehicle movement, and faster emergency notifications. The design remains cost-effective, scalable, and compatible with existing urban traffic systems, making it a practical solution to improve both efficiency and road safety.

KEYWORDS: Smart Traffic Management, Adaptive Traffic Signal Control, Accident Detection, Arduino, Infrared Sensors, Emergency Notification.

Some Issues in the Creation of Avatars of Loved Ones Using Virtual Reality

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ABSTRACT. Avatars have become an important part of our lives, playing their role in various contexts like Video gaming, social media, instant messaging platforms, Virtual fields, and a lot more. There are various types of avatars Digital avatars, Corporate Avatars, Chatbot avatars, Character Avatars, Personal avatars, and animated avatars et.al. There are some existing techniques for creating avatars like Photorealistic scanning, Motion capture, AI-generated avatars, Face recognition and reconstruction, art-to-avatar conversion, VR avatar systems, parametric avatars, and 3D modeling software like Blender and Maya.

The limitations of the existing techniques are time-consuming, require artistic skills, limited customization, lack uniqueness of avatar, have expensive equipment requirements, inability to capture fine details accurately and require multiple high-quality photos. In this paper, we present a comprehensive survey on issues related to avatar creation in Virtual reality. For providing realistic images and unique avatars and to improve interactivity deep learning techniques can be used.

KEYWORDS: Avatar, Virtual reality, Deep learning, customization, and interaction environment.

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Intelligent Waste Classification and Interactive Disposal Guidance Using Cutting-Edge Deep Learning Models

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ABSTRACT. Waste management remains a critical environmental challenge worldwide, with improper waste disposal and classification contributing to pollution, resource depletion, and public health concerns. The increasing volume of waste necessitates efficient and accurate classification systems to facilitate proper recycling, disposal, and resource recovery. This paper presents a comparative analysis of five state-of-the art convolutional neural networks, a custom CNN alongside transformer-based models for automated waste classification, with the best-performing model integrated into an interactive disposal guidance system. The models were trained and evaluated on a comprehensive dataset comprising 4752 images across 9 distinct waste categories, including cardboard, food organics, metal, glass, paper, plastic, textile trash, vegetation and miscellaneous trash. This study aims to identify the most effective deep learning architecture for practical waste classification, considering accuracy, computational efficiency, and scalability. Experimental results show that CNN-based models achieve high classification performance, laying the groundwork for intelligent waste management systems deployable in recycling facilities, smart bins, and waste processing centers. The proposed automated classification system can improve the effectiveness of waste separation, minimize contamination in recycling processes, and encourage sustainable waste management methods in both advanced and emerging regions.

KEYWORDS: Waste classification, Deep learning, Convolutional Neural Networks (CNN), Transformer models, Smart waste management, Recycling automation, Image-based classification, Environmental sustainability, Waste disposal guidance system.

Smart AI Examination Suite: Automated Question Generation, Answer Evaluation, and Intelligent Support for Educators and Students

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ABSTRACT. Despite many educational activities taking place online today, many teachers are still using traditional, custom-based test writing, grading, administering tests and providing extra assistance methods. This paper presents a Smart AI Examination Suite that takes the place of many of those tedious activities and in turn enables students to learn from assessments. The Smart AI Examination Suite produces test papers, quizzes, and assignments from either saved curriculum or uploaded documents and uses Large Language Models (LLM) to do so. Teachers are able to schedule the assessments, auto-grade evaluations both subjective and objective in nature, and utilize an AI tutoring to assist students in comprehending complex understandings. In addition, students are able to complete assessments online, receive feedback immediately, submit work, and use an AI tutor that provides personalized practice based on their learning through assessments. This tool provides flexibility in the use of an adaptive intelligent assistant, as it decreases the burdensome workload of many of the teachers' previous activities, while improving the accuracy of the marking of assessments and enhances the engagement and personalization for students learning experiences

KEYWORDS: Artificial Intelligence, Large Language Models, Automated Question Generation, AI-based Evaluation, AI Teaching Assistant, Online Assessment, Personalized Learning, Digital Education

A Deep Learning Based Approach for Psoriasis Detection Implementation

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ABSTRACT. Psoriasis is a long-term disease that affects people of all ages, an inflammatory skin disorder it is identified by red patches of skin with scales, which may cause discomfort, itching, and pain due to which the body attacks normal skin cells unnecessarily. Detection of psoriasis at an early and correct stage is important for successful disease management. Early diagnosis enables the physicians to recommend the appropriate treatment course, which may include topical therapies, phototherapy, or systemic therapy. Advancements in the technology of deep learning in recent years have enabled skin disease diagnosis, including psoriasis, to become automated and economical. DL methods, such as convolutional neural networks (CNNs), has given superb output. This models processes large datasets of skin images, identify salient features, and identify complex patterns that could go unnoticed by human experts. It applies transfer learning by incorporating pre-trained ImageNet weights enhancing the feature extraction and reducing training complexities. By this method, systems can produce consistent, objective, and high-accuracy results in psoriasis detection. This research is performed by using DenseNet121 showing us promising results in detecting between psoriasis and normal skin.

KEYWORDS: Psoriasis**,** Deep Learning**,** DenseNet121, Convolutional Neural Networks (CNNs), Transfer Learning, Feature Extraction.

AI-Powered Medical Chatbot with ECG Analysis and Lung Cancer Detection using CNN

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ABSTRACT. This research presents an AI-powered medical chatbot that integrates Convolutional Neural Networks (CNNs) for ECG analysis and lung cancer detection. The chatbot provides an interactive platform for users to assess their health conditions through real-time diagnostic evaluations. The system employs deep learning models trained on medical datasets, ensuring high accuracy in disease detection. The chatbot is designed to assist in remote healthcare monitoring, allowing individuals to receive preliminary medical insights before seeking professional diagnosis. Future improvements will focus on expanding its capabilities, enhancing accuracy, and integrating with healthcare information system

KEYWORDS: Medical Chatbot, ECG Analysis, Lung Cancer Detection, Convolutional Neural Networks, Artificial Intelligence, Healthcare, Deep Learning.

Mult-Functional Mining Rover with Articulated Robotic Arm

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ABSTRACT. The primary objective of this work is to design, develop, and validate a rocker-bogie rover integrated with a robotic arm and environmental sensors for underground mining applications. The system aims to enhance miner safety by reducing human exposure to hazardous conditions such as toxic gases, collapses, and unstable terrain, improve efficiency in debris removal, sample retrieval, and ore transportation, and generate accurate environmental and terrain data through sensor integration for hazard prediction and operational planning. The system architecture uses an ESP32 microcontroller as the central processing unit, with the FS-i6 transmitter for communication. The L298N motor drivers are used for wheel actuation, and a PCA9685 servo controller to operate the robotic arm's servos. While manipulator control is achieved through precise PWM-based servo actuation. The integration of

LiDAR, magnetometer, and vision sensors (YOLOv8-based object detection) provides situational and environmental awareness. It enables autonomous obstacle avoidance, terrain mapping, and path planning. The experimental and simulation analyses show that the rover maintains excellent path-tracking accuracy, with close overlap between planned and executed trajectories. The system achieved stable linear velocities of approximately 0.28 m/s during straight motion and smooth steering transitions with minimal tracking error. Torque and wheel-speed data reveal the system's ability to adapt to uneven terrain and recover from transient disturbances such as sudden yaw shifts or obstacle encounters. The manipulator exhibits precise joint control, maintaining its trajectory even during base instabilities, demonstrating effective decoupling between base and arm subsystems. Furthermore, sensor validation confirms reliable perception accuracy for environmental data collection and magnetic anomaly detection. Overall, the integrated control framework delivers robust stability, accurate motion execution, and efficient manipulation under dynamic conditions. The results validate the system's capability for real-world applications such as underground inspection, sample collection, and autonomous navigation in complex environments, highlighting its potential for future deployment in industrial and research-based exploration missions.

KEYWORDS: Rover, Robotic Arm, Rocker-Bogie, Path planning, Sensors.

Edge AI-Driven Algorithms for Real-Time Monitoring in Renewable Energy Systems

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ABSTRACT. This study introduces a hierarchical edge–cloud intelligence architecture for renewable energy system real-time monitoring, anomaly identification, and performance optimisation. The innovative TinyTransformer architecture for edge devices uses attention-head reduction, dynamic quantisation, and pruning-aware distillation to achieve sub-100 ms inference latency with low accuracy loss. This approach uses federated and blockchain-secured learning pipelines to assure privacy, integrity, and scalability across regionally distributed energy assets, unlike lightweight Transformer research. The system is validated using real sensor streams and available benchmark datasets (NREL Solar Radiation and Wind Turbine SCADA). Extensive investigations include baseline comparisons with MobileNetV3, EfficientNet-Lite, and Tiny-YOLO, pruning and quantisation effects ablation studies, and statistical significance testing proving consistently improved accuracy and latency. The integrated method detects problems in loud situations, providing early warning for inverter and turbine issues while retaining

energy efficiency on Raspberry Pi 4 and Jetson Nano devices. The study presents a repeatable, privacy-preserving, and energy-aware edge-cloud cooperation approach for future sustainable renewable energy operations.

KEYWORDS: Edge AI, Federated Learning, Sustainable Energy Management, Anomaly Detection, Tiny Transformer, Edge–Cloud Collaboration, Blockchain Security

Vision Based Weed Eliminator Bot for Precision Farming

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ABSTRACT: The proposed work introduces a YOLOV8 solar- powered autonomous bot designed to simplify weed removal and promote greater viability in both agricultural fields and landscape areas. With solar energy backed by an energy storage system, the bot can operate continuously outdoors without relying on conventional fuels, making it an environment friendly choice for modern land care. The bot also includes a deep learning system powered by Convolutional Neural Networks (CNNs), which allows the bot to visually distinguish between weeds, grasses, and crops with high accuracy.

This system uses advanced reinforcement learning for smart path planning, obstacle avoidance, and terrain-aware decision making. Its cutting tool is designed to reduce the risk of damaging nearby crops and improve overall efficiency. The robot can remove unwanted growth while leaving actual plants untouched, helping maintain healthy crops or to maintain lawns. A robust computer vision setup, enhanced with sensor input, enables the robot to navigate and perform tasks independently, even in conditions such as uneven terrain or changing weather.

It is evident from field tests that the bot performs reliably in a range of environments, demonstrating its practical reliability. This work presents a scalable and feasible solution that reduces manual labour and supports sustainable land management, bringing intelligent automation to agriculture in a meaningful way.

KEYWORDS: Autonomous Robot, Vision-based Weed Detection, Convolutional Neural Network (CNN), Sustainable Weed Management, Obstacle Avoidance, Non-chemical Weed Control.

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Automated Handwritten Answer Evaluation: A Curriculum Agnostic Framework Using Vision Transformers and Retrieval Augmented Generation

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ABSTRACT. The manual evaluation of handwritten answer scripts remains one of the most resource-intensive processes in education, leading to delayed results, inconsistent grading, and human bias. With the recent evolution of artificial intelligence, particularly Vision Transformers (ViTs), Retrieval-Augmented Generation (RAG), and Large Language Models (LLMs), there exists a unique opportunity to develop a curriculum-aware, explainable, and efficient evaluation framework. This paper presents EvalAI, a novel AI-powered system for automated handwritten answer evaluation that combines Optical Character Recognition (OCR) using Microsoft's TrOCR, context retrieval using FAISS-semantic embeddings of NCERT textbooks, and rubric-based scoring using Mistral-7B-Instruct. The framework performs text extraction, context alignment, semantic similarity evaluation, and detailed feedback generation. Experiments conducted on 32 Class 10 handwritten answers from 10 subjects demonstrated an OCR accuracy of 96.8%, grading accuracy of 96.4%, and Pearson correlation of 0.94 with human evaluators. The system processed each response in ≈49.5 seconds, including feedback generation. Unlike prior works that provide numeric marks only, EvalAI produces concept-level, interpretable feedback explaining the awarded marks and identifying conceptual gaps.

KEYWORDS: Optical Vision Transformers, Optical Character Recognition, Retrieval-Augmented Generation, Large Language Models, Educational Assessment, Explainable AI, Curriculum Alignment.

Augmented Reality–Enhanced Online Automobile Rental and Sales Platform

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ABSTRACT. Rapid digital transformation within the automobile industry has reshaped how customers rent and purchase vehicles. Existing platforms remain fragmented, with

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separate systems handling rentals, sales, and ride-sharing, resulting in reduced convenience and inconsistent user experiences. This work presents a unified web-based automobile platform integrating rental and sales operations with immersive Augmented Reality (AR) visualization. The system enables users to explore 3D vehicle models, project them into real-world environments, and make informed decisions with greater confidence. The platform incorporates role-based access for users and administrators, efficient booking and purchase workflows, and secure backend management using PHP and MySQL. Experimental evaluation and user feedback demonstrate enhanced usability, reduced reliance on physical showrooms, and improved trust in online vehicle transactions. The proposed solution offers a scalable, interactive, and customer-centric framework for modern digital automobile services.

KEYWORDS: Augmented Reality, Automobile Rental, E-Marketplace, 3D Visualization, Digital Commerce.

Machine Learning Based Air Quality Index Prediction Using Ensemble and Deep Learning

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ABSTRACT. The proposed system involves the use of machine learning techniques to forecast the level of air quality by processing historical and real time data on the environment. The system brings together the diverse sources of data to generate reliable information on the trend of pollution and associated health hazards, and make proactive environmental decisions. There is the use of machine learning algorithms such as Random Forest algorithm, the XGBoost algorithm and Neural Networks to model and predict changes in the Air Quality Index (AQI). Random Forest builds arrays of decision trees to reduce the variance and enhance generalization, but XGBoost makes use of gradient boosting to minimize both bias and variance. Neural networks determine the unintuitive correlations between pollutants and the air quality index

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(AQI). These two hyperparameter optimization methods, i.e. Grid Search and Bayesian optimization, enhance the efficiency of the model. To analyze predictive accuracy, the Mean Absolute error (MAE), Root mean squared error (RMSE) and R-squared (R^2) are used to evaluate the models. The results show that the Proposed framework makes accurate and timely air quality predictions and increases awareness of environmental health and makes the management of air quality sustainable.

KEYWORDS. Air Quality Index (AQI), Random Forest, XGBoost, Neural Networks, Hyperparameter Optimization, Machine Learning, Environmental Monitoring.

VigilAI: Email Spam and Phishing Classifier with Language Models and DDoS and MITM Detector

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ABSTRACT. Cybersecurity is one of the most significant challenges facing our digital world today. Despite advancements in defense systems, the malevolent cyber actor has exploited human and systematic weaknesses using methods such as spam, phishing, and even large-scale attacks on the network layer, such as distributed Denial-of-Service (DDoS) and Man-in-the-Middle (MITM). This paper presents VigilAI, designed as an integrated and modular framework to consider cybersecurity issues on the network layer and content layer using both transformer-based natural language processing (NLP) and machine learning (ML)-based anomaly detection. In the content layer of VigilAI, an optimized DistilBERT NDA model is applied to detect contextual spam and phishing in emails. An Isolation Forest model is used to detect anomalous traffic, suggesting DDoS and MITM attacks are being performed on the net. The suggested model is compared in a number of experiments with standard datasets and yields a classification performance of 94% for emails, a detection performance of greater than 96% for DDoS attacks, and detection of greater than 90% for MITM attacks. Compared with existing approaches to email and network security using disparate technological approaches to treat DDoS and MITM attacks, VigilAI provides a protective, scalable, adaptive, unified framework suitable for enterprise and institutional development.

KEYWORDS: Cybersecurity, Phishing Detection, DDoS, MITM, Language Models, Machine Learning.

Analyzing Student Social Media Usage Using TextBlob and the Scope for Transformer Based Advancements

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ABSTRACT. In the digital era, social media has emerged as an inseparable part of students' lives, shaping how they communicate, learn, and express emotions. This research focuses on understanding the patterns of social media usage among students, the underlying reasons for engagement, and the emotional tone conveyed through their online communication. By integrating survey data with computational sentiment analysis using TextBlob, the study evaluates both behavioral and emotional aspects of student interaction with social media.

The analysis reveals that students predominantly use social media for entertainment, communication, and networking, while academic use remains secondary. The study also explores how prolonged usage correlates with academic performance, attention span, and emotional well-being. Sentiment analysis of over 30,000 student-related tweets highlights that neutral and positive sentiments dominate[2], whereas negative tweets tend to attract higher engagement.

Furthermore, the paper discusses the potential of transformer-based models like BERT and RoBERTa, which can outperform traditional lexicon-based models by providing context-aware sentiment interpretation. The comparative understanding of both approaches opens opportunities for more accurate emotion recognition in educational analytics. The findings underscore the need for digital well-being programs that encourage healthy social media habits among students.

KEYWORDS: Social media, student engagement, sentiment analysis, polarity, subjectivity, TextBlob, BERT, contextual learning.

AETL: Redefining Evaluation for Agentic AI - Framework for Trust, Safety, and Compliance

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ABSTRACT. Agentic AI systems mark a paradigm shift from deterministic software to autonomous, context aware agents capable of dynamic reasoning and adaptive behavior. Their non-deterministic and evolving nature renders traditional software testing methodologies insufficient, exposing significant operational, ethical, and security risks. This paper introduces the Agentic AI Evaluation and Testing Lifecycle (AETL) a lifecycle-integrated framework that embeds evaluation across all operational phases of

agentic AI. AETL incorporates behavioral checkpoints, risk-aware feedback loops, and continuous observability to ensure sustained trustworthiness, safety, and regulatory compliance. Complementing AETL, we propose the concept of Dynamic Risk Profile (DRP) a real-time, adaptive risk assessment mechanism that recalibrates based on agent behavior, environmental context, and emergent threats. Furthermore, the framework redefines Non Functional Requirements (NFRs) including robustness, fairness, transparency, and resilience as dynamic, measurable properties that evolve alongside the agent. Together, AETL and DRP address critical gaps in existing evaluation models and offer a comprehensive, scalable, and regulation-ready strategy for the safe and accountable evaluation of agentic AI systems across diverse domains.

KEYWORDS: Agentic AI, AETL, DRP, Agent Testing, Evaluation, Testing, Agent Trust, NFR, Observability, GenAI, Risks, Ethical, Risk, Governance.

Spearman's Rank Correlation in Cluster Validity: A Comparative Analysis across Various CVIs

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ABSTRACT. Clustering is an important part of data analysis and artificial intelligence, as it helps in discovering meaningful groups within large datasets. This study introduces a new approach for evaluating how effective a clustering result is by using correlation-based techniques, mainly Spearman's rank correlation along with Pearson correlation. The method measures how well the clusters reflect relationships within the data. Unlike traditional cluster validity indices (CVIs) that usually suggest only one best cluster count, the proposed approach identifies several suitable clustering options. This makes it more flexible for real-world problems where data boundaries are often unclear. Experiments conducted on multiple artificial and real-world datasets show that the proposed index performs better than conventional indices such as PBM, Dunn, and Silhouette. It provides stronger adaptability and clearer interpretation, making it useful for tasks like customer grouping and pattern recognition where multiple valid cluster structures can exist.

KEYWORDS: Clustering, Cluster Validity Indices, Spearman Rank Correlation, Pearson Correlation, Unsupervised Learning.

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A Comprehensive Federated Learning Framework for Multi-Disease EHR Diagnosis With DQRE- SCNeT, RAG, And Explainable AI

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ABSTRACT. This study presents a multi disease prediction using electronic health records with privacy-focused and interpretable Explainable AI. This approach uses federated learning DQRE-ScNet, which trains on data that comes from different hospital that does not have to be stored in one place. This customized deep learning model named DQRE-ScNEt (Dynamic Quantum-Resilient Encryption Secure Convolutional Network) handles encryption while having reinforcement-based learning with client selection method that chooses which sites participate in each round of training by minimizing the unnecessary computations. To get meaningful insights for clinical research, this system offers two layers of explainability. The First, Retrieval-augmented generation (RAG)is used to give healthcare recommendations retrieved from the provided medical reports for both doctors and patients. Second, an explainable AI algorithm called SHAP is used to analyse highlights which contain clinical features that contributes each prediction. The sources of datasets used in this study are from Pima Indians Diabetes (768 samples), Indian Liver Patient Dataset (583 samples), and the UCI Heart Disease dataset (303 samples). Across all three, the model reached accuracy above 90%, with an average ROC-AUC of 0.93 and an F1-score of 0.91. The DQRE selection strategy also shortens training time. A Streamlit Web interface was built to provide access to the users to upload data and instantly see predictions with SHAP-based explanations, and read short medical suggestions. Therefore, this complete Framework tackles common issues that we usually see in healthcare AI, such as fragmented data, limited transparency, and compliance requirements while showing how secure and interpretable prediction tools can be deployed in real settings. Keywords: Federated Learning, Explainable AI, DQRE-SCNet, Multi-Disease Diagnosis, SHAP, RAG, Healthcare Informatics.

KEYWORDS: Federated Learning, Explainable AI, DQRE-SCNet, Multi-Disease Diagnosis, SHAP, RAG, Healthcare Informatics.

AI-Powered Clinical Support for Personalized Osteoarthritis Care

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ABSTRACT. Shared decision-making is essential in modern, in patient-centered healthcare, especially for osteoarthritis (OA) a progressive joint disease that varies in severity, often appears with other medical conditions. To help clinicians design more individualized care plans, this study presents an intelligent clinical support system that merges X-ray image interpretation with personal health and lifestyle data. A DenseNet-based deep learning model to identify and grade knee OA from radiographs, achieving a validation accuracy of 82.4%. Alongside imaging, the framework applies a Random Forest model to estimate comorbidity risks and drug responsiveness using variables such as age, BMI, and daily activity. When medication is less effective, the framework's combined insights can assist doctors in creating more individualized care plans that include lifestyle-based therapies. For example, the system hypothetically illustrated how non-pharmacological therapy could be recommended for a patient with significant cardiovascular risk and a low expected medication response. This method shows how AI-driven tools can facilitate more informed and cooperative decision-making between doctors and patients, ultimately improving the accuracy and customization of osteoarthritis treatment, even though it is still a proof of concept.

KEYWORDS: Osteoarthritis, Deep learning, DenseNet, Shared decision making.

AI Powered Latency Reduction in delay sensitive apps

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ABSTRACT. In modern high-performance networks, latency remains one of the most critical parameters influencing user experience, real-time communication, and overall system reliability. Delay sensitive applications such as cloud gaming, remote healthcare, and industrial IoT require continuous monitoring and predictive control to sustain low-latency operations. This paper presents an AI-Powered Latency Reduction System that integrates machine learning–based prediction, real-time diagnosis, and intelligent mitigation for network performance optimization. The proposed framework employs supervised learning models trained on diverse network metrics to forecast potential latency spikes before they affect performance. Additionally, a secondary model detects attack patterns such as DDoS, SYN flood, and Ping flood that often contribute to abnormal delay fluctuations. A FastAPI-based backend enables seamless communication between the machine learning models and a user-friendly web interface that provides real-time results, visualizations, and recommended mitigation actions. Experimental results demonstrate high accuracy and rapid response, proving that the

system effectively minimizes delay and enhances the stability of delay-sensitive networks. This research contributes toward the development of adaptive, AI-driven network infrastructures capable of proactive latency management and intelligent security defence.

KEYWORDS: Artificial Intelligence (AI), Latency Reduction, Machine Learning (ML), FastAPI, Network Performance Optimization, Attack Detection, Delay-Sensitive Applications, Edge Computing.

Multilingual Voice-Based Answer Evaluation System for Inclusive Education

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ABSTRACT. Students with physical limitations, who encounter major obstacles in conventional handwriting examination methods, the current state of educational evaluation presents serious accessibility issues. Manual grading procedures are labour-intensive, time-consuming, and prone to subjective bias and inconsistency. Large segments of the student body are excluded by current automated assessment frameworks because they mostly concentrate on text-based inputs and provide little support for voice-based responses or multilingual contexts. This study suggests a novel voice-based answer evaluation system that processes and assesses spoken responses using cutting-edge Natural Language Processing (NLP) and Machine Learning (ML) approaches. The system supports Telugu, Hindi, and English and uses Sentence Transformers (Bert) with cosine similarity for semantic analysis and OpenAI Whisper for speech-to-text conversion. The system achieves an average accuracy of 88% by handling a variety of dialects and speech patterns with the integration of multiple datasets, such as Common Voice 22.0. Inspecting experimental results of the past work displays development in multilingual support and semantic relevance, precision, and good performance. In order to help students attain a more profound understanding, comprehension, and conceptual clarity, the system further incorporates adaptive feedback mechanisms. Its modular structure facilitates scalable integration in a diverse educational context by facilitating a smooth connection with existing Learning Management Systems (LMS). By connecting the gap between equitable assessment techniques and technology advancements, this research assists inclusive education.

KEYWORDS: Natural Language Processing, Machine Learning, Bert, speech-to-text, OpenAI Whisper.

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Secure Web-Based Ransomware Detection System Using LSTM and Machine Learning Techniques

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ABSTRACT. Ransomware poses a major cybersecurity threat by encrypting user data and demanding ransom, often bypassing traditional signature-based detection methods through new or obfuscated variants. This project presents an intelligent ransomware detection system that integrates machine learning and LSTM models with a Flask-based web interface and SQLite database. The system securely scans uploaded files or compressed folders using a multi-layer approach: hashed pre-screening quickly identifies known malicious signatures, while the LSTM deep learning module analyses static file features and sequence patterns to detect novel ransomware behaviours. The platform supports user registration, login, real-time scanning, and automated threat alert emails, offering a scalable, lightweight, and user-friendly solution for effective ransomware detection and prevention in evolving digital environments.

KEYWORDS: Ransomware Detection, Machine Learning, Deep Learning, LSTM, Cybersecurity, Malware Analysis, Threat Prevention, File Hashing, Web Application Security, Email Alert System, Static Analysis, Dynamic Detection, Data Security.

Privacy-Preserving Stock Prediction: A Federated Learning Framework for Stock Forecasting with LSTM and Hybrid CNN-LSTM Models

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ABSTRACT. Financial forecasting faces a fundamental challenge: achieving high prediction accuracy while protecting sensitive data. Traditional machine learning methods require centralizing vast amounts of financial information on a single server, creating serious privacy risks and regulatory concerns. This centralization has created

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the ”data island problem,” where valuable information remains isolated because institutions are reluctant to share proprietary data. While deep learning models like Long Short- Term Memory networks have dramatically improved forecasting capabilities, they have historically relied on centralized training, which intensifies these privacy challenges.

This paper presents a comprehensive framework that evaluates Federated Learning as a solution to this dilemma. Federated Learning enables multiple institutions to collaboratively train a shared model without exposing their raw data only model updates are exchanged, not the sensitive information itself. We implement and compare three federated algorithms FedAvg, FedProx, and FedNova against a centralized baseline using both LSTM and hybrid CNN-LSTM architectures. The complete system integrates a FastAPI backend for training orchestration, TensorFlow for model development, and an interactive React dashboard for real-time monitoring. We evaluate performance using multiple metrics including Mean Absolute Error, Root Mean Square Error, R-squared, and Directional Accuracy while also measuring communication costs.

Our experimental results demonstrate that advanced federated learning algorithms, particularly FedProx, deliver performance remarkably close to centralized training while maintaining data privacy. The centralized model achieved an R^2 score of 0.97, while FedProx reached 0.96 with significantly improved stability on heterogeneous data. This framework contributes an extensible research platform with modular architecture that separates data handling, model training, and visualization, making it valuable for future investigations into privacy-preserving machine learn- ing. As data protection regulations intensify globally, this work demonstrates that federated learning offers a practical path where collaboration and confidentiality can coexist in financial applications.

KEYWORDS: Federated Learning, Centralized Learning, LSTM, CNN-LSTM, Financial Time-Series Forecasting, Privacy- Preserving Machine Learning, Stock Prediction, FedAvg, FedProx, FedNova, Data Privacy, Non-IID Data, Distributed Machine Learning.

EconCausalAI: An Integrated Framework for AI-Powered Economic Policy Analysis and Simulation

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ABSTRACT. Overlapping intricacy and emergent dynamics along with structural interpretability are often exchanged in the case of economic models. We introduce EconCausalAI, an artificial intelligence-powered integrated computational model for economic policy analysis, as a solution to this challenge. Our approach provides extensive and plausible macroeconomic data by emulating a country's economy through a dynamic Agent-Based Model (ABM) [1]. A Reinforcement Learning (RL) agent

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in this experiment learns an optimal policy rule through interaction with the ABM environment [2]. The major breakthrough of the framework is its analysis pipeline with multiple facets, which applies a range of sophisticated methods to the simulated data: (1) hybrid DSGE-ML models for structural interpretation [3], (2) Double Machine Learning (DML) for robust, model-agnostic causal inference [4], and (3) Neural Ordinary Differential Equations (ODEs) to gain insights into the system's dynamics [5]. EconCausalAI connects the dots between conventional econometrics and complex systems by uniting simulation, policy optimization, and causal analysis into a single reproducible digital laboratory for economic theory testing and multi-scale policy impact assessment of interventions through interpretation of intricate effects.

KEYWORDS: Computational Economics, Agent-Based Modelling (ABM), Reinforcement Learning (RL), Economic Policy Analysis, Causal Inference, Double Machine Learning (DML), DSGE-ML, Neural Ordinary Differential Equations (Neural ODEs), Macroeconomic Simulation.

AURA: Autonomous Unified Resilient Analytics for Intelligent Demand Forecasting and Inventory Optimization

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ABSTRACT. Demand forecasting and inventory management are ongoing challenges in today's supply chain systems. Volatility and uncertainty often disrupt planning accuracy. Traditional statistical models work well with stable data but struggle in changing environments. Meanwhile, machine learning and deep learning methods usually function as separate predictors that do not offer actionable insights. This paper introduces AURA (Autonomous Unified Resilient Analytics), a unified framework that combines ARIMA, Prophet, XGBoost, and LSTM models within an adaptive feedback system. AURA merges predictive forecasting with inventory optimization using Economic Order Quantity (EOQ) and dynamic safety stock models. Simulated experiments on synthetic retail datasets demonstrated that AURA improved forecasting accuracy by 12–18% and reduced inventory holding costs by approximately 12% compared to standalone models. This study emphasizes AURA's potential to change forecasting systems into self-learning and reliable decision-making tools that can perform well in real-world uncertainty.

KEYWORDS: Artificial Intelligence, Demand Forecasting, Ensemble Learning, Inventory Optimization, Supply Chain Analytics

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Academix: A Privacy-Preserving AI Study Assistant Based on Retrieval-Augmented Generation

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ABSTRACT. Artificial intelligence has been transforming the field of education by providing the learners personalized learning experiences, and usually platforms implementing AI-based solution heavily depend upon external 3rd party providers which creates concerns regarding user's data integrity and which also involves recurring costs for each query. Academix addresses these concerns by providing user study platform uses a LLM which that runs entirely on infrastructure which is controlled by the platform itself, without relying on third-party APIs for any query. At its core, Academix uses Gemma-3-1b-it which is an open-source model hosted within Academix-managed cloud with a Retrieval Augmented Generation (RAG) pipeline developed using ChromaDB, LangChain and FastAPI. This architecture makes sure that all generative responses for the features which comprises of quizzes, summaries, chatbot and flashcards are accustomed to user uploaded materials such as PDFs, while also making sure that no critical user data leaves the platform. The platform is flexible when considering Authentication options, allowing user to log in either through traditional manual credentials or via Google OAuth. Learners are also provided options between choosing manual authored flashcards or automatically generated by the RAG on user's requested topic. The quiz feature generates user specified number of questions based on the specified topic from the user's material. The summary feature provides condensed version (either concise or detailed) of selected range of pages from the uploaded PDF. The RAG interfaced chatbot is provided context from the PDF uploaded and provides concrete responses without hallucinating. Thus, Academix provides a reliable and scalable learning environment that safeguards user privacy while offering learners an efficient and affordable platform for their learning.

KEYWORDS: Smart Study, Personalized Learning, AI Study Assistant, Machine Learning, Retrieval Augmented Generation (RAG), Quizzes, PDF Summarization, Hallucination-Free Chatbot, Flashcards, In-House LLM, No Third-Party ML Inference, Zero External AI/ML Dependencies.

Analytical Prediction of Obstetric Delivery Methods Using Machine Learning Algorithm

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ABSTRACT. Determining the most suitable mode of childbirth is one of the most important aspects of obstetric care. It plays a key role in ensuring the safety, comfort, and well-being of both the mother and the baby. Traditionally, these decisions have relied on the clinical experience and judgment of healthcare professionals, guided by established risk assessment methods. While effective in many cases, such approaches may not always account for the wide range of individual differences among patients. By learning from large and diverse datasets, ML models can complement clinical expertise and help doctors make more confident, evidence-based decisions about the safest and most effective delivery method for each mother. As a result, the analytical prediction system is designed to perform the study using Random Forest, which is a highly complicated ensemble machine learning tool that the organization intends to use for the prediction of normal or cesarean delivery mode based on both maternal and fetal conditions. This work applies the methods of machine learning to identify the mode of delivery, based on a careful analysis of each individual patient's specific medical profile. This implementation also used several datasets that contained necessary demographic, clinical, and obstetric information, including maternal age, gestational age, BMI, pre-existing health conditions such as diabetes or hypertension, previous delivery history, and numerous fetal wellbeing parameters.

KEYWORDS: Childbirth prediction, Machine learning, Decision support system, Delivery mode classification, Maternal and Infant health.

MalwareNet: A Web-Based Multi-Classifier for Improved Threat Detection

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ABSTRACT. This research presents a machine learning–based web application for Android malware detection using static analysis. A custom dataset is constructed by combining benign applications (non-virus APKs) manually created and collected, with malware samples downloaded from established online repositories. The top 1000 features are extracted from the application packages to represent structural and behavioral characteristics of the apps. Four classifiers, K-Nearest Neighbors (KNN), Random Forest (RF), Deep Neural Network (DNN), and Support Vector Classifier (SVC), are trained on the dataset and evaluated based on detection accuracy and strength. KNN offers baseline performance via similarity of instances, Random Forest illustrates enhanced results via ensemble decision, SVC distinguishes between benign and malicious applications using margin-based

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learning, whereas DNN embodies intricate feature interactions and attains the highest accuracy. A Flask-based web application integrates these models, enabling users to upload APK files and obtain real-time classification outputs with relevant app metadata. The proposed work demonstrates the viability of machine learning classifiers for malware detection and emphasizes the importance of curated datasets combining benign and malicious applications.

KEYWORDS: Android malware, Machine learning, Dataset construction, KNN, Random Forest, Deep Neural Network, Support Vector Classifier, Static analysis.

Agri-Assist-AI: A Voice-Based Chatbot for Farmer Queries, Crop Disease Detection, and Policy Literacy in Local Language

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ABSTRACT. Agriculture remains a cornerstone of India's economy, yet farmers continue to face pervasive challenges in accessing modern agricultural support systems due to linguistic obstacles and technological asymmetry. This paper presents Agri-Assist-AI, an AI-driven conversational system developed to offer holistic agricultural assistance. It functions primarily in the native Kannada language via a voice interface. The system integrates four core components: a bilingual voice chatbot powered by Groq's Llama 3.3 70B model, a machine learning-based crop recommendation system using ensemble methods, a multi-task CNN-based disease detector utilizing the InceptionV3 architecture, and a policy literacy portal providing voice-assisted access to government schemes and subsidies. The solution is implemented as a Progressive Web Application (PWA) to address rural connectivity and offline operation challenges. Comprehensive evaluation demonstrates 90% accuracy in Kannada speech recognition under varying acoustic conditions,92% accuracy in crop recommendation across 22 crop categories. The integrated disease detection module achieves 97.2% classification accuracy for paddy leaf disease detection (covering Leaf Blast, Sheath Blight, and Brown Spot) along with disease severity estimation. Agri-Assist-AI bridges the gap between local farmers and advanced agricultural technology by eliminating language and literacy barriers.

KEYWORDS: Agriculture AI, Voice Assistant, Kannada Chatbot, Crop Disease Detection, Disease Severity Estimation, Progressive Web App, Machine Learning, Deep Learning, Ensemble Methods, Transfer Learning.

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A Data-Driven Smart Notification System to Support Fair and Efficient Ration Allocation

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ABSTRACT. The Public Distribution System is a crucial program in India which provides subsidized food and essential commodities to below the poverty line and low-income households. However, there will be no communication between the ration distributer and beneficiaries so they will not know that what dates ration will be provided. Due to this there will be long formation of queue near distribution canters early morning by wasting their valuable time. This paper aims to develop Smart Ration Alert that will improve the communication and reducing the waiting time by providing timely notifications for the beneficiaries about the ration availability, The system is designed to connect with existing ration distribution databases and automatically notify beneficiaries through SMS. The SMS system provides essential details such as ration availability, token numbers, time slots, and pickup dates. It supports multiple languages, delivers real-time updates, and tracks whether messages are successfully delivered. A simulation was conducted to evaluate the system's reliability and user responsiveness. Early testing showed a clear improvement in beneficiary awareness, with fewer missed ration pickups. Users responded positively, appreciating the system's simplicity and the usefulness of timely notifications. These findings suggest that the solution can play a vital role in improving ration distribution in a costeffective manner and strengthening public welfare delivery. Designed to integrate seamlessly with existing government infrastructure, the system enhances communication and ensures that beneficiaries remain informed and engaged throughout the distribution process.

KEYWORDS: Smart Notification, Public Distribution System (PDS), SMS Alert, Ration Allocation, Digital Governance.

Multimodal Reasoning at Scale: Building Real-Time, Document-Level MoE LLMs

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ABSTRACT: Modern artificial intelligence systems face a fundamental challenge in processing heterogeneous documents that combine text, tables, formulas, and images.

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Traditional large language models (LLMs) struggle with the computational tradeoff between achieving deep multimodal reasoning and maintaining efficiency at scale. This paper presents a comprehensive framework for building parameter-efficient Mixture-of-Experts (MoE) multimodal LLMs using open-source architectures. We review selective expert routing mechanisms, multimodal adapters, and optimized inference strategies that enable real-time documentlevel reasoning with contexts exceeding 128,000 tokens and inference latencies under 3 seconds for complex queries. Through analysis of state-of-the-art models including GLM-4.5V and Qwen2.5-VL, we demonstrate how sparse activation of specialized expert networks can reduce computational costs by up to 80% while maintaining over 95% of dense model quality. Our ablation studies reveal that configurations with 8-16 experts provide optimal accuracy-efficiency tradeoffs across diverse document understanding tasks. The paper provides detailed architectural designs, implementation strategies, performance benchmarks, and production deployment considerations for building practical multimodal AI systems capable of processing scientific literature, financial documents, healthcare records, and legal materials with sub-3-second latency and minimal resource requirements.

INDEX TERMS—Mixture of Experts, Multimodal Learning, Large Language Models, Document Understanding, Parameter Efficiency, Sparse Activation, Vision-Language Models, Real-time Inference.

Intelligent Detection of Invasive Ductal Carcinoma: A Machine Learning Implementation Framework

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ABSTRACT. This study introduces a machine learning-based automated approach for the precise identification of Invasive Ductal Carcinoma (IDC), the most prevalent kind of breast cancer, from histopathological pictures. This study uses a deep learning approach—specifically a Convolutional Neural Network (CNN)—to overcome the limitations of manual diagnosis, which can be time-consuming and prone to human error. The model was trained on a large dataset of labelled tissue images to learn and identify subtle, complex features that indicate the presence of malignant cells. The system's performance was thoroughly assessed utilising key metrics, achieving high accuracy, precision, and recall. The results demonstrate that the developed model serves as a highly effective diagnostic aid, with performance comparable to or exceeding that of traditional methods. Better patient outcomes in clinical settings could result from this technology's potential to increase diagnostic efficiency, improve reporting uniformity, and enable earlier, more accurate breast cancer diagnosis. Personal experience, inattention, and exhaustion are just a few of the elements that might readily impact the corresponding diagnostic outcomes. These subjective differences increase the rate of misinterpretation and make it challenging to repeat the pathological diagnostic results. For pathologists, manual IDC detection is laborious and time-

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consuming, and it may be impacted by considerable variation in diagnosis and specimen interpretation between and within pathologists. Histopathology is essential to the diagnosis of cancer in the field of medical image analysis. By digitising biopsy slides for computer analysis, whole-slide imaging (WSI) has revolutionised this industry. Convolutional Neural Networks (CNNs) are among the most widely used artificial neural network architectures in deep learning, particularly for image extraction and analysis. Recently, both CNN-based deep learning models and transformer architectures have demonstrated strong performance in the automated classification of histopathology images.

Index Terms—CNN, histopathology, IDC

AGRO VISION: Deep Learning Perspectives on Medicinal Plant Species Recognition and Disease Detection

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ABSTRACT. Medicinal plants play a vital role in traditional healthcare systems, yet their accurate identification and disease diagnosis remain challenging due to limited datasets and expert dependency. Agro vision proposes an integrated deep learning framework that simultaneously performs binary plant classification, medicinal plant species identification, and disease detection through a multi-task learning approach. The framework utilizes a hierarchical structure where a custom convolutional neural network first classifies images as plant or non-plant. Subsequently, a multi-task ResNet50 model, enhanced by transfer learning and domain adaptation from datasets such as Plant detection dataset, PlantVillage, efficiently recognizes plant species and detects diseases. The system also incorporates image quality assessment to ensure reliable results and integrates a medicinal database providing therapeutic and safety information. The proposed approach offers a resource-efficient and practical solution for researchers, educators, and traditional medicine practitioners.

KEYWORDS: Artificial Intelligence, Deep learning, Plant Disease Detection, CNN, Image Processing, ResNet50.

An Enhanced System for Detecting Plant Leaf Diseases Using Deep Learning

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ABSTRACT. Agriculture is a cornerstone of many countries' economies, yet plant diseases can severely diminish both the yield and quality of crops. Early and precise disease detection is essential for boosting crop productivity and encouraging sustainable farming. This paper introduces a web-based system that leverages deep learning to identify plant diseases through leaf images. The system uses a convolutional neural network trained on a varied dataset containing healthy and diseased leaf samples. By embedding this model into an easy-to-use web app, farmers and agricultural experts can capture leaf photos with their smartphones and obtain instant disease classification results. Designed to enable prompt action, reduce reliance on expert diagnosis, and support precision agriculture, the system's experimental results reveal high accuracy in disease detection. This underscores the potential of web AI solutions to transform modern agriculture.

KEYWORDS: Deep learning, web application, plant disease detection, precision agriculture.

Deep Learning Framework for Mental Disorder Identification via Facial Emotions

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ABSTRACT. This project presents a deep learning–based system for mental health detection using facial emotion analysis. The system captures or uploads a facial image through a web interface, preprocesses it, and classifies emotions using an EfficientNet-B2 model trained on benchmark datasets. Grad-CAM is applied to highlight important facial regions, enhancing interpretability and trust. A rule-based inference layer maps detected emotional patterns to indicative mental health conditions such as anxiety or depressive tendencies. The final output includes emotion scores, heatmaps, and a mental health indication. The system aims to provide an assistive, non-invasive, and real-time preliminary mental health assessment.

KEYWORDS: Facial Emotion Recognition, Deep Learning, EfficientNet-B2, Mental Health Awareness, Affect Analysis, Grad-CAM, Image Classification, Web-Based Diagnostic Support System.

AI-Powered System for Early Detection of Psychological Issues

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ABSTRACT. As of now physiological issues includes bipolar disorder, anxiety, and stress are becoming more usual. Early detection is critical for prompt intervention and effective treatment. This artificial intelligence(AI) framework that combines machine learning and natural language processing ways to diagnose psychological problems early. The framework integrates structured(questionnaire-based) and unstructured (text-based) data to improve diagnostic reliability. More than 1,000 psychological health records from Kaggle datasets were used to train models. Term Frequency– Inverse Document Frequency vectorization was used to extract text features, identifying linguistic patterns suggestive of distress. The suggested framework's potential for scalable, interpretable digital mental health screening is confirmed by experimental results showing that it uses XGBoost to attain a maximum accuracy of 78% in the Kaggle Mental Health dataset.

KEYWORDS: TF-IDF, Machine Learning, Random Forest, Logistic Regression, XGBoost, Natural Language Processing (NLP), Mental Health Prediction.

AdaBoost Accelerated Face Detection for Robust Real-Time AI Systems

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ABSTRACT. Facial recognition is an important element in the real-time applications of AI which are used in surveillance, authentication, and human-computer interaction. Nevertheless, current face detection algorithms are prone to the problems such as the issue of variable lighting, occlusions, pose changes, and inefficient computational nature. To resolve these problems, the study can describe the proposed AdaBoost-accelerated face detector system with a robust and real-time task. The model is trained and tested using the large-scale CelebFaces Attributes (CelebA) dataset, comprising of more than 202,599 annotated celebrity faces images with 40 facial attributes. Image resizing, histogram equalization, and data augmentation which are preprocessing techniques are used to improve the quality and diversity of data. The AdaBoost ensemble learning algorithm is used to extract haar-like features and combine them to pay attention to difficult samples so as to build a powerful classifier. Multi-scale face detection is done by a sliding window method and a redundancy method called an overlap suppression algorithm is adopted to minimize unnecessary detections. The experimental findings testify to the fact that the suggested method with the accuracy of 99.74, the precision of 0.95, the recall of 0.68, F1-score of 0.73, and the true positive rate (TPR) of 0.99 at a false positive rate (FPR) equal to 0.8275.

KEYWORDS: Face detection, Deep learning, AdaBoost, AI, Real-Time AI.

Evaluating Performance Trade-Offs in Web-Based Computational Workloads

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ABSTRACT. The web continues to extend with emerging technologies that introduce new ways of performing computationally intensive tasks on the client side. In this work, different execution models are compared in terms of efficiency, memory use, and processing speed for several environments. We conduct a battery of microbenchmarks to assess the effect of execution decisions on performance and scalability. It is observed that the approaches studied exhibit significant trade-offs with each other, thereby providing insights into designing efficient web applications with high-performance computing requirements.

KEYWORDS: Recurrent Neural Networks (RNNs), Batch Normalization, Long Short-Term Memory (LSTM), Sequence Modeling, Gradient Flow, Language Modeling, Deep Learning Optimization, Attention Mechanisms.

AI Computation: Compressed Inter-Process Satisfiability Protocol

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ABSTRACT. This paper introduces an efficient and extensible wire protocol designed for facilitating communication with incremental satisfiability (SAT) solvers in computer applications. The protocol enables remote or local server interaction over standard sockets, prioritizing data transfer efficiency and minimizing communication overhead through a compact design. It is built for ease of extension, allowing its adaptation to diverse Boolean reasoning and optimization tasks beyond core SAT solving. The paper demonstrates the protocol's effectiveness in achieving significant data compression, offering a streamlined and flexible solution for integrating advanced AI computational capabilities into broader software ecosystems.

KEYWORDS: SAT Solvers, Boolean Satisfiability, Wire Protocol, Lookahead SAT, Equivalence Reasoning, Local Learning, Tree-Based Lookahead, DPLL Algorithm.

Real-Time Smart Irrigation Systems using IoT, ML Models and Blockchain for Water Management

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ABSTRACT. Water scarcity and inefficient irrigation methods remain critical obstacles in modern agriculture. This study introduces a real-time intelligent irrigation system that leverages the synergy of Internet of Things (IoT) technologies, Machine Learning (ML) algorithms, and Blockchain infrastructure to enhance water efficiency, preserve data integrity, and support sustainable farming practices. The framework utilizes a network of sensors to continuously gather data on soil moisture, ambient temperature, and humidity. ML models such as Random Forest and Long Short-Term Memory (LSTM) are employed to forecast the most effective irrigation schedules. To ensure secure and verifiable transactions between IoT devices and cloud-based storage, a blockchain layer is integrated, offering full transparency and traceability of water usage logs. Experimental findings reveal a 23% decrease in water usage and an 18% boost in crop yield efficiency compared to traditional irrigation systems. This multifaceted approach highlights the transformative potential of combining IoT, ML, and Blockchain to create smart, transparent, and data-centric solutions for agricultural water management.

KEYWORDS: IoT-based Smart Irrigation, Machine Learning Models, Blockchain Technology, Water Resource Management, Precision Agriculture, Sustainable Farming, Sensor Networks, Predictive Analytics, Smart Contracts.

Design and Analysis of 2D Photonic Crystal for the detection of Breast cancer and augmentation of biosensor using Deep regression methods.

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ABSTRACT. This paper addresses the silicon based 2D photonic crystal biosensor for the detection of breast cancer. For the design of the photonic crystal square lattice is used with a ring resonator using defect engineering. Designed photonic crystal senses the change in (refractive index) RI and produces ab wavelength shift. The obtained result is done for the cancers cells MDA-(MB)-231 and MCF-7 which is used to detect the breast cancer. The simulation is done through the Finite Difference Time Domain (FDTD). The designed Biosensor have the highest sensitivity of 148 and quality factor of 1045.Then classification of the breast cancer done through the logistic regression (LR) method. By using the Binary variables 0 and 1, classification of the cell done as cancerous and non-cancerous. The Optical characteristics of the designed biosensor characterized through the LR methods and produces an accuracy of 100%.

KEYWORDS: Photonic crystal, Biosensor, FDTD, Logistic Regression, Quality Factor.

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Integration of an Adaptive rear wing for Racing and Performance applications

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ABSTRACT. High-speed vehicles, particularly formula racing cars, are prone to accidents during cornering, often due to excessive speeds and inadequate aerodynamic control. While traditional braking systems are essential for deceleration, aerodynamic aids can significantly enhance vehicle stability during such critical maneuvers. Among these, drag-based devices like the Drag Reduction System (DRS) are commonly used in racing, but they are expensive due to the use of electric actuators, sensors, and control electronics. A typical automotive-grade DRS actuator module costs around 2 lakh – 5 lakhs, whereas professional motorsport systems can exceed several lakhs. In comparison, the proposed mechanical adaptive spoiler costs only 1,200–2,000Rs, resulting in a cost reduction of over 95 percent, while still providing functional aerodynamic assistance through a fully mechanical, electronics-free linkage. This project introduces a cost-efficient, resulting in a cost reduction of over 95 percent, while still providing functional aerodynamic assistance through a fully mechanical, electronics-free linkage. This project introduces a cost-efficient adaptive rear spoiler mechanism designed to improve aerodynamic performance during turning while serving as an affordable alternative to the DRS. The proposed system actively alters the spoiler's angle based on the steering input, thereby generating controlled aerodynamic drag to aid in deceleration and cornering stability. Unlike existing high-end systems that utilize hydraulic actuators and sensor arrays, this design employs a mechanical cable-actuation system directly linked to the steering wheel. The spoiler is centrally mounted using a pivot bracket and C-clamp mechanism. When the driver steers the vehicle, a pair of tension cables attached to the steering column modulates the spoiler angle, it in the direction opposite the turn. This mechanical linkage ensures that the spoiler tilts counterclockwise during a right turn and clockwise during a left turn, enhancing grip and reducing the risk of skidding or rollover. The results indicate that this cable-operated adaptive spoiler offers a practical, low-cost solution suitable for both race and regular passenger vehicles, particularly in budget-conscious segments.

KEYWORDS: adaptive rear spoiler, aerodynamic braking, increased rear down force, enhanced vehicle stability, reduced cornering skids, anti-roll support, mechanical tilt mechanism.

3D FixGen: An AI-Assisted Voxel-Morphological Framework for Patient- Specific Prosthetic Design and Additive Manufacturing

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ABSTRACT. The creation and development of orthopedic prosthetics continue to be hampered by time-consuming manual processes, lack of personalization, and expenses, which can con- tribute to poor fit, discomfort, and multiple surgeries. Here we describe a 3D FixGen workflow that is assisted by artificial intelligence and is based on voxel morphology to create anatomically precise, patient-specific prosthetics from DICOM and CT (computed tomography) scans. The workflow uses deep learning–based segmentation with the TotalSegmentator model on DICOM images, 3D volumetric morphological reconstruction processes to isolate bone struc- tures and determine defect regions, and automatically generate watertight, print-ready implant geometry. Specifically, for printed tissue-specific devices, the framework applies volumetric dilation–erosion shell model processes of anatomical change, restoration of appropriate adaptive shape, and biomechanical conformation of buccal and mandible segments for femoral caps and tibial/non-femoral inserts. In contrast to traditional methods using computer-aided design software, 3D FixGen operates in voxel space, which may facilitate computational time and improves surface fidelity across varying degrees of defect severity. Experiments with relevant datasets have resulted in anatomically known geometries with structural continuity and print readiness while achieving significant reduction in design time and material waste. Overall, the workflow represents a first step toward AI-driven, personalized, and sustainable orthopedic prosthetic manufacturing in the area of implantable tissue-specific 3D printing.

KEYWORDS: AI-assisted prosthetics, medical image segmentation, voxel morphology, TotalSegmentator, 3D printing, additive manufacturing, orthopedic reconstruction.

AI empowered smart surveillance with YOLO

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ABSTRACT. The high rate of development of the urban infrastructure and social areas has created the urge of the intelligent surveillance system. The use of artificial intelligence to predict object positions and locations has disrupted the real-time detection and tracking of objects, especially through YOLO (You Only Look Once) algorithms, which have led to the effective surveillance of traffic, crowds, and places of interest to security personnel. YOLO-based surveillance provides solutions to the problems associated with the multi-object detection in varying environmental conditions due to its capability to combine speed, accuracy, and flexibility. The current review

summarizes contributions to the YOLO that have been made up to now, the challenges, as well as the prospective research interests of smart surveillance.

KEYWORDS: AI, Smart Surveillance, YOLO, Real-Time Object Detection, Intelligent Monitoring.

Multimodal Detection of Parkinson's Disease Using Speech & Sensor Biomarkers

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ABSTRACT. Parkinson's Disease (PD) is a progressive neurological disorder that requires continuous monitoring over time to ensure effective treatment. The PD Tracker is a Flutter-based mobile application that has a machine learning backend, designed to help users detect PD early and monitor its progression over time. Users are required to complete a series of voice recording tasks every week, which the trained ML models assess for patterns of PD diagnosis. The application also monitors the user's motion through embedded sensors to assess motor functionalities. To continue, this application also offers symptom tracking, a personalized health summary, and secure registration and onboarding. The PD Tracker utilizes a streamlined interface for instant and reliable access. The application aims to help patients and their caregivers seek treatments and medications by providing continuous health data for early PD detection.

KEYWORDS: Parkinson's Disease, Machine Learning, Sensors, Symptom Tracking, Multimodal Detection.

Implementation of Artificial Intelligence Models within Enterprise Systems using Microservices Architecture with Java Spring Boot and Maven

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ABSTRACT. In terms of enterprise systems, de- ploying computational services presents signifi- cant challenges regarding scalability, maintain- ability, and compatibility with existing Java- based systems. This paper introduces an ef- fective deployment architecture based on mi- croservices, developed using the Java Spring Boot framework alongside the Maven build au- tomation tool. The architecture addresses vari- ous deployment challenges via modular service boundaries, continuous dependency manage- ment, and synchronization with cloud delivery methods. This guide demonstrates how compo- nents for specific domains are packaged and presented as secure RESTful APIs, along with subjects like containerization, configuration management, observability, and continuous integration/continuous deployment processes. This study presents a detailed framework of performance enhancements and security best practices for production microservices, cov- ering connection pooling, asynchronous I/O, zero-copy transfers, JVM configuration, re- source isolation, auto-scaling strategies, cir- cuit breakers, and secrets management. Exper- imental findings indicate that the enhanced ar- chitecture can realize a 60.3 percent decrease in average request latency and over 250 per- cent boost in throughput, in comparison to the baseline monolithic system.

KEYWORDS: AI Model Deployment, Spring Boot, Maven, Microservices, Enterprise Appli- cations, Scalable Architecture, Cloud Deployment.

Voice-Enabled Autonomous AI Shopping Agent Using NLP-A Systematic Literature Review

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ABSTRACT. The rapid evolution of Artificial Intelligence (AI) has transformed online shopping experiences through conversational agents, voice assistants, and autonomous systems. Recent advancements highlight the growing role of voice-based interfaces in enabling personalized, hands-free, and efficient e-commerce transactions. However, existing approaches still face challenges in terms of scalability, multimodal integration, real-time personalization, and secure payment handling. This paper surveys innovative AI developments on AI-powered agents for e-commerce, categorizing into chatbots, voice assistants, and autonomous shopping systems. Our primary observations show that while chatbots are highly effective for offering customer help, and voice assistants make communication feel organic and effortless, a significant deficiency exists: there is minimal fusion of a system that can make its own decisions (autonomous decision-making) with simultaneous voice interaction, all within one cohesive framework. This paper pinpoints crucial knowledge gaps, examines the weaknesses of current methodologies, and suggests avenues for future work. These future directions involve incorporating various input types (multimodal interaction), developing superior methods

for earning user confidence (improved trust mechanisms), and tailoring experiences based on the user's specific situation (context-aware personalization). This review serves to give both academics and industry professionals a detailed understanding of the domain, clearly marking the journey toward the next wave of sophisticated shopping support tools.

KEYWORDS: Chatbots, Context-Aware Personalization, Conversational Artificial Intelligence, E-Commerce, Multimodal Interaction, Voice Assistants.

Voice Enabled E-Learning Platform for Specially Impaired Learners

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ABSTRACT. This paper details the design, implementation as well as assessment of voice-based e-learning platform adapted to. learners who are visually or motor impaired. The system integrates end-to-end automatic speech recognition, optional audio-visual. fusion and neural text-to-speech to allow hands- free navigation, interactive assessments, content access, and interactive assessments. Robustness is attained with noise sensitive front ends, parameter- efficient self-supervised, multimodal adaptation to missing modalities, and multimodal. The data efficiency representations. The conceptual design incorporates QoE-aware prosody control and semantic communication which are based on earlier literature. But these modules were not incorporated in the existing prototype and no physiological signal or semantics feature transmission was involved in the functioning of the system. usability versus traditional keyboard and screenreader baselines. According to the findings, voice-first interaction can serviceably enhance access in real world learning. networks and environments and still be feasible to run on heterogeneous devices and networks [1]-[4]. Index Terms—Accessibility, e- learning, audio-visual speech recognition, speech recognition, text-to-speech, multimodal learn- ing, quality of experience. Keywords—Accessibility, E-learning, Speech Recognition, Audio- Visual Fusion, Text-to-Speech, Multimodal Learning, Quality of Experience

KEYWORDS: Accessibility, E-learning, Speech Recognition, Audio- Visual Fusion, Text-to-Speech, Multimodal Learning, Quality of Experience.

Agriculture price Prediction Using Machine Learning

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ABSTRACT. This project is a Flask-based web application that forecasts Indian agricultural commodity prices and presents market insights through a lightweight UI. Server-side, each commodity is modeled from its CSV dataset using a Decision Tree Regressor trained on three features—month, year, and monthly rainfall—then mapped from predicted WPI to Rupee prices via a configurable base-price dictionary. The app computes current "Top Gainers/Losers," a rolling six-month "star commodity" ticker, and 12-month commodity-level forecasts and retrospectives, exposing routes for a dashboard and per-commodity detail pages. The prediction pipeline encapsulates a Commodity class that loads data, fits a depth-bounded tree, and serves point predictions; for pre-2019 dates it retrieves historical labels directly, ensuring continuity with legacy records. Seasonal and monsoon effects are approximated via a monthly rainfall vector, and price conversion applies commodityspecific base factors. Metadata such as representative images, prime producing states, crop type (kharif/rabi), and major export destinations enrich the commodity profiles displayed to users. The front end, built with Materialize CSS and Chart.js, renders a home dashboard of winners/losers plus a live right-rail ticker that pulls periodic updates from a /ticker endpoint, while commodity pages visualize 12-month forecast vs. previous-year trends alongside current price, location, type, and export info.

KEYWORDS: Flask-based web application, agricultural commodity price forecasting, Decision Tree Regressor, CSV datasets, WPI to Rupee conversion, rainfall-based features, dashboard, commodity detail pages, Materialize CSS.

Comparative Analysis of Machine Learning and Ensemble Models for Liver Disease Prediction

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ABSTRACT. Liver disease is still a major worldwide health concern, and increasing patient survival rates depends on early detection. In order to accurately prediction of the disease, this study provides a thorough comparison examination of various models of machine learning methods as tested with the Indian Liver Patient Dataset (ILPD). Logistic regression, Support Vector Machine (SVM) method, Decision Tree method, Random Forest method, K-Nearest Neighbours (KNN) method, XGBoost, and Light GBM are the various models of supervised learning that were analysed and assessed. The

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models were examined using important measures of performance such as like accuracy percentage, precision value, recall value, F1-score, and ROC-AUC.
Validation-based tuning was utilized to optimise classification thresholds and alleviate dataset imbalance. Accuracy value of 82.1% and a ROC-AUC of 0.895, ensemble approaches combining XGBoost and LightGBM outperformed all baseline models among the individual models. The findings show that ensembles based on gradient boosting may efficiently capture non-linear patterns and feature interactions, improving diagnostic accuracy for knowing the disease progression of liver disease. The suggested paradigm can be applied to other biomedical classification issues and provides a dependable, data-driven method to assist medical decision-making.

KEYWORDS: Liver Disease Prediction, Machine Learning, Indian Liver Patient Dataset (ILPD), Classification, XGBoost, LightGBM, Ensemble Learning.

Smart Collar Belt for Real Time Dog Health Monitoring and Location Tracking Using IoT

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ABSTRACT. Continuous and real-time visibility into a dog's health and position has become increasingly important for pet owners, handlers, trainers, and veterinarians. Traditional monitoring approaches rely heavily on manual observation and intermittent checkups, which fail to capture critical variations in vital signs or sudden changes in location. Many existing commercial solutions provide either activity tracking or GPS monitoring, but rarely combine physiological sensing, wide-area connectivity, and emergency alerting into one unified system.

KEYWORDS: IoT, Smart Collar, Dog Health Monitoring, GSM, LTE, GNSS, GPS Tracking, Firebase, ESP32, MAX30102.

LLaMA2 and Gemma2B: A Comparative Study on Performance, Accuracy, and Trustworthiness of Large Language Models

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ABSTRACT. Large Language Models (LLMs) such as those developed by Meta and Google have revolutionized natural language processing by enabling highly advanced text generation, understanding, and reasoning capabilities. This study presents a comparative analysis of two prominent open-source LLMs: Meta's LLaMA2 and Google's Gemma2B. Leveraging the Ollama platform for fair and consistent benchmarking, both models were evaluated on key performance indicators including tokens generated, inference time, generation speed, and human-rated accuracy. LLaMA2 produced slightly more tokens per output, making it suitable for verbose tasks, while Gemma2B responded more than twice as fast and generated tokens at double the rate. Notably, Gemma2B achieved a higher human-rated accuracy score, reflecting superior fluency and coherence. All tests were conducted using standardized prompts under identical local hardware conditions to ensure reproducibility and fairness. These results highlight that while LLaMA2 excels in generating detailed responses, Gemma2B is better suited for speed-critical and accuracy-sensitive applications. The findings aim to inform developers and organizations in making context-driven decisions for responsible and effective language model deployment.

KEYWORDS: Large Language Models (LLMs), LLaMA2, Gemma2B, performance benchmarking, token generation, inference time, trustworthiness, accuracy.

A Hybrid Unsupervised Framework for Cloud Anomaly Detection Using Deep Autoencoders and Multi-Stage Clustering

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ABSTRACT. The environment of cloud computing creates large amounts of high dimensional and unlabeled operational data and the conventional rule-based or supervised intrusion detection methods prove inefficient to detect unknown attacks. The paper suggests a hybrid unsupervised anomaly detection system, which combines the use of deep autoencoders and multi-stage clustering to enhance the accuracy of detecting anomalies in cloud environments. The autoencoder is trained to learn the small latent representations of typical cloud behavior and detects unusual behavior with high reconstruction error. Latent vectors are also analyzed with K-Means, DBSCAN, and Gaussian Mixture Models to enhance detection ability, which allows finding structural deviations and low-density outliers. A hybrid score that is the result of a reconstruction error and a cluster deviation is calculated to reduce false positives. Tests on UNSW-NB15, CICIDS2017, and artificial cloud log data show that the presented framework is much more effective than standalone deep learning or clustering algorithms, with high detection rates and strong generalization to cloud workloads of different types.

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KEYWORDS: Cloud Security, Anomaly Detection, Deep Autoencoder, Unsupervised Learning, Clustering, Intrusion Detection.

Design and Simulation of a 1D Electrochemical Glucose Sensor Using Cyclic Voltammetry and Electroanalysis in COMSOL Multiphysics

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ABSTRACT: This work presents the design and simulation of a one-dimensional electrochemical biosensor for glucose detection using COMSOL Multiphysics. The model is based on electroanalysis principles and employs cyclic voltammetry (CV) to study redox behavior at a microelectrode surface. A single-line electrolyte domain is used to represent diffusion and electron-transfer processes, while a glucose-related redox species is introduced at the electrode boundary. The study investigates the effect of different scan rates and electrode kinetics on the measured current response. The CV curves show clear oxidation peaks corresponding to the glucose, demonstrating the feasibility of using a 1D model for glucose concentration sensing. The results indicate that CV response varies proportionally with glucose concentration, proving that simplified geometries can still provide meaningful biosensing insights.

KEYWORDS: Electrochemical biosensor, Electroanalysis Principles, Cyclic Voltammetry, Redox behaviour, Scan rates.

Comparative Analysis of YOLOv8 and YOLOv11 for Real-Time Vehicle Detection and Tracking with DeepSORT Algorithm

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ABSTRACT. Real-time vehicle detection and tracking is one of the smartest characteristics of transportation systems which not only enables precise traffic monitoring, but also helps in congestion management and urban mobility planning. The research work presented is aimed at comparing the effectiveness of YOLOv8 and YOLOv11 which are both equipped with DeepSORT tracking along, by road conditions. The DeepSORT model has the ability to keep track of object identities through the frames which leads to less ID switching and thus more accurate counting in both

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directions. The models were built and assessed under the same circumstances on a dataset containing a mix of vehicle categories with detection accuracy (precision, recall, mAP), execution speed (FPS), and tracking robustness (IDF1, MOTA) as the evaluation metrics. The findings reveal that YOLOv11 surpasses YOLOv8 in performance almost all the time - particularly for small and partially hidden vehicles - but at the same real-time speed, therefore, it is more suitable for heavy and mixed-traffic conditions typical of Indian roads. The study strongly indicates the progressive way of YOLO architectures and simultaneously, it demonstrates that their amalgamation with tracking systems provides scalable, real-time solutions for smart city applications.

KEYWORDS: Vehicle detection, YOLO, Object identification, Motion detection, Machine learning.

Fusion-Based Bridge Health Monitoring via Random Forest Regression Using Vibration and Corrosion Indicators

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ABSTRACT. Bridges are vital components of transportation networks, but their continuous exposure to mechanical loading and harsh environmental conditions leads to gradual degradation. Conventional inspection practices are labor-intensive and often fail to capture subtle or early-stage damage. This work introduces an IoT-assisted structural health monitoring (SHM) approach that integrates vibration sensing and corrosion monitoring into a unified machine learning framework. Accelerometer readings from bridge decks and girders are processed to derive statistical and frequency- domain indicators, while electrochemical probes and environmental sensors provide corrosion-related parameters. These features are fused to compute a Bridge Health Index (BHI), scaled between 0 and 100, to assess the condition of bridge elements. The system further classifies health states into four categories—Healthy, Moderate, Severe, and Critical—and estimates the Remaining Useful Life (RUL) of the structure in years. Based on these outcomes, the model generates maintenance recommendations ranging from routine observation to urgent intervention. By converting raw sensor signals into interpretable decision- support metrics, the proposed framework supports timely maintenance planning and enhances the safety and serviceability of bridges.

KEYWORDS: IoT, structural health monitoring, vibration sensing, corrosion rate, data fusion, bridge health index, remaining useful life.

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AI - Driven Solutions for Reducing Human Wildlife Conflicts in Forest Areas

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ABSTRACT. Human-wildlife conflict along forest-fringing agricultural lands has increased as a result of climate change, habitat fragmentation, and encroachment by humans, which results in high crop damage and puts both humans and animals at risk. Conventional measures are ineffective and not sustainable, so alternative measures utilizing AI as a proactive solution are being explored. This research is an examination of AI-based methods to manage HWC in Wayanad Wildlife Sanctuary, Kerala. The goal is to sense, classify, and forecast wildlife movement with a hybrid deep model. A heterogeneous dataset with images from mobile photography, camera traps, and motion sensors was gathered in conflict hotspots. Images were labeled over 15 classes of species and preprocessed with techniques involving augmentation and normalization. The CNN-LSTM ensemble was applied by connecting YOLOv5 and Efficient Net for finding objects in space and LSTM networks for examining temporal features. Infrared cameras and environmental sensors were installed during the hardware deployment to supply feedback quickly. To check model accuracy, precision, recall and F1-score were used. The CNN-LSTM model performed better than each of the separate models, with precision at 0.94, a recall of 0.92 and a high F1-score of 0.93. These results support the idea that AI-based systems can cut down on wildlife conflicts and improve peace between rural people and animals.

KEYWORDS: Human Wildlife Conflict, Artificial Intelligence, Wayanad, CNN, LSTM.

Implementation of Hybrid Deep Learning Framework for Real-Time Fake News Detection

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ABSTRACT. In today's digital era, information travels faster than ever, and with it, the rise of fake news has become a serious concern. The constant flood of online content makes it difficult to separate truth from misinformation, threatening public trust and social stability. To tackle this issue, our study explores the power of Machine Learning

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(ML) and Deep Learning (DL) in automatically identifying fake news. Using the WELFake dataset and real time RSS feed simulations, we evaluated various models under both Normal training and Real-time (FactNet System) setups. Among these, the ANN model achieved the highest accuracy of 95.14%, while BERT proved most effective in real-time conditions with 92.0% accuracy. The findings show that while traditional models perform slightly better in accuracy, the proposed FactNet System offers the right balance between speed, scalability, and reliability—making it a strong step toward real-world, real-time fake news detection.

KEYWORDS: Fake News Detection, Misinformation, Machine Learning (ML), Deep Learning (DL), Natural Language Processing (NLP), Real-Time Systems, FactNet System, ANN, BERT, and Feature Selection.

Real-Time Spectral Dispersion with Anaglyph 3D Rendering for Virtual Reality Environments

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ABSTRACT: This article discusses a new method for creating immersive Virtual Reality (VR) environments. It produces real-time light dispersion effects and anaglyph stereoscopic rendering. The system is based on a physics model of light dispersion with 31 bands of light. It also includes depth-aware anaglyph 3D generation. This combination improves visual immersion. The system allows for correction parameters for strabismus, helping users with eye alignment issues benefit from VR. This improvement makes VR more available to the public. Experimental results show effective real-time processing of 360° equirectangular video with adjustable dispersion patterns and stereoscopic depth cues. The system achieves interactive frame rates while maintaining suitable visual quality for VR headsets. This work opens the door for physics-based visual effects in accessible VR content creation.

KEYWORDS: Virtual Reality, Spectral Dispersion, Anaglyph Stereoscopy, 360° Video Processing, Strabismus Correction, Real-time Rendering.

HealthBridge: A Telemedicine Platform for Accessible Rural Healthcare

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ABSTRACT. Access to healthcare in rural areas remains a major challenge, often leading to delayed diagnoses and treatments. HealthBridge is a telemedicine platform designed to connect rural patients with urban doctors through live video consultations. The platform features an AI-driven symptom checker that supports voice and image inputs to provide preliminary diagnoses and recommend relevant specialists. It also includes multi-lingual support, appointment scheduling, personalized medication reminders, and a feature to locate nearby specialists. By combining telemedicine with intelligent assistance, HealthBridge aims to provide timely, accessible, and patient-friendly healthcare to undeserved communities.

KEYWORDS: AI in TelemedicineRural, Healthcare Accessibility, Multilingual Symptom Checker, LLaMA-4 Scout Model, Real-time Doctor Teleconsultation.

Context-Aware Hate Speech Detection Using Transformer Models and Dynamic Event Knowledge Graphs

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ABSTRACT. Hate speech on social media continues to expand in scale, complexity, and linguistic variation, creating challenges for automated content moderation. Traditional text-only detection systems often fail to identify implicit, event-driven, or context-dependent hateful expressions. This work proposes a context-aware hate speech detection framework that integrates transformer-based text embeddings with a dynamic event-driven knowledge graph. The system continuously updates relevant entities,

events, and relationships from news streams and social trends, enabling context-enriched representation of social media posts. A hybrid classification pipeline combining deep learning and ensemble models is developed to improve robustness. Experiments on a multi-source, multilingual dataset demonstrate an accuracy of 92% and balanced precision–recall performance, significantly outperforming baseline text-only classifiers. The findings highlight the importance of contextual modeling in identifying subtle and evolving hate speech patterns and provide a foundation for scalable, adaptive, and ethically aligned moderation systems.

KEYWORDS: Hate speech detection, social media, context-aware analysis, knowledge graphs, event detection, Natural language processing.

Towards Zero Accidents: A Survey of Detection and Prevention Systems

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ABSTRACT : The increase in the number of vehicles being owned has resulted in a corresponding increase in road accidents, requiring the development of sophisticated methods for detecting and preventing accidents. This study provides a thorough examination of current technology and systems designed to reduce the consequences of road accidents. We analyze a diverse array of methodologies, including IoT based systems, machine learning techniques, and sensor-based solutions. Although there have been notable advancements in accident detection, emergency response, and driver behavior analysis, there are still obstacles to overcome in terms of infrastructure, data protection, and practical use in real-world scenarios. The study highlights significant areas of research that have not been addressed and provides a clear plan for future research to improve the efficiency of accident detection and prevention systems. This article outlines the creation and use of a cutting-edge Automatic Speed Control System (ASCS) for cars, using up-to-the-minute geolocation data. The ultimate objective is to formulate all-encompassing approaches that use technology progress to provide safer conditions on roads.

KEYWORDS: Accident Detection, Prevention, IoT, Machine Learning, Intelligent Transportation Systems, Road Safety.

Efficient Power Conversion Using Dual Active Bridge for BLDC Motor Drive in Electric Vehicles

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ABSTRACT. The performance of the Dual Active Bridge (DAB) converter in steering BLDC motors for electric vehicle (EV) applications is thoroughly evaluated in this research in comparison to the H-Bridge. Motor control optimization is essential for increasing vehicle reliability and economy as the need for effective, high-performance power conversion systems in electric mobility grows. Because of its high efficiency and bidirectional power flow, the DAB converter is being researched as a superior alternative to the traditional H-Bridge converter, which is often used in BLDC motor drives. Both converter topologies are thoroughly examined using key performance parameters, such as torque stability, control accuracy, system complexity, and energy conversion efficiency. The DAB converter works better than the H-Bridge in terms of overall efficiency and motor smoothness, according to simulation data produced by MATLAB/Simulink. The experimental validation of the proposed system further demonstrates the practical advantages of DAB in EV applications. This study provides a more dependable and effective power conversion solution for electric vehicles by illustrating how DAB technology may enhance BLDC motor performance.

KEYWORDS: BLDC (Brushless-DC) Motor, DAB (Dual Active Bridge) converter, H-bridge converter, HPS control scheme, Battery, Electrical vehicle.

Composite Air Quality Index-Based Health Risk Classification Using Interpretable Machine Learning Models

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ABSTRACT. The air quality index (AQI) is crucial for assessing urban air quality. This study seeks to offer valuable information to researchers and practitioners on the strengths and limitations of different models to improve the prediction and monitoring of air quality. This work examines four machine learning techniques/frameworks: XGBoost, LSTM, Prophet, and Vertex AI, comparing their performance in environmental monitoring. The results suggest that advanced tools and frame- works enhance the precision and simplicity of machine learning applications, facilitating their use to address air quality issues even for those without significant programming experience. The analysis underscores the need to further investigate hybrid strategies that merge the user-friendliness of local tools with the computational capability of cloud platforms to improve the prediction of AQI.

KEYWORDS: Air Quality, KNIME, LSTM, Prediction, PROPHET, VERTEX AI, XGBOOST

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AI BASED INDUSTRIAL ROBOTIC ARM

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ABSTRACT. This Paper describes a new Artificial Intelligence (AI) powered robotic arm intended for industrial and assistive use cases, combining real-time gesture sensing, computer vision, and affordable 3D printing technology in a unified system. In contrast to traditional robotic arms, which depend on pre-coded motions, the proposed arm uses AI algorithms that allow it to learn from experience, adapt to new tasks, and make real-time decisions, thus optimizing efficiency, productivity, and safety in changing environments. One of the major innovations here is its ability to mirror gestures in real time, where a camera assisted by OpenCV and MediaPipe recognizes certain positions of human fingers (e.g., raised thumb, point gestures). These are then interpreted as microcontroller instructions that power the motors of the robotic arm, enabling the device to mimic human finger movement with a great degree of accuracy. This offers a new, low-cost method of intuitive human–robot interaction that closes the gap between powerful AI systems and user-friendly user interfaces. Additionally, the robotic hand is produced using 3D printing technology, which minimizes the cost of production significantly in comparison to conventional manufacturing processes. Integrating AI-controlled control, vision-based gesture recognition, and inexpensive additive manufacturing, this study presents a new, inexpensive framework for creating adaptive robotic arms. The system, as suggested, shows great promise in industrial automation, amputee assistive robots, and human–machine interaction in safety-critical applications.

KEYWORDS: Artificial Intelligence, 3D Printing Tech.

Optimizing Hybrid Energy Storage for Renewable Generation Stability

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ABSTRACT. Alternative sources of energy, including solar and wind power, have become a major component of contemporary power systems, mainly due to their natural sustainability and the many environmental benefits they provide over conventional fossil fuels. However, the natural variability associated with these renewable energy sources can negatively affect the reliability of the electrical grid. To counter this problem, this research investigates a hybrid energy storage system (HESS) that optimally integrates

batteries and capacitors to effectively counteract power fluctuations that are experienced in photovoltaic (PV) systems. The HESS in this case takes advantage of the high energy density of batteries, in addition to the fast response capability provided by capacitors, to develop a more reliable energy storage system. A simulation in MATLAB/Simulink confirms the performance of the system, demonstrating its operation under Maximum Power Point Tracking (MPPT) using Particle Swarm Optimization (PSO) algorithms for maximum performance under any condition. The results of the simulation validate that the proposed system has a high ability to stabilize the output obtained from renewable energy sources, while improving the overall quality of the electrical power produced.

KEYWORDS: Hybrid Energy Storage System, Renewable Energy, Photovoltaics, MPPT, Particle Swarm Optimization, MATLAB/Simulink.

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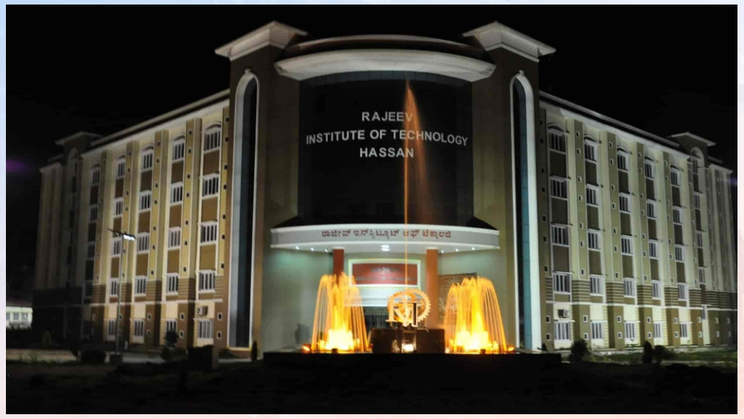

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